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Diet Diversification and Health Promotion

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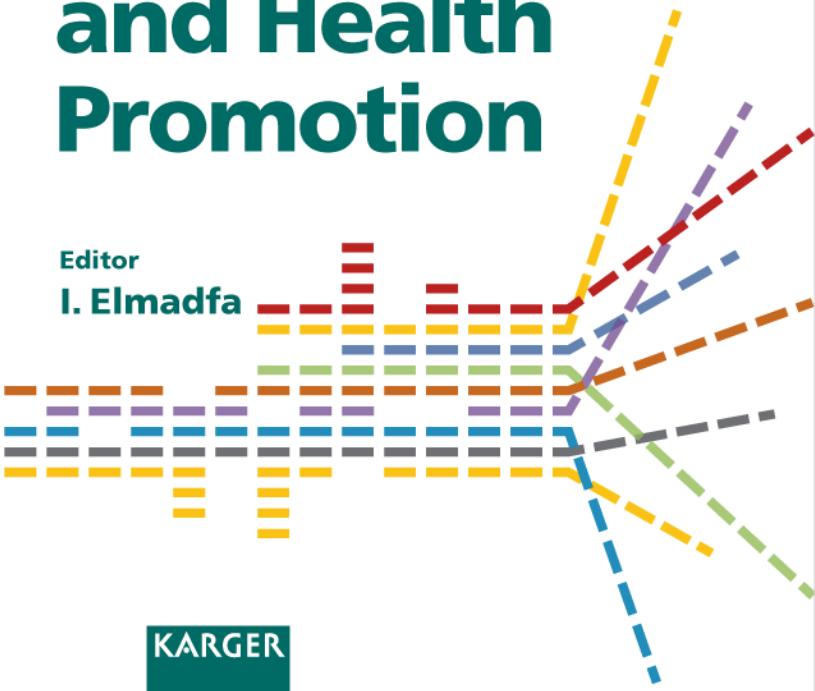
I. Elmadfa



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Diet Diversification and Health Promotion

Volume Editor

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Contents

Preface

Nutrition related chronic noncommunicable diseases are considered major causes for morbidity and mortality. Unbalanced diet and malnutrition among other behavioral and lifestyle determinants are modifiable risk factors for the development of obesity, metabolic disorders, cardiovascular diseases and cancer, which cause around half of the global burden of disease.

Nutrition transition over the last few decades was characterized by different drastic dietary changes. These include a shift towards high energy density with low proportion of foods of plant origin; high consumption of fat and fatty foods and in parallel low consumption of vegetables, pulses, and cereals. Such diet profile proved to be inadequate to meet the physiological needs for various micronutrients and so provide insufficient basis for health promotion and disease prevention.

Main purpose of the 14th EANS symposium was to raise awareness and interest in the health benefits of the diet diversification and of informed food choice as determinants of promising food based dietary guidelines.

This annual EANS meeting took place at the University of Vienna on May 14/15, 2004. This issue of 'Forum of Nutrition' comprises the proceedings of nearly all relevant presentations. Therefore, I would like to thank all the authors, who helped by delivering their manuscripts in time and enabled us to publish the proceedings without major delays.

Thanks also to my colleague Dr. Petra Rust and the publisher S. KARGER AG for their patience and qualified assistance.

Vienna, October 2004–10–25

Professor *I. Elmadfa*
EANS President

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Fat Intake, Diet Variety and Health Promotion

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Abstract

Different epidemiological studies indicated that the optimization of diet and nutrition combined with healthy life style can decrease the risk and even lead to amelioration of various noncommunicable diseases. Promising food-based dietary guidelines have been recommended in order to improve the nutritional and health status. One of the most popular recommendations is related to the amount (less fat and fat-rich foods) and type of the dietary fat component (less saturated, more polyunsaturated fatty acids, lower n-6:n-3 ratio).

An overview on the nutrient intake among different age groups in Austria shows that the general consumption of some food groups – especially those rich in carbohydrates – is too low and that the intake of fat is far beyond the recommended amount of 30% of total energy (E%). The results of the 24-hour recall made among Austrian adults (n = 2,585) showed that about 18% of this population group had a fat intake of 30–35 E%, whereas 60% had an intake higher than 35 E%. Only 24% of the female and male adults had a fat intake lower than 30 E%. A result of this high proportion of fat – in the form of foods rich in fat – in the average total energy consumption is a too low intake of carbohydrates, and foods rich in carbohydrates, respectively. An increasing fat intake is associated with an increasing intake of some nutrients such as vitamin A, E, calcium and zinc, but a decreasing intake of other nutrients like vitamin C, folate, carotenoids and others. The diversity of foods consumed during a day increases with decreasing amount of fat in the diet of adults. People with a high amount of fat in their daily diet show a lower intake of vegetables and fruit, cereal products, carotenoids, folates and dietary fibers, but a higher intake of meat and meat products, milk and milk products, sweets and flummeries as well as saturated fatty acids (SFA) and cholesterol.

Of course, a higher variety of food items in the daily diet should not be associated with a higher energy intake. Thus, foods with a high nutrient density (vegetables, fruits, low-fat milk products, whole grain cereals, legumes etc.) are recommended.

Finally, it has to be annotated that a high diversity in the daily diet with reduced fat and SFA intake allows a sufficient nutrient intake and is an important approach for health promotion.

Introduction

Nutrition, diet and lifestyle are major influencing factors of morbidity and mortality of a population. It cannot be ignored that a growing epidemic of chronic noncommunicable diseases (NCDs) was associated with dietary and lifestyle changes.

Nowadays, NCDs contribute to 60% of total reported deaths in the world and approximately 46% of global burden of disease. Around 50% of NCDs are cardiovascular diseases and over 25% are cancers [1]. In obesity and diabetes alarming trends can be observed: worldwide a constantly high incidence is reported and younger age groups are increasingly affected.

During the last decades there were significant changes in diet profile towards higher energy density, i.e., diets rich in fat and added sugars, greater intake of saturated fatty acids (SFAs), reduced intake of complex metabolizable carbohydrates and dietary fibers, vegetables and fruits and also of different micronutrients. Additionally, these patterns were accompanied by a decline in energy expenditure due to the sedentary lifestyle and reduced physical activity. Today's mixed diet can be described as unbalanced, based on a rather limited food choice with a low consumption of plant foods.

Over the past three decades the dietary supply of fat in the European Community increased from 117 g per capita per day (approximately 35% of energy) to 148 g per capita per day (approximately 40% of energy) [1]. A considerable proportion of these fat calories are provided by SFAs (over 10% of energy). The ratio of dietary fat from animal sources to total fat is a key indicator, since foods from animal sources are high in saturated fat.

The risk factors for the development of NCDs can be divided into non-modifiable (age, sex, genetic susceptibility) and modifiable factors. The latter are behavioral factors (e.g., diet, physical activity, tobacco use, and excessive alcohol consumption), biological factors (e.g., dyslipidemia, hypertension) and societal factors.

In the following, behavioral factors in the context of the situation in Austria will be discussed in detail.

Dietary and Life Style Patterns in Austria

In order to reduce the burden of chronic diseases, different expert groups of the WHO/FAO, in the German-speaking countries and of the European Commission have released population goals for nutrients and features of lifestyle, like those which are consistent with the prevention of major public health problems [1–3]. Although, these guidelines are quite similar, the values

Table 1. Population goals (EURODIET) and current situation in Austrian adults (19–60 years)

Component	Population goal EURODIET project	Situation in Austrian adults*
Physical activity level (PAL)	PAL > 1.75	1.4**
Body weight as BMI	BMI 21−22	24
Dietary fat E%	<30	37
Saturated fatty acids E%	<10	17
n-6 PUFAs E%	4–8	4.5
n-3 PUFAs (g/d; mg/d)	2 g linolenic + 200 mg very long chain	1.4 + 280
Carbohydrates total E%	>55	45
Fruit and vegetables (g/d)	>400	330
Folate from food (μg/d)	>400	270
Dietary fiber (g/d)	>25	20
Sodium (g/d)	<6	8
Iodine (μg/d)	150	140

*Data derived from a single 24-hour recall, conducted in the period of 2000–2002 in different regions of Austria, n = 2,585; table shows arithmetic means.

**Assumed from energy expenditure.

from the 'Eurodiet project' can be regarded as valid for the European Union. Table 1 shows selected population goals and the corresponding situation in Austrian adults.

The rather low physical activity level (PAL about 1.4) in Austrian adults was assumed from the average energy intake (female 8.4 and male 10.6 MJ/day), as in general the energy consumption correlates well with energy expenditure [4]. Motorized transport, labor-saving devices in the home, physically undemanding pastimes etc. lead to a more and more sedentary lifestyle. Only one third of the Austrian adults were at least three to five times per week moderately active (e.g., walking).

The desirable PAL would be 1.75, which is equivalent to 60–80 min of daily walking to avoid weight gain on high fat intakes, in which the goal for preventing cardiovascular diseases and diabetes (30 min a day) is included [1, 3].

Due to the energy dense diet and the above-mentioned sedentary lifestyle, it is not surprising that the mean adult body mass index (BMI) of 24 kg/m^2 was well above the desired level of 21–22 kg/m^2 [3]. As height and weight was self-reported, a higher mean BMI has to be expected.

Recently, deviating BMI values calculated from measured or self-reported data have been published by a study group in Australia. In the National Nutrition

Table 2. Fat calories of total energy intake in Austrian adults (n = 2,585)

E% from fat	n = 2,585	Percentage of participants
up to 25	270	10.5
25 to 29.9	351	13.5
30 to 34.9	460	18.0
35 to 44.9	1,032	39.5
>45	472	18.5

Survey 1995 in Australia, the BMI based on self-reported data classified 52% of males and 36% of females as overweight, compared with 64 and 47%, respectively, from measured data [5].

Fat is a critical nutrient in the Austrian diet in regard to the level of intake and its fatty acid composition [6]. The mean intake in adults (both sexes) was 37 E%.

An overview on the nutrient intake among different age groups in Austria shows that the general consumption of some food groups – especially those rich in carbohydrates – is too low and that the intake of fat is above the recommended maximum amount of 30 E%. The results of the 24-hour recall made among Austrian adults (n = 2,585) showed that just about 24% of the subjects had an intake lower than 30 E% of energy from fat (table 2).

The composition of the fat consumed is very important for health maintenance as well. With regard to that, the mean intake of SFAs in Austria is considered to be too high (17 E% in adults) and the mean intake of polyunsaturated fatty acids (PUFA) is quite low (~6 E%), particularly the n-3-PUFA intake.

As a consequence of the high proportion of fat in the daily diet, only 45% of energy is derived from utilizable carbohydrates. Furthermore, the average intake of dietary fiber was low.

The goal for fruits and vegetables intake of more than 400 g per day was not achieved in Austrian adults. A higher consumption of these food groups would help to ensure an adequate intake of folates and other micronutrients.

Another micronutrient of concern in Austria is iodine. Due to the special situation in Austria (endemic iodine deficiency area), the national recommended dietary allowance for iodine is 200 μg per day [2].

In contrast, the average salt consumption in Austria is excessive. In adults, the mean intake of table salt was around 8 g/day. Most of the salt consumed is

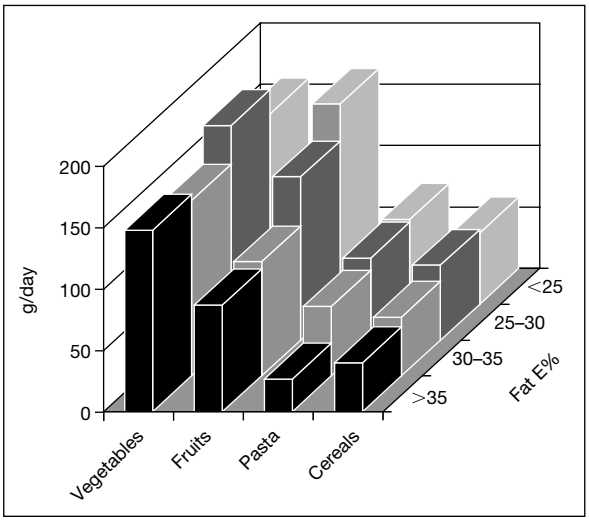

Fig. 1. Relationship between the consumption of vegetables, fruits, pasta, cereals and fat intake in Austrian adults (n = 2,585).

not iodized. As food manufacturers rarely use salt fortified with iodine, the potential of salt regarding the iodine supply is unused.

Energy from Fat and Diet Variety

Dietary intake data of single 24-hour recalls (n = 2,585) collected from 19- to 60-year-old Austrians, were analyzed with main focus on the fat contents of the diet. The participants were divided into four groups, of which the first group had a fat intake of lower than 25 E%, the second between 25 and 29.9 E%, the third between 30 and 35 E% and the fourth consumed more than 35% of energy from fat (table 2).

As shown in figure 1, higher the consumption of vegetables, fruits, pasta and cereals, the lower was the percentage of fat in the diet. These food groups are characterized by a high nutrient density and they can contribute to an adequate supply especially of folate from food and dietary fiber.

On the other hand, when the consumption of milk products, meat and meat products and sweets was higher, the higher was the fat intake (fig. 2). These food groups are contributing to an adequate supply of nutrients as well, but the share especially of meat and meat products is rather imbalanced in Austria.

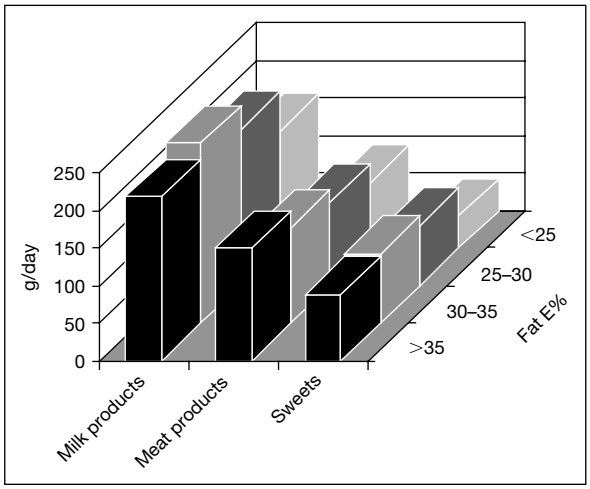

Fig. 2. Relationship between the consumption of milk products, meat products, sweets and fat intake in Austrian adults (n = 2,585).

At the nutrient level, the fat content in the daily diet influenced the nutrient intake considerably (table 3).

An increasing fat intake was associated with an increasing intake of energy, fatty acids, especially SFAs, and cholesterol. The intake of carbohydrates decreased.

The mean intake of n-3 and n-6 PUFAs was quite low in the group, which consumed less than 25% of energy from fat.

In terms of absolute figures, the intake of some nutrients such as vitamin A, E, calcium and zinc was higher in the groups with a high fat intake. In other nutrients like vitamin C, folate, and carotenes, it was lower. However, the higher intake of some micronutrients in the high-fat groups might also be due to the higher energy intake.

The calculation of the nutrient density (μg, mg, g per MJ) showed in almost all micronutrients and dietary fiber a higher intake in the low-fat groups (table 3). Just the intake (in terms of nutrient density) of calcium, vitamin B_2 and of the fat soluble vitamins (A, D, E) was unaffected by the fat content of the diet.

Additionally, an evaluation of the nutritional status in 6- to 18-year-old boys and girls in Austria (n = 1,400) confirmed that a reduction of the fat intake from >35 E% to 25–30 E% does not affect the status of fat-soluble vitamins and total cholesterol [6].

Table 3. Mean density of selected nutrients (μg, mg, g/MJ) in the diet of Austrian adults, (n = 2,585, 24-hour recall), aged 19–60 years, according to the fat content

Component	<25 E% fat	25–29.9 E% fat	30–35 E% fat	>35 E% fat
Energy (MJ/d)	7.6 ± 3.5	8.8 ± 3.5	9.3 ± 3.5	9.7 ± 3.5
CHO E%	59 ± 11	52 ± 8	48 ± 7	39 ± 8
SFA E%	7.8 ± 2.9	11.4 ± 2.3	13.6 ± 2.6	17.9 ± 6.2
MUFA E%	6.6 ± 2.3	9.7 ± 1.8	11.5 ± 2.0	15.9 ± 7.6
PUFA E%	3.3 ± 1.8	4.2 ± 2.1	4.9 ± 2.5	6.3 ± 3.8
Linoleic acid E%	2.7 ± 1.7	3.4 ± 2.0	4.0 ± 2.3	5.2 ± 3.4
Linolenic acid E%	0.4 ± 0.3	0.5 ± 0.3	0.5 ± 0.3	0.7 ± 0.3
Cholesterol (mg/d)	216 ± 222	294 ± 192	346 ± 219	407 ± 287
Dietary fiber (g/MJ)	2.9 ± 1.5	2.5 ± 1.3	2.4 ± 1.1	2.1 ± 0.9
Vitamin A (mg/MJ)	0.15 ± 0.17	0.15 ± 0.18	0.15 ± 0.16	0.14 ± 0.12
β-Carotene (mg/MJ)	0.6 ± 0.9	0.5 ± 0.8	0.4 ± 0.5	0.4 ± 0.6
Vitamin D (μg/MJ)	0.5 ± 1.0	0.5 ± 0.6	0.4 ± 0.6	0.4 ± 0.5
Vitamin E (mg/MJ)	1.4 ± 1.0	1.4 ± 0.9	1.4 ± 0.8	1.5 ± 0.8
Vitamin B1 (mg/MJ)	0.19 ± 0.11	0.16 ± 0.11	0.16 ± 0.07	0.15 ± 0.08
Vitamin B2 (mg/MJ)	0.22 ± 0.12	0.22 ± 0.14	0.20 ± 0.11	0.19 ± 0.09
Vitamin B6 (mg/MJ)	0.27 ± 0.19	0.25 ± 0.21	0.23 ± 0.16	0.20 ± 0.12
Folate (μg/MJ)	34.7 ± 15.0	33.2 ± 17.2	30.6 ± 12.3	28.8 ± 13.7
Vitamin C (mg/MJ)	21.9 ± 21.2	17.8 ± 14.0	15.7 ± 12.0	14.3 ± 12.8
Calcium (mg/MJ)	102 ± 53	105 ± 63	104 ± 48	103 ± 51
Magnesium (mg/MJ)	47 ± 17	41 ± 13	39 ± 11	35 ± 10
Iron (mg/MJ)	1.9 ± 0.8	1.8 ± 1.2	1.6 ± 0.7	1.5 ± 0.6
Zinc (mg /MJ)	1.4 ± 0.6	1.3 ± 0.5	1.3 ± 0.4	1.2 ± 0.4
Iodine (μg/MJ)	19.8 ± 17.3	16.1 ± 9.6	16.8 ± 23.1	15.1 ± 9.3

Table 4 shows two hypothetical menu plans, which can be considered as usual in a current diet. These plans should demonstrate that the nutritional quality of a diet is mainly influenced by the consumer's choice and the nutritional quality of the products available. The diets were analyzed with the German 'Bundeslebensmittelschlüssel' (BLS II.3) in regard of selected nutrients, which are of public health interest.

The nutritional quality of the two menu plans is considerably different (table 5). The importance of a deliberate and diverse food choice is again illustrated. Most of the selected goals can be reached; however, despite the thorough planning of menu A, the mean intake of SFAs and salt exceeded the corresponding goals. This emphasizes the important role of the food manufacturing industry.

An important aspect of the amount of fat in the diet is the relationship to food variety. A high fat content in the diet is often accompanied by a smaller amount of ingested food items (table 5).

Table 4. Hypothetical menu plans in a current diet

Meal	Menu plan A	Menu plan B
Breakfast	cereals with low fat milk, 200 ml orange juice, 1 coffee 480 kcal	cereals with whole milk, 1 coffee 340 kcal
Snack	1 whole-grain bread with ham and cucumber, 200 ml apple juice 510 kcal	2 rolls with salami, 1 coffee 380 kcal
Lunch	1 fish with dill sauce, spinach, rice, 2 kiwi, 250 ml mineral water 450 kcal	1 fried sausage with french fries 1 cola (200 ml) 790 kcal
Snack	1 fruit yogurt, 1 coffee 240 kcal	1 piece of cream pie, 1 coffee 390 kcal
Dinner	1 mixed salad with mayonnaise dressing, fresh tomato, 2 whole-grain bread, 1 banana 520 kcal	1 lasagna bolognese, 1 caramel pudding with vanilla cream 520 kcal

Conclusion

Different epidemiological studies indicated that the optimization of diet and nutrition combined with a healthy lifestyle can decrease the risk of different NCDs and even lead to amelioration.

What is required for a healthy diet? Some available evidence suggests that, a broad food choice, at least 20 and probably as many as 30 biologically distinct types of foods, with the emphasis on plant foods, are consistent with good health [1].

The above-presented assessment showed that a high fat content in the diet was associated with a small number of ingested foods. Furthermore, people with a high amount of fat in their daily diet had lower intakes of vegetables and fruits, cereals and cereal products, but a higher intake of meat and meat products, milk and milk products, sweets and pastries. Consequently, the differences at the nutrient level were considerable, too. The groups, which consumed less fat, showed significant higher intakes in most of the micronutrients, especially

Table 5. Hypothetical menu plans compared to selected population goals

	Menu plan A	Menu plan B	EURODIET
Food items	19	12	–
Energy (kcal)	2,130	2,420	–
Fat (E%)	26	46	<30
SFA (E%)	12	19	<10
Cholesterol (mg)	224	362	<300
Dietary fiber (g)	34	12	>25
Salt (g)	9	8	<6

SFA: Saturated fatty acids.

water-soluble vitamins, higher intakes in dietary fiber and, on the other hand, lower intakes of SFAs and cholesterol ($p < 0.05$). The status of fat-soluble vitamins was not affected by a low fat diet (25–30 E%).

Promising food-based dietary guidelines have been recommended in order to improve the nutritional and health status. One of the most popular recommendations is related to the amount (less fat and fat-rich foods) and type of the dietary fat component (less saturated, more PUFAs, lower n-6:n-3 ratio). A high diversity in the daily diet with reduced fat and SFA intake allows a sufficient nutrient intake and is an important approach for health promotion.

Dietary variety contributes an additional aspect of dietary quality, which is not captured by the Food Guide Pyramid servings or energy intake [7].

Chronic diseases are largely preventable diseases. The public health approach of primary prevention is considered to be the most cost effective, affordable and sustainable course of action.

Along with a desired PAL and extensive social interactions, the food variety in the daily diet characterizes the most likely lifestyle profile to optimize health [1].

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Mixed Diet in Europe

A Historical Overview

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Abstract

Aims: Successful health promotion in Europe depends on an adequate knowledge of everyday nutrition. An analysis of consumption structures and eating patterns is therefore a basic scientific task. This paper has two main aims: on the one hand it gives empirical data on European food consumption during the last 50 years. On the other hand it stresses the scientific problems of constructing and reflecting a 'diet' or 'everyday nutrition'. **Methods:** The paper starts with a discussion on the different levels of a 'diet' and gives some hints for an adequate analysis of an eating culture. Empirical data is presented, first of all consumption figures, then information on single 'national' dishes and last on meals in the former European Economic Community. **Results/Conclusion:** The empirical analysis shows the complex structure of European eating culture. Health promotion cannot be founded on simple consumption figures, because they do not reflect everyday nutrition in an adequate way. A successful policy needs to be founded on a detailed knowledge of dishes, meals and symbols of eating; and it has to reflect the problems of one-sided awareness of nutritionists and doctors.

It is always a risk to read papers from different scientific cultures – terms and languages are different, theoretical background and methodological standards, too. But health and nutrition are fields too important to analyze and discuss them only from the point of view of natural sciences or applied social sciences. If we want to understand the principles of diet diversification and health promotion, we must combine resources of cultural and natural sciences.

As a historian, I am not only interested in empirical information on mixed diets in Europe. This topic is interesting, too, because we – as scientists – can reflect on the way we are constructing a specific understanding of food and eating patterns, which is often far away from everyday experience.

What Is a 'Diet'? Some Remarks on the Complexity of Eating Culture

What is a 'diet'? And what does it mean, when we are talking about 'diet in Europe'? It seems obvious that geography matters, but it is obvious, too, that this is only one criterion of characterizing a diet [1, 2]. To define the term in an adequate way, we must be aware of very different levels of eating patterns. The most common criteria of differentiation in modern societies are social ones. The diets of a manager, of a teacher, of a laborer or an unemployed citizen are different, but they are different on a comparable level. Other factors such as time could be added. On a personal level, this means the age or the generation of persons, while on a structural level, we must differentiate between seasons, feasts, weekdays and times of day. However, eating culture, of course, is even more complex. The different structures of households and families must be mentioned, as well as different religion and gender. Geographical or better regional criteria are another important group of factors in the complex world of eating culture. If we want to understand and explain diet diversification in Europe, if we want to improve health promotion, we must reflect on our analysis first of all. For this reason please have a look at figure 1:

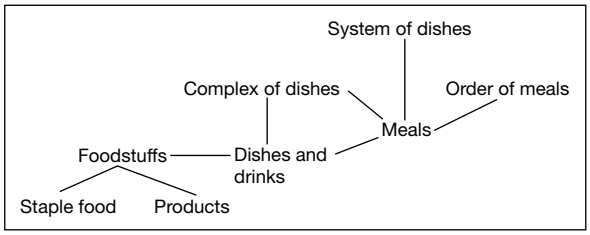

Fig. 1. Levels of analyzing a diet.

Figure 1 gives us terms, which constitute a diet in total. Perhaps you will miss terms normally used by nutritionists and doctors, especially calories and nutrients. But we have to recognize that from a cultural point of view, only specific elements of reality must be mentioned: human beings do not eat calories. Diets are not selected based on proteins, carbohydrates and fats. The regional differences of caloric intake in Europe are relatively low. They vary – with the exception of extreme climatic zones – only by some hundred calories [3, 4]. Diets may be founded on natural conditions, but at the same time they are always an expression of culture, of practical activity of man. Diets follow a specific cultural logic – which normally is different from scientific logic of nutritionists.

Diets are based on foodstuffs. These are no longer only stable foods, which were harvested, bought and prepared, cooked and eaten in our households. Today, most of them are products, a term, which stands for processed food sold through commercialized supply chains. Products and foodstuffs mostly become dishes, which implicates, that they are ready to eat. Dishes do not consist of foodstuffs only. The way of preparation, cooking and preserving techniques must be mentioned, the variations of ingredients, of spices, the preferred taste, the form and texture of dishes, and at least the linguistic expression. For example, it makes a difference in Austria, if you order Schlagsahne or Schlagobers cream. Dishes depend on the cultural context of their preparation and consumption. Drinks are dishes, too. And it is obvious that although we use only single terms, the number of variations is high. The regional structure of beer tastes is a good example [5, 6].

Dishes normally must be grouped for analysis. Then we have to look either to complexes of dishes, for instance of meat, milk or cheese dishes or we can explore systems of dishes, for instance, the wedding meal or the sweat bread at breakfast.

Complexes and systems of dishes consist not only of dishes, but of meals, too. Meals are based on the kind, number and sequence of dishes, which means objects, but most of all, the acting of human beings. This human acting can be, for instance, a specific form of behavior or communication. Meals are varying, because they are depending on the richness of human life, by being a part and expression of lifestyle. However, for analysis and comparison we can and must group and order meals. Then we can look, for instance, on daily, weekly or seasonal rhythms or on holiday or business meals.

Of course, it would be possible to differentiate this simple scheme. But even at this stage it can help to be concerned about different and perhaps unusual levels of analyzing a diet, levels, which often are excluded by epidemiological research. This perhaps can help to elucidate blind spots in our knowledge.

Changing Food Consumption Patterns in Europe since the 1950s

We start our historical analysis of European diets on a common level, on the level of staple foods. Diets are based on specific foodstuffs. Nations and regions are characterized by consumption patterns today and in history. Encyclopedias of the early 19th century summarized this quite simply: ‘Nordic nations tend more to animal, southern more to vegetarian food. In general, southern and oriental nations tend to a relatively natural, moderate and simple

Table 1. Consumption of potatoes in Europe 1953/56–2001/02 [8–12]

State	Potatoes				
	1953/56	1970/71	1981/82	1994	2001/02
Belgium	149.0	115.0	103	99.0	85.1
Germany (W)	161.5	101.8	74	73.3	68.5
Denmark	132.0	83.9	68	57.0	56.9
Finland	n.d.	92.3	59	59.7	78.6
France	131.7	96.0	73	72.6	50.9
Greece	n.d.	58.9	77	87.4	86.1
Great Britain	100.7	101.6	106	108.3	101.7
Ireland	n.d.	123.1	111	171.9	136.9
Italy	46.3	40.6	38	41.0	43.2
Netherlands	106.9	84.6	82	81.8	93.2
Austria	107.6	67.4	60	60.6	55.2
Portugal	n.d.	109.8	89	145.5	93.6
Sweden	102.8	86.4	72	n.d.	83.6
Spain	n.d.	110.4	113	92.3	89.0
SU	n.d.	138.0	138	107.0	n.d.

way of consumption, not yet influenced by an overwhelming civilization' [7]. Although we would prefer a different language, this impression is basically right, even today. To obtain more precise information, we should use comparable data – this is our way of creating and communicating knowledge. But numbers, of course, are a specific technique of creating significance. In addition, numbers have only been gathered for a century in most European countries. Let us go back to the 1950s, when reconstruction of Western European economies was finished.

First we will analyze the consumption of three vegetarian foodstuffs; and even on a first glance we find significant national consumption differences (table 1; fig. 2a): For example, in the 1950s, Western German customers consumed 161.5-kilogram potatoes per year and head, while Italian customers ate less than a third [13]. During the last decades, potato consumption decreased in nearly all European countries, being part of a more general decline of the consumption of foodstuffs with complex carbohydrates. As a result, the national differences diminished during the last 50 years; but on a lower level they still exist and they are still important. Even today, Irish potato consumption is more than three times higher than the Italian one. In general, on the one hand we can find relatively high potato consumption figures at the British and Iberian Islands, in Middle and Northwest Europe. On the other hand the data of

Fig. 2a. Graphical representation of consumption of potatoes in Europe 1953/56–2001/02 [8–12].

Table 2. Consumption of vegetables in Europe 1953/56–2000/01 [14–18]

State	Vegetables				
	1953/56	1970/71	1981/82	1994	2000/01
Belgium	n.d.	85.1	79	110.7	144.9
Germany (W)	n.d.	63.8	69	80.0	94.0
Denmark	n.d.	53.1	61	n.d.	n.d.
Finland	n.d.	16.1	25	63.1	n.d.
France	n.d.	130.0	115	n.d.	n.d.
Greece	n.d.	139.4	180	246.9	327.4
Great Britain	n.d.	62.6	79	n.d.	n.d.
Ireland	n.d.	62.4	82	87.7	90.2
Italy	n.d.	168.5	154	175.4	220.2
Netherlands	n.d.	80.6	86	118.5	n.d.
Austria	n.d.	66.5	90	79.8	100.4
Portugal	n.d.	141.9	134	112.9	104.9
Sweden	n.d.	40.1	43	n.d.	58.8
Spain	n.d.	129.2	133	162.1	198.1
SU	n.d.	67.5	68	77.0	n.d.

France, the Scandinavian States and the other Mediterranean states are below average.

The picture will be different, if we look at the consumption of vegetables (table 2; fig. 2b). Generally, vegetable consumption has increased significantly during the last 50 years. But we find clear south-north differences. The citizens of the Mediterranean states are consuming more than twice as many vegetables as their western and northern counterparts. Italians, for example, consume more than twice and Greeks more than a triple amount of vegetables than Germans. In France you can find an average level. Britons and Irishmen are consuming less and Scandinavians are clearly under average. In spite of all the improvements of free inner European markets and in spite of all the improvements of cold-resistant plants and glasshouses, we have to recognize that climate and regional cultivation still play an important role for everyday consumption. And it is obvious, too, that the diet of Mediterranean states is based on different foodstuffs as the diet of their Northern and Western European neighbors [19, 20].

This difference is also evident if we look at the consumption of drinks (table 3; fig. 2c). The grape product wine is consumed in significantly higher proportions in the Mediterranean states [22]. This concerns, first of all, red wine. In Scandinavia, the British Islands and in Northwest Europe, wine consumption is still something special even today. The consumption even of a wine-producing country like Germany is under the European average.

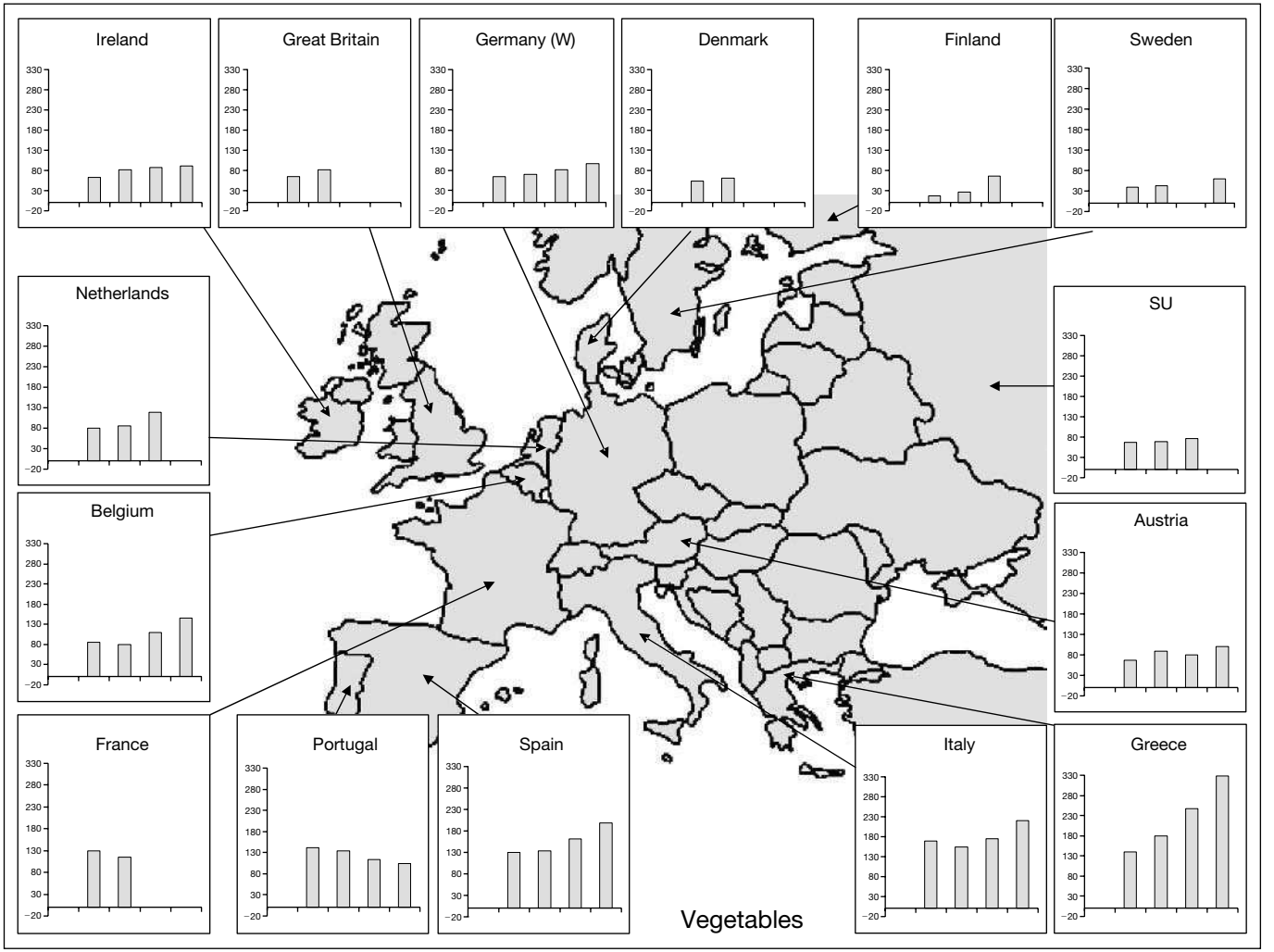

Fig. 2b. Graphical representation of consumption of vegetables in Europe 1953/56–2000/01 [14–18].

Table 3. Consumption of wine in Europe 1953/56–2001/02 [14–17, 21]

State	Wine				
	1953/56	1970/71	1981/82	1994	2001/02
Belgium	n.d.	13.1	21	19.5	24.2
Germany (W)	n.d.	17.5	25	23.3	24.3
Denmark	n.d.	n.d.	17	23.1	32.8
Finland	n.d.	4.3	8	5.5	6.1
France	n.d.	107.4	89	63.5	52.5
Greece	n.d.	42.4	42	30.0	27.3
Great Britain	n.d.	n.d.	8	11.6	16.4
Ireland	n.d.	n.d.	3	5.8	13.2
Italy	n.d.	109.0	85	62.8	48.5
Netherlands	n.d.	5.7	13	13.1	15.6
Austria	n.d.	39.8	35	n.d.	30.1
Portugal	n.d.	71.7	87	58.8	41.7
Sweden	n.d.	6.3	9	n.d.	15.0
Spain	n.d.	56.1	60	42.5	34.3
SU	n.d.	n.d.	n.d.	n.d.	n.d.

Interesting enough, the differences are decreasing relatively quickly. While in the Mediterranean states the consumption is decreasing, the figures of the other countries are increasing steadily. The trend to convergence is obvious, although the consumption patterns are still very different.

A similar development can be found if we look at the consumption of meat (table 4; fig. 2d). The great differences during the 1950s have diminished significantly. Of course we would find stronger regional differences, if we would analyze the different kinds of meat, but today meat consumption is relatively homogenous in Europe, with differences of only 58% between Great Britain and Spain in 2002.

The comparison of butter consumption (table 5; fig. 2e) shows that these convergence tendencies on a foodstuff level do not mean that there are convergence tendencies on a dish level, too. Fats play a typical and relatively traditional role in European diets. The overall consumption of fats is quite similar, but the specific fats are very different [28]. The example of butter again shows a strict separation between the Mediterranean countries Italy, Greece, Spain and Portugal on the one hand, and the other European countries on the other hand. Butter is consumed relatively seldom in Southern Europe, oils, especially olive oils, are dominating. But butter consumption is not homogenous in the rest of Europe. While consumption figures in France are on the top, the data of Scandinavian states are much lower, because of high margarine consumption.

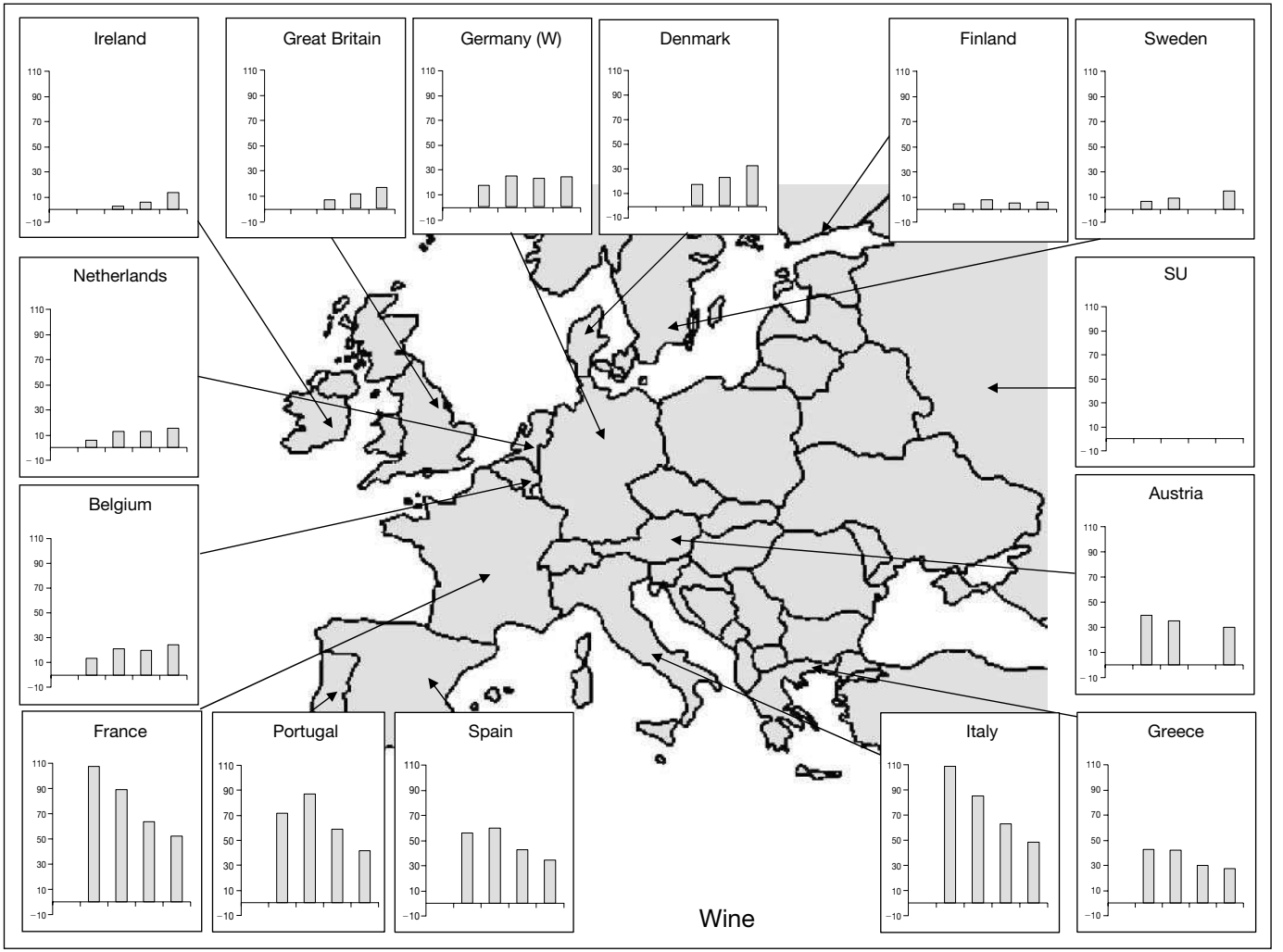

Fig. 2c. Graphical representation of consumption of wine in Europe 1953/56–2001/02 [14–17, 21].

Table 4. Consumption of meat in Europe 1953/56–2001/02 [23–27]

State	Meat				
	1953/56	1970/71	1983	1994	2001/02
Belgium	49.8	82.7	97	103.2	94.2
Germany (W)	46.1	87.2	97	93.1	87.9
Denmark	60.5	62.5	78	105.6	113.9
Finland	n.d.	49.3	65	n.d.	68.6
France	74.6	96.0	109	106.8	107.2
Greece	n.d.	41.0	77	83.2	91.2
Great Britain	59.8	72.3	72	73.3	82.6
Ireland	n.d.	83.6	97	90.6	109.9
Italy	19.4	57.3	79	89.4	90.5
Netherlands	37.5	65.7	79	90.2	86.9
Austria	45.3	78.7	86	n.d.	97.6
Portugal	n.d.	33.7	57	87	103.4
Sweden	51.2	53.8	62	n.d.	73.4
Spain	n.d.	44.3	75	108.4	130.1
SU	n.d.	n.d.	n.d.	49	n.d.

Let me end my short statistical remarks on foodstuffs with a look at milk, which is both a drink and a food (table 6; fig. 2f). Again we can see decreasing consumption figures since the 1950s, but still significant national differences in Europe. But there is no reciprocal picture to the consumption of wine. Although northern and northwestern nations are consuming much more milk than southern ones, the picture is heterogeneous. In Spain, for instance, milk consumption is higher than in Germany. Although the figures are stressing specific consumption patterns of the Mediterranean nations once again, it is obvious that there is no simple north-south difference in Europe.

These findings are backed by the information of household budgets. Instead of consumption figures, they include bought foodstuffs and give a more precise picture of consumption patterns. Although it is obvious that waste figures are higher in more wealthy states, they underline the main trends of consumption, of traditional differences between European countries and the relative convergence of European diets on the level of foodstuffs [30–34]. Today the differences are much lower than after World War II, when every nation had its typical stereotyped eating patterns.

Investigations of agrarian economists show that there are dominant convergence tendencies in Europe and in the OECD on the level of foodstuffs. The consumption of eggs, meat, wine, sugar and sweets and – on a lower level of

Fig. 2d. Graphical representation of consumption of meat in Europe 1953/56–2001/02 [23–27].

Table 5. Consumption of butter in Europe 1953/56–2001/02 [28]

State	Butter (pure fat)				
	1953/56	1970/71	1983	1994	2001/02
Belgium	9.4	8.5	8	6.4	4.8
Germany (W)	5.7	7.0	6	6.9	6.5
Denmark	7.2	7.5	8	6.3	4.5
Finland	n.d.	12.1	10	5.3	4.0
France	5.6	7.3	7	8.6	8.6
Greece	n.d.	0.9	1	1.1	1.6
Great Britain	6.1	8.5	5	4.1	2.6
Ireland	n.d.	10.2	11	5.9	2.9
Italy	1.2	1.6	2	2.2	2.8
Netherlands	2.6	2.2	3	6.0	3.3
Austria	5.2	5.0	4	5.2	4.8
Portugal	n.d.	0.6	1	1.5	1.7
Sweden	8.8	5.2	6	5.8	4.7
Spain	n.d.	0.3	1	0.5	1.2
SU	n.d.	n.d.	n.d.	n.d.	n.d.

probability – butter, vegetables, grains, potatoes, milk, vegetable fats and pork has become more similar during the last decades. Only the consumption of poultry, cheese and fruits shows growing differences of consumption in Europe [34–37].

The convergence of European diets on the level of food consumption is a fact, but the reasons are not clear yet. Often mentioned is the increasing influence of the European food regulation [38, 39]. In my opinion this is misguiding, because the convergence tendencies already started long before. We can find, too, convergence tendencies between the members of the European Union and most of the former Comecon members although the regulation was very different. Moreover, there is a regulation of culinary differences [40]. The European law may be helpful to create greater markets, but it is not responsible for a new European diet.

Furthermore, convergence tendencies are understood as a result of the products of multinational food producers, like Nestlé, Unilever, Danone or Kraft. The number of so-called ‘Euro foods’ is increasing. These are products, which are offered under the same brand in at least three European countries [41]. But it is misguiding to look only at the economics of size. Cost reduction with the help of mass production matters, but the food market is not a typical mass market. Most of the more than a quarter million food products buyable in the European Union are results of the so-called customer or batch production.

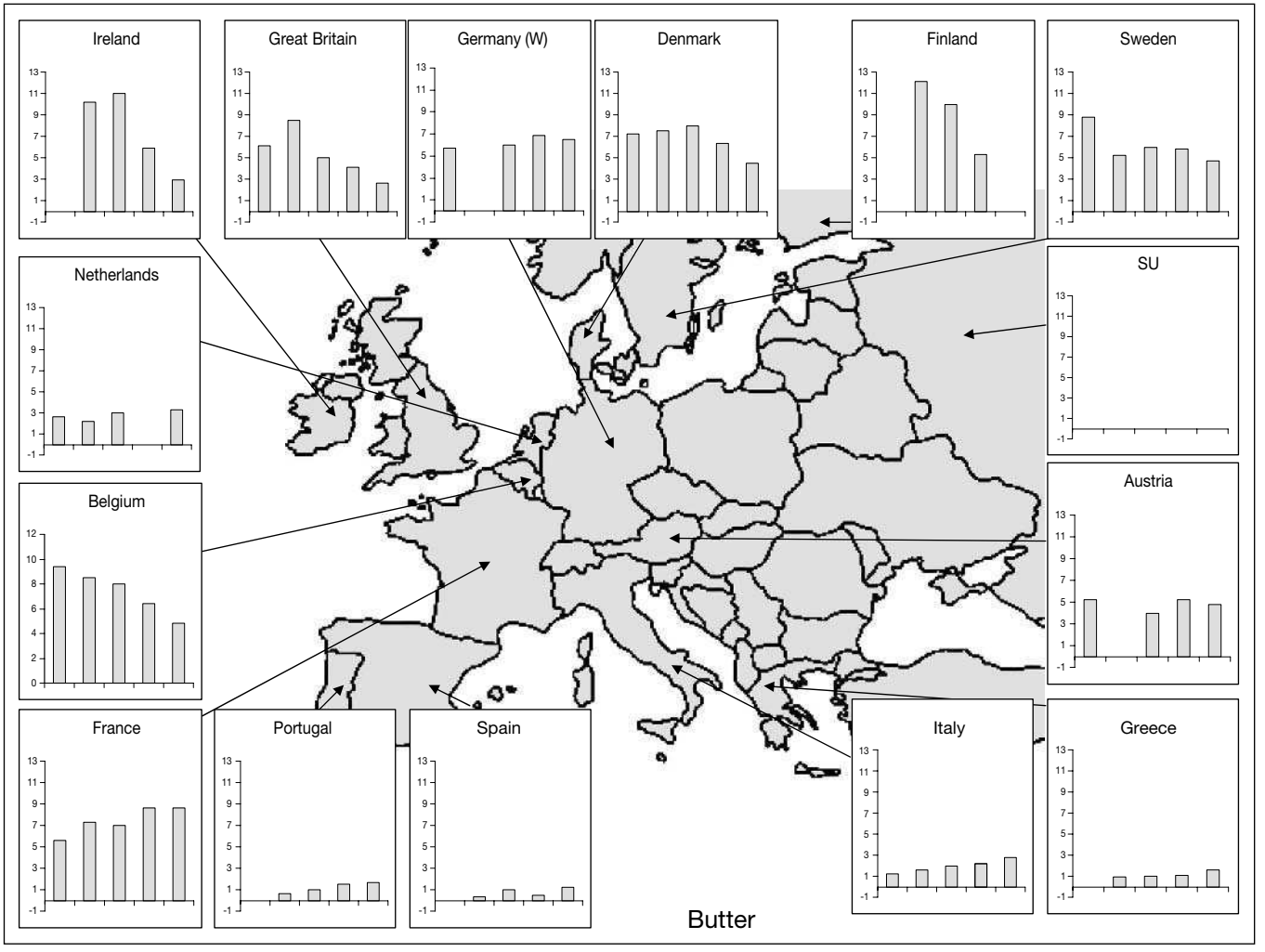

Fig. 2e. Graphical representation of consumption of butter in Europe 1953/56–2001/02 [28].

Table 6. Consumption of milk in Europe 1953/56–2001/02 [23–26, 29]

State	Milk				
	1953/56	1970/71	1983	1994	2001/02
Belgium	91.6	78.0	88	83.4	90.3
Germany (W)	128.0	77.4	91	92.3	90.6
Denmark	159.6	112.5	169	143.4	133.2
Finland	n.d.	252.6	228	201.5	190.3
France	88.6	71.3	96	95.3	97.5
Greece	n.d.	66.0	65	64.4	70.1
Great Britain	155.7	139.7	133	138.5	128.4
Ireland	n.d.	212.6	192	196.2	179.9
Italy	52.3	66.6	89	62.1	71.5
Netherlands	199.9	107.0	140	129.0	122.3
Austria	178.4	148.7	148	111.1	94.8
Portugal	n.d.	42.9	114	100.8	117.3
Sweden	222.5	161.7	161	153.4	144.7
Spain	n.d.	78.5	114	125.8	133.1
SU	n.d.	n.d.	n.d.	251	n.d.

The multinationals try to concentrate on specific brands, but normally the recipes of these products differ from region to region. Knorr (now Unilever), for example, offered 15 different minestrone soups in Europe [42]. And new products, for instance fruit yoghurt, which was introduced into the mass market since the 1970s, show immense national consumption differences: Dutch and French consumers are eating more than four times as much yoghurt than Irish or Italian consumers [43, 44]. In other words there is no regional leveling of the yoghurt market although it is a new market dominated by multinational companies.

In times of saturated markets, convergence of diets cannot be a successful business strategy. For example, the fast growing market of nonalcoholic beverages is a highly fragmented market segment [45]. Immense consumption differences exist for water, lemonades, refreshments, fruit juices and syrups. Eastern European consumption patterns stress that purchasing power is the main limiting element of market building, while traditional drinks are still important. Therefore, you can find strict and traditional differences between wealthy Western European countries. Today, the different national markets of spirits, for instance, are dominated by local specialties. Fruit spirits, cream and bitter liquors are important in France and Italy, in Germany corn schnapps and brandy and in Great Britain whiskey [46]. These traditions are promoted by the producers to survive in a decreasing market.

Fig. 2f. Graphical representation of consumption of milk in Europe 1953/56–2001/02 [23–26, 29].

Table 7. European diet in 1927 as reflected in typical dishes [47–57]

Region/Nation	Typical dishes
Alps	Spinach soup with milk, mushroom pudding with macaroni, Salzburger Nockerln, fillet with mushrooms, Pogatschen with greaves, cream strudel
Bohemia	Soup with bacon dumpling, Bohemian roast, lung roast with smoked meat, cabbage schnitzel, dill sauce, cream-horseradish sauce, stuffed pancake, Powidlataschkerln, Powidla (plum jam), fruit dumpling, Schischky (potato noodles)
England	Meat pie, pound cake, orange pudding, butterbread pudding, roly-poly, plum pudding
France	Onion soup, cremé caramel, kidneys in Madeira, pommes frites, entrails from Bordeaux, rum pudding
Italy	Minestrone, risotto, fritto misto, gnocchi, spinach, costolette de vitella alla Milanese, zabaioine
Poland	Pepper carp, filled pike, calves' tongue, calves' feet, beetroot as a vegetable, mushroom sauce, Polish marron cake
Romania	Fig pudding, eggs with chanterelle, cabbage meat, roe mayonnaise, roasted sausages, vegetable meat, vegetable dish, cabbage meat ball, cheese meat ball, nut cake, cheese and nut bread
Russia	Bortsch, blini, shish-kebab, wareniki with cheese, fish soljanka, kasha (buckwheat gruel)
Spain	Chicken croquettes, braised rabbit, ropa vieja, arroz catalán
Hungaria	Caraway soup, fish goulash, veal or porc pörkölt, filled onions à la Rudnpansky, baked fish, simple nockerln
Vienna	Soup from dried mushrooms, onions sauce, spinach pudding, red turnip, rice pudding, cheese bakery, poppy cake

Dishes and Meals in Transition

In summary, we wonder if public health promotion will lead to changes in everyday consumption. There are clear trends, but no real explanation of human behavior, of human actions. Of course, I have some arguments, but they cannot explain very much. In such a case it is necessary, to change the level of argumentation. Until now, I have only argued on the level of foodstuffs. As we have already seen, this is only one, and perhaps not the decisive level to analyze European diets. So I have to go a step further and look at different dishes in Europe. As a historian, I will start with typical regional dishes from 1927 (table 7).

I have chosen this because its relevance surprises me. Although we would miss, for example, pizza as an element of a traditional Italian diet, the sample seems to be relatively typical. It reduces the exceptional elements of diets to some meaningful examples and creates the impression of a culinary unity.

It is important to understand the imaginations of other countries and the symbolic meaning of their diet. But were these classifications right? Did the nations and states really exist from a culinary point of view? Were these dishes really typical for their diets? Or were they not symbolic excesses, simple and easily commercialized stereotypes? We know, for instance, that national or regional dishes can even exist when the culinary practice has ended a long time ago. Dishes did not refer to real consumption patterns, but to an ideal and ordered world of past, of childhood. Their tradition and unity is often only a cultural or commercial construction.

A good example for this is the Austrian or the Vienna diet. This is mainly a grain- and pastry-based cuisine with a great number of famous meat dishes and an exquisite variety of sweets and bakery dishes. Although the small Alp republic looks proudly on its national dishes, an analysis of older cooking books show: 'Austrian cuisine is less reality, but myth, cliché, desire or marketing target' [58]. Vienna as a melting pot of very different ethnics and culinary traditions of the Habsburg monarchy was too heterogeneous for a clear-cut diet, for a typical cuisine. Even famous dishes like Vienna schnitzel or Palatschinken did not appear before the end of 19th century.

National dishes and diets normally are cultural and commercial constructs established mostly during the age of nationalism in the 19th century. They allow the concentration of specific aspects of different regional diets and the creation of a homogenous picture of an eating culture for foreigners and citizens. The German or the British examples show that national constructions have structural limits. There is no 'German' or 'British' diet; both are divided into a northern and southern part. Although the difference between eating reality and scientific construction is obvious, different attempts were made to map different European diets (fig. 3).

On a first glance, these give a well-ordered impression, which underline the fact that diets are mostly orientated at national borders. Nevertheless, in some cases, national borders are able to blur them. Thinking about these maps in a more differentiated way will lead to the conclusion that sources, analytic levels and methodology of most of these maps are unclear because they compile information of different times and social classes [60, 61].

Of course, it would be possible to add more actual maps or data, but the fundamental problem remains. The complexity of diet patterns cannot be reduced to some simple pictures [62, 63]. So I have to go one step further just to describe the direction an adequate analysis of European diets has to go. I will

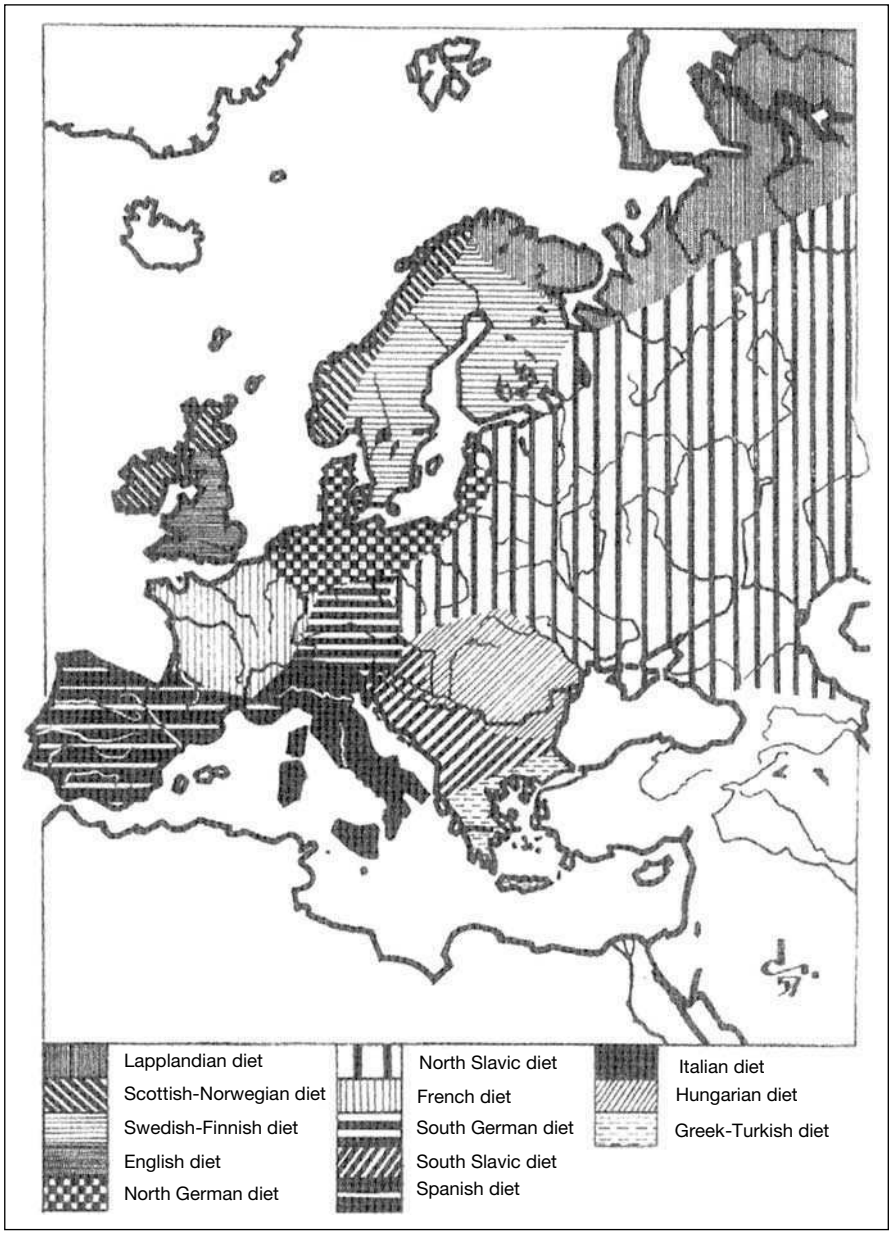

Fig. 3. European diets ca. 1920 [59].

go back to the 1960s and will follow an impressive study of German geographer Wolf Gaebe. His work was founded on household budgets and a great compilation of geographical, agrarian and economic studies. As a consequence, he analyzed not only foodstuffs and diets, but also preparation techniques, tastes and meals [64].

In Northern Germany and parts of the Netherlands, we can find heavy and relatively fat dishes. Here – in opposite to South Germany – potatoes played a significant role. This plant could be used in very different forms and preparations: boiled, with and without peel, fried or mashed, at least as a salad. In Southern Germany, preparation of potatoes was different; they were used as salad, fried or as dumplings. The smaller amount of potatoes was balanced with a higher flour and (in Southwestern Germany) pasta consumption. In West Germany, it was common to boil vegetables and meat although stews were mostly cooked in Northern Germany: 'This has two consequences for the diet. During cooking with water the added fat loses its taste value and so cheaper animal and vegetable fats are suitable. If foodstuffs were boiled, it's rational to prepare vegetables, potatoes and even meat together' [65]. In Germany, stews like this, mostly combined with fat meat, were much more common than in France, even in Northern France, and were served two times per week. In parallel, fresh vegetables were consumed relatively seldom, while green salad was eaten mostly in Southern Germany and the Rhineland.

In Germany, lunch was still the main meal – a relatively unique development. As a consequence eating breaks, gender relations and eating outside were structured in a specific way. In the 1960s hot dishes in the evening were familiar only in every fourth, today in every third, household. Therefore bread is the main foodstuff of breakfast, dinner and snacks. Bread characterized a cold meal, was eaten during a hot meal only sporadically, and – as a consequence – had strong and varied taste. The structure of snacks caused a relatively high consumption of spreads and toppings, especially fat and sausages, cheese and jam. Cheese was not eaten separately, with the exception of feasts.

In contrast the French diet is characterized by the distinctiveness of dishes. Combined versions are relatively rare. The single dishes were prepared and partly even served in a separate way. The preparation itself was very flexible and needed a lot of care. Vegetables were not boiled in water, but often steamed, while meat was grilled and fried. Fresh salads were a regular course of the meal and were not eaten as a side dish. Normally a good piece of high-quality meat was the 'piece de resistance', which was refined with a great number of herbs and spices (like parsley, thyme, tarragon or garlic). While tasty red and white wines were regular elements of French meals in the 1960s, today nonalcoholic beverages are dominant. White bread (baguette) was part of nearly every meal. It was spread only with some butter or eaten plain. Because of this it must be

fresh and crusty and must be bought daily. The meal was normally finished with either fruit or cheese, even if the whole meal consists only of one course of vegetables and meat.

Let me add some hints about the Italian diet: here, comparable to Germany, combined dishes were important although they consist of different foodstuffs (i.e., minestrone). Pasta was highly important; noodles were eaten as a starter or as a main course. They make up the fundamental part of meals. Variations came from different ingredients and sauces: olive oil and different cheese, tomatoes in heterogeneous preparations and a wide range of herbs and spices (like onions, garlic and basil) allowed very different tastes and shades. Italy – like Germany – has no national cuisine. Dishes like polenta or different rice meals can be found mainly in the North. Tomatoes are the most important vegetable, which is used in very different preparations. The taste of meals is dominated mainly by oil. Olive oil is normally used for salads, while cheaper fats dominate cooking, roasting and baking. Butter is used only rarely, margarine and lard too. Instead, tasty cheese is of high importance, especially soft cheese made from cow, sheep or goat milk. Combined with wine, they often finish the meal.

Different traditions can be found in minor elements, for example, the way of preparing coffee: 'In Germany it is drunk with small additives of milk (conventional milk, evaporated milk, cream). In France coffee is boiled in a concentrated way, and consumed either pure or as 'café au lait' with a lot of milk – normally more than half of the drink. Italians prefer – apart from milk coffee in the morning – strong black coffee in small cups. Belgians drink their coffee mostly black, while Dutch normally use milk' [66]. Coffee is part of the different meals, and it is consumed in Europe at different times. In Belgium and France it is an integral element of breakfast, in Germany and in Italy this habit is spread widely too. Instead, in the Netherlands and in northern Germany tea is the morning drink. Coffee follows in the later morning and after dinner. In France coffee is consumed after lunch, while coffee drinking in the afternoon is quite common in Germany and Belgium also.

These short hints on meals and systems of meals may show the complex structure of European diets at this level. Health improvements, which only try to change one or some of these elements, must fail because these changes are linked with a lot of different elements of everyday eating and life.

As a consequence, the relevance of scientific or public health promotion is low. The most important changes come from structural economic, social and lifestyle-related developments. A good example is the so-called Mediterranean diet. Main elements of this predominantly vegetarian diet are, as we all know, vegetables, fruits and grain products. High consumption of olive oil and wine are characteristic, too. The relatively high living expectation and the relatively low significance of cancer and cardiovascular diseases makes the Mediterranean

Table 8. Characteristics and change of regional diets [68]

Characteristics	Contemporary situation
Regional production of food	National and international markets
Meals with traditional and religious ties	Secular, deprived world
Combination of conservation, preparation, and meal patterns	Time pressure and growing supply of adding spices convenience food
Continuity of minor matters	Rationalization of time and households
Traditional taste	Innovative taste
Identity	Identities

diet an important research topic of epidemiologists and nutritional scientists who promote this diet as a healthy and tasty one. I agree with these recommendations, but as a historian I am convinced that these efforts will not be successful. This Mediterranean diet today is not practised in the Mediterranean countries any longer. It is a cultural construction built up by scientists, a lost ideal of a pure peasant diet, which has lost its relevance more and more since the 1960s [67]. As we have already seen, animal products have become more and more important, while bread, potatoes and grain consumption is declining. The increasing consumption of meat and milk led to a higher proportion of animal fats, olive oil is replaced partly by cheap sunflower or maize oil. Only the consumption of vegetables and fruits remains on a high level and has even increased. In general we must realize that the Mediterranean diet today becomes more and more like the diet in Middle or Western European countries. This long-term change has structural reasons, especially growing incomes, effects of tourism, the influence of refugees and foreign workers, the growing importance of European retail firms, the secularization and the changing role of women.

To analyze this change more precisely, we must look at the characteristics of traditional or regional diets (table 8). Six points should be stressed besides the significant questions of local identity and traditional taste: regional production structures, meals with traditional and religious ties, a systemic combination of food conservation, preparation, herbs and spices and meal patterns and, as a last point, the continuity of minor patterns. These fundamentals are breaking more and more. We can find national and international markets, a secular deprived world, growing time pressure in everyday life combined with a growing supply of different convenience food. We can find a rationalization and mechanization of household and a search for new, innovative tastes and new identities. These developments must have consequences for diet, otherwise

eating and nutrition will not be a central element of human life. Growing wealth, increasing opportunities of self-realization, intensified mobility and more and more contacts with persons from different cultures – these are important reasons for the changing European diets. Nutrition and eating culture are not primarily a problem of nutrients, metabolism and medical forms of 'health', but it is a mirror of us and our society, an expression of economic power and individual opportunities.

The result is similar all over Europe, even if the speed of change is different: The consumption of traditional stable foods is decreasing, while processed foods are pushing to the front. Modern life- and working style has deep social and nutritional consequences. The nuclear family, established in the 19th century, has lost its obligations. Outdoor eating becomes more important, while home preparation loses ground and simple dishes win significance. If we want to eat the traditional dishes, we must visit restaurants or wait until Sunday or feasts.

European Eating Habits and the Perspectives of Health Promotion

At the end of this preliminary analysis two conclusions can be drawn, which are relevant for the discussion on health promotion:

First, we have to think about the problems of constructing our topic of a 'European diet'. Scientists normally discuss these at the level of data quality or methodology. But this is not the main point, it is an internal scientific discussion, partly misleading when we look at health promotion or public communication. On the one hand the different levels of diets gave an impression of the complexity of eating patterns and everyday culinary culture. Culture and tradition matter. We must be aware that there are direct relations between these different levels. To change the foodstuffs does not mean that meals will be changed adequately. Intervention and health promotion will only be successful if we look at the whole range of diet. This is a complex task, which shows the necessity of interdisciplinary cooperation to improve health promotion. On the other hand we have to recognize that the way of eating is closely linked with the way of living. The great gap between knowledge of healthy eating and a different 'unhealthy' practise is mainly caused by this relationship. If we want to change eating patterns we have to change the world we are living in – nothing more and nothing less. But the problem is well known. For example Max Rubner, one of the founders of nutritional science, summarized in 1928: 'You cannot expect very much from public promotion in the field of nutrition in the form of public education' [69].

But there is no need for resignation. There is need for change, change of science itself, and for communication strategies. The example of 'European diet' shows that there are not only different levels of 'real' consumption, but also of 'real' eating culture. We must be aware that 'reality' consists of different levels, that images and symbolic constructions are important, too. On the one hand, this can help us to understand the relative failure of conventional forms of health promotion. Without knowing and taking seriously the world of beliefs and fears, prejudices and yearnings, we will not be able to communicate with ordinary people. On the other hand we should be able to recognize that scientists themselves are part of the game. They are constructing a reality of their own; a reality far away from everyday experiences and partly from everyday needs. Although science can be characterized as a mode of hierarchization of specific forms of knowledge and specific elements of reality, it is necessary to reflect on the unintended consequences of our work and proposals. If we are able to do this, we perhaps will be able to improve health promotion. Otherwise in 80 years another historian will reflect on your work and he will summarize it with the same words as Max Rubner did in 1928.

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Influences on Food Choice and Dietary Behavior

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Abstract

There are a number of possible reasons for the lack of effectiveness of attempts at changing dietary behaviors. While lack of information and knowledge about foods and nutrient contents might play a part, motivation to change is likely to be much more important. Food choice, like any complex human behavior, is influenced by many interrelating factors, including various physiological, social and cultural factors, and these need to be taken into account when considering dietary interventions. In many cases people lack motivation to change. This can be related to optimistic bias, where people underestimate the risk to themselves relative to others from a variety of hazards. People feel less at risk personally for many dietary risks and this is related both to the control they feel they have over dietary behaviors and also to their considering themselves to have better diets than the average. The 'stages of change' model is a possible means for trying to address these motivational issues. While this model has been applied to various forms of behavior such as smoking, there are a number of problems transferring such a model from smoking to dietary behaviors, including the lack of clear cut specific behaviors and behavior change targets in the dietary field.

Introduction

Changing the dietary behavior of populations is not easy. Official recommendations have been in place in the UK since 1984 [1] for a reduction in dietary energy derived from fat, but the changes over time in fat as a percentage of energy at the population level have been slow. Given recommendations, for example, to reduce fat in the diet or to increase the consumption of fruit and vegetables, it is necessary to understand what influences people's choices of foods and what obstacles there might be to effecting such changes.

There are a number of possible reasons for the lack of effectiveness of attempts to change dietary behavior. Two specific issues will be discussed here, the complexity of human food choice and optimistic bias. This will be followed by a discussion of the transtheoretical model [2] as a possible means for implementing dietary changes more effectively.

Complexity of Human Food Choice

Food choice is a complex human behavior, or set of behaviors, and consequently is influenced by many interrelating factors. It is not determined solely by physiological or nutritional needs nor by beliefs about and interest in the health benefits of particular foods or diets. Instead, it is influenced by a complex set of factors ranging from biological mechanisms and genetics to social and cultural factors.

A number of models have been presented in the literature [3], which aim to show the types of factors, which might influence food choices. Such models are useful in pointing to the variables to consider in studies of food choice and, also emphasize the complexity of food choice behavior. The factors influencing food choice can be divided into those related to the food, to the person making the choice and to the external economic and social context in which the choice is made.

There are chemical components and physical properties of the food, which will have an impact on choice, via sensory perception. Some chemical and physical properties of the food will be perceived by the person in terms of attributes such as flavor, texture or appearance. However, perceiving a particular sensory attribute in a food does not necessarily mean that a person will choose to consume that food. It is the person's liking for that attribute in that food which influences choice. Other chemical components in the foods, such as the amount of protein or carbohydrate, will have effects such as reducing hunger, and the learning of the association between the sensory attributes of a food and its postingestional consequences appear to be a major mechanism by which preferences develop. Psychological differences between people, such as personality, may also influence food choice.

In addition to factors associated with the person and the food, there are also many other factors in the context within which the choice is made that can be important in food choice. These include marketing and economic variables as well as social, cultural, religious or demographic factors [3]. The culture in which a person is brought up has a very strong influence on the types of choices made and social interactions can have a profound effect on our views of foods and our eating behavior. The impact of these factors has been receiving increasing attention [4].

The impact of different factors is likely to vary across different types of choices, e.g., choosing a sandwich for lunch versus Christmas dinner or a celebration meal. Also, nutritionists are not usually interested in the choice of particular foods but are interested in overall diets and the intakes either of types of foods (e.g., vegetables) or in the outcome of the choice of many different types of foods, e.g., fat intake or calcium intake. It has long been recognized that there is a need to present nutritional and health information to consumers by referring to foods rather than to nutrients, but if the aim is to change fat intake there are many potential changes in behavior, which could achieve this and the changes are likely to differ across people. The translation of nutritional messages into changes in behavior by individuals is far from easy and this may be one of the reasons why dietary interventions are not very effective.

Given the discussion above it is not surprising that messages on health and nutrition have relatively little impact. There are many competing influences on people's choices of foods and people's motives for particular choices are complex. Therefore, an intervention which is primarily related to health may have limited impact.

Optimistic Bias

Getting people to recognize the need to change is one of the major problems in implementing dietary change. This can be related to the phenomenon of 'optimistic bias', which has been studied in psychology for a number of years. It refers to the finding that people underestimate the risk to themselves relative to others from many types of hazards [5, 6]. Optimistic bias can be illustrated by asking a question such as 'Compared to other men/women my age, my chances of having a heart attack in the future are' with responses on a scale running from 'much below average' to 'much above average', and a midpoint of 'average for men/women my age'. There is a consistent effect, at the group level, of people rating their own personal risk as below average [6]. However, if the sample of people is representative of the appropriate population (i.e., they are not a special group such as nutritionists comparing themselves to the general population) then the mean response over the sample of participants should be near the center of the response scale, i.e., on average people should be at average risk.

An alternative method for assessing optimistic bias is to ask for separate ratings of personal risk and of risk for 'other people'. This has been done for a number of different types of hazards associated with foods [7]. The potential hazards included a high fat diet along with microbiological and technological risks (e.g., genetically modified foods). In each case people rated the risk to themselves and

separately rated the risk to 'other people'. Optimistic bias was found for all of the hazards included in the study. People saw themselves as at significantly less risk than other people for all of the hazards included, but the effects were larger for the lifestyle hazards of a high fat diet and alcohol abuse as well as for food poisoning from home prepared foods. The size of effect was less pronounced for more technological hazards (e.g., pesticides, genetically modified foods) and for microbiological risks from foods prepared outside the home.

In the same study people were also asked to rate how much control they felt that they had over the same set of hazards, again separately rating personal control and control by other people [7]. People saw themselves as having more control than other people over lifestyle hazards, e.g., high fat diet and alcohol abuse. Also, the absolute levels of ratings of control were very high for these hazards. This confirms results from other studies that feelings of control are related to increased optimistic bias and it would appear that people see nutritional risks both as ones over which they have personal control, and where they are at less risk than other similar people.

In a separate study people rated the chances of their putting on weight, having heart disease and being unwell because of a high fat diet [8]. In this case, the ratings were direct comparisons of these outcomes relative to other people of the same age and gender, on a scale ranging from 'much below average' through 'average' to 'much above average'. In each case, they rated their susceptibility as significantly below average. These same people also rated their consumption of cheese, meat, fat, margarine/butter and biscuits, buns, cakes and pastries relative to the average person of the same age and gender. In each case (except cheese), people rated their consumption of these foods as significantly below average.

Thus, people have a positive view of the risks to themselves from various hazards and also a positive view of their own dietary behaviors, both in terms of intake of nutrients and of individual foods. There is still, of course, a question as to whether this has any impact on their behavior.

The impact of 'perceived need' to reduce fat intake on intention to change was addressed in a study [9] using the theory of planned behavior, an attitude-behavior model widely used in social psychology. Perceived need was assessed by asking participants 'Do you feel that you need to reduce your fat intake' with responses on a 5-point scale labeled 'no need to increase', 'not at all', 'slightly', 'a great deal' and 'a very great deal'. Perceived need significantly increased the prediction of intention to change even after taking account of the components of the theory of planned behavior. Thus the feeling of the need to change has an impact and if people feel that their diet is already healthy and that they are at less risk than other people then they may be less likely to implement change.

A number of explanations have been put forward for optimistic bias. There may be a need to deny risks in order to avoid anxiety or people may not consider what other people do to avoid risks, hence attaching too much weight to their own risk avoiding behaviors [10]. Whatever the cause of such biases, it is extremely difficult to reduce them [11], and therefore attempts to address bias directly may not be useful as a means of making dietary interventions more effective. However, it needs to be taken into account in attempts to change dietary behaviors.

Stages of Change Model

Optimistic bias points to one of the main issues in dietary intervention: the need to address people not feeling it is necessary to change. This is also highlighted in the transtheoretical or stages of change model [2, 12]. This model was originally developed from an analysis of different therapies for changing addictive behaviors such as smoking. Most applications have been on addictive behaviors but the model seeks to be applicable to other forms of behavior change and there have been more recent applications to other forms of behavior, including diet [13, 14].

The first key aspect of the transtheoretical model is that when people change a behavior they go through a series of stages rather than its being a continuous process; these stages are precontemplation, contemplation, preparation, action and maintenance. Someone in precontemplation is not thinking about changing and has no intention to change. In contemplation the person recognizes that a problem exists and is thinking about changing but has not yet made definite commitments to change. Preparation is defined as including those people intending to take action within the next month [12]. In the action stage, significant changes are made to the behavior and this stage lasts from the first day until 6 months after such changes. Maintenance is when the changes have persisted for more than 6 months. Relapse is also sometimes included, since in many cases (and possibly the majority) people will move back rather than simply progressing through each of the stages in turn.

As well as stages, the transtheoretical model also introduces the idea that different processes of change will be matched to these various stages [2]. Thus in the early stages, consciousness raising and other cognitive strategies will be important, whereas in the later stages (action and maintenance) behavioral processes will become more important. Other parts of the model are that self-efficacy (the perceived ability to act) will vary across stages, as will the perceived pros and cons of action (decisional balance). This leads to the suggestion for different types of intervention for people at the different stages of change.

This model has been applied extensively to addictive behaviors, and particularly smoking, with some success [2, 12]. However, it is presented as a model for all forms of behavior change, and therefore should be applicable to effecting changes in dietary behaviors. There have been a number of applications of this type of model within the dietary area, including reducing fat intake, increasing fruit and vegetable consumption and weight loss or weight control [14].

The model is not without its critics [15] and its application to dietary behaviors is far more problematic than for behaviors such as smoking. A number of criteria have been suggested as necessary in order to have a useful stage model [16]. It is necessary to have an accurate method for classifying people into the appropriate stages. Secondly, most people should move through the stages in the specified sequence, although there may be some exceptions to this. This criterion is often not met. People at the same stage should face similar issues, which can be addressed for that particular stage. Finally, different factors should be important for different stage transitions; if all stage transitions depend on the same factors then a single intervention will be effective regardless of stage. The advantage of a stage model should be that interventions can be targeted specifically at people seeking to move from a particular stage to the next and that intervention would not be effective for someone at a different stage. However, processes are found to occur at more than one stage. Also when processes are shown to be used at a particular stage this might be because they are inhibiting stage movement rather than being the most useful processes at that stage.

The above criticisms apply to the use of the stages of change model with any type of behavior. Application of the stages of change model to dietary behaviors brings an extra set of problems in both conceptualization and application of the model. The first is that the goal in dietary change is not elimination of the behavior, as for addictions, but rather some level of intake or consumption (e.g., 35% of food energy from fat, five portions of fruit and vegetables per day). The second is that these targets are often in the form of an outcome rather than a specific behavior. Thus consuming 35% of energy from fat is not a behavior, but rather a person eats amounts of various foods and this nutrient intake is the outcome of that set of behaviors. Also people do not know when they have reached the target, since they do not know their own nutrient intake either before or after they have changed. With other types of behavior, such as fruit and vegetable consumption, people can more easily estimate whether they do consume five portions per day, but the situation is not so straightforward as smoking where the goal is not to smoke at all. With dietary behavior multiple changes are needed, for example, changing the amounts consumed of several foods rather than changing a single behavior (as in smoking). Although it could be argued that emphasis should be given to a clear and

definable behavior, since that is how the model is conceptualized, often practitioners are interested in outcomes (e.g., fat intake) rather than a specific behavior (e.g., eating chocolate biscuits).

One of the consequences of these differences between dietary behaviors and smoking is difficulty of self-classification into stages. Where targets are specified (e.g., 35% energy from fat), a number of people who classify themselves as maintainers will fail to meet the target. Should these people be classified into the same group as those who have achieved the target and are maintaining it or should they be classified into preparation [13] or into precontemplation since they have not met the target and are not thinking of changing further [17]? However, neither of these strategies overcomes the problem, since psychologically these 'pseudo-maintainers' are not similar to those in preparation or in precontemplation and interventions designed for people in those stages would not be expected to be effective with them. An alternative might be to reclassify them into a new group of 'failed maintainers' and to develop interventions specifically for that group. Since dietary change is a series of changes rather than one discrete change, it might be better to assess whether people placing themselves in maintenance are interested in further change.

A review of 34 dietary studies involving the transtheoretical model [14] showed the majority to be cross-sectional, simply classifying people into stages and then relating one or more of the transtheoretical model constructs (e.g., processes, decisional balance, self-efficacy) to the stage. In order to test the model effectively, it is necessary to carry out interventions comparing the effectiveness of stage-matched interventions against controls of mismatched interventions or general interventions. Horwath's [14] review lists only one study meeting this criterion. Thus, although this model has some potential for more effectively tailoring information for people seeking to change their diets, it requires more critical testing in this field.

Conclusions

There are many potential reasons why dietary change is difficult to implement effectively. One of the most important is the competing influences on food choice, which will reduce the effectiveness of interventions based solely on the health benefits of dietary changes. Food choice is complex and is influenced by a large range of disparate factors. Interventions need to take account of these competing influences and of the likely mechanisms underlying food preferences and food choice. Optimistic bias is also likely to impede the effectiveness of interventions. Overcoming optimistic bias is not easy, but messages which are more personalized may offer one means for addressing it.

The transtheoretical, or stages of change, model appears to offer one means for improving behavior change through allowing more personalized interventions. However, due note needs to be taken of the differences between the addictive behaviors, such as smoking, where this model was originally developed and dietary behaviors. While the model offers a means for classifying people and targeting messages more effectively, it needs to be tested critically in order to determine if it really is a useful addition to dietary intervention strategies.

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Age and Gender Dependent Profile of Food Choice

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Abstract

Several studies have described remarkable differences in food choice between men and women. Consistently, women are reported to have higher intakes of fruit and vegetables, higher intakes of dietary fiber and lower intakes of fat. In accordance with such more healthy food choice, women usually attach greater importance to healthy eating. In addition, the motivation of weight control is more prominent in women and they are more likely to diet or restrain their eating behavior. Recently, studies found that health beliefs and weight control motivation may explain up to 50 percent of gender differences in food choice. In addition, less healthy food choice profiles of men may be related to their poorer nutritional knowledge. However, health beliefs, eating attitudes and dieting appear to be phenomena which vary throughout the life span. In growing older, changes in the chemosensory perceptual systems play an important role in food choice. The decline of gustatory and – perhaps even more pronounced – in olfactory function may lead to a decrease of the pleasantness of food, thus limiting the reinforcing properties of food intake which eventually results in a decrease of appetite, often reported in elderly people. In addition, there are some indications that sensory-specific satiety diminishes with age. Sensory-specific satiety is the reduction in the pleasantness of food as it is consumed. This decrease of pleasantness usually motivates the choice of other foods and therefore, a varied diet. Therefore, the decrease of sensory-specific satiety may in part explain the limited variety of the diet sometimes seen in elderly people. However, lifestyle, socio-economic situation and other variables may limit the influence of such physiological changes and help to maintain an adequate food intake despite these age-related processes.

Gender Differences

A number of studies have consistently reported gender-dependent differences in food choice, women generally showing a healthier pattern of food

choice. For example, the International Health and Behaviour Survey (IHBS) examined a range of health behaviors in a total of 19,298 university students from 23 different countries using a self-report, questionnaire based study [1]. In almost all of the 23 countries, a higher percentage of women than men reported to avoid high-fat foods, to eat high-fiber foods, to eat fruit daily, and never adding salt to their meals. Similarly, in a study on 1,024 UK adults aged 55–64 years who participated in a population-based screening of colorectal cancer, women reported to consume a larger number of portions of both, fruit and vegetables, than men [2].

In Germany, the Nutrition Report 2000 reported that average meat consumption of men exceeded meat consumption of women by 10–20 gram per day, dependent on the age group [3]. The average consumption of meat products and sausages of males exceeded that of females over the whole range of age groups from 4 to 6 years up to more than 65-year-old subjects. However, there were no substantial differences between men and women in the absolute amount of fruit and vegetables (in gram per day) consumed. With regard to energy and macronutrient intakes, men have higher intake of energy and higher absolute intakes of fat (in gram per day) but energy adjusted, relative intake of fat does not differ. On the other hand, men and women had similar absolute fiber intakes, but women had higher energy-adjusted fiber intakes resulting from difference in their energy intakes. These findings were not questionnaire-based, but resulted from the household income and consumption survey. Thus, methodological differences in assessing food choice and intake patterns may in part explain slightly different results on gender-specific food choice. Nevertheless, all reported findings are consistent with the view that women generally show slightly healthier food choices.

Health Beliefs and Weight Control as Factors Underlying Gender Dependent Food Choice

A number of studies address factors underlying gender-specific patterns of food choice. One important factor appears to be nutritional knowledge. In the study on older UK adults [2], aged 55–64 years, men estimated the number of recommended portions of fruit and vegetables to be significantly lower than women (3.4 vs. 4.5 portions). Likewise, only 28% of the males correctly knew that the recommended amount is five or more portions per day whereas 63% of the females were aware of this recommendation. In addition, only 28% of the men, but 35% of the women were aware of the relationship between disease and fruit- and vegetable intake. Nutritional knowledge was positively correlated with actual self-reported fruit and vegetable consumption. A multivariate analysis

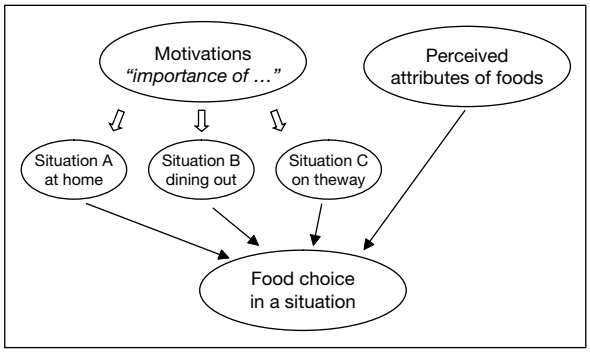

Fig. 1. Pathway model of food choice.

predicting fruit- and vegetable intake from gender, knowledge, liking or preference and dieting status (trying to lose weight) showed that nutritional knowledge was the independent factor explaining the highest proportion of variance.

Another study examined the factors which influence judgments about the healthiness of foods [4]. Participants were visitors of three grocery stores in the USA. Overall, subjects considered 'freshness' and 'fat content' as the most important characteristics of healthfulness of foods. There were no significant differences between different age groups. However, subjects who were currently dieting to lose weight considered 'fat content' significantly more often to be the most important characteristic of healthfulness than subjects who were not dieting. In line with this, non-dieting subjects considered significantly more often than dieting subjects, 'freshness' to be the most important characteristic. Gender differences in these importance judgements were completely explained by dieting status.

In the International Health and Behaviour Survey of University students in 23 countries, it was shown that women not only had healthier food choices, but also had higher health beliefs, i.e. attached more importance to food choice for health outcomes. They were also more likely to diet to lose weight [1]. Taken together, the differences in health beliefs and dieting status explained, approximately 50 per cent of the differences in dietary behavior.

A German study examined a complex model of food choice (fig. 1) [5]. A representative sample of the West German population (n = 1,997) judged the importance of a number of motives for food choice in different eating occasions. Multivariate analyses were used to successfully predict food choice in different eating occasions, e.g., a meal at home, dining out, or having a snack on one's way from the perceived attributes and the relative importance of the choice motives in different occasions. In line with the above mentioned results,

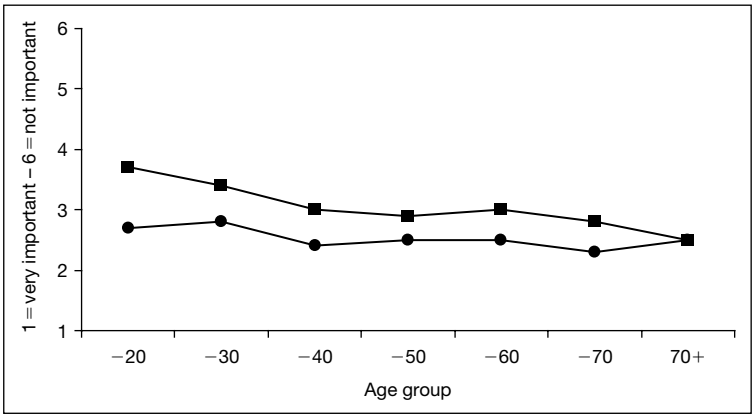

Fig. 2. Average importance ratings for the food-attribute 'low in calories' considering a regular meal at home. Data from a representative sample of the West-German population (circles are women, squares are men, n = 1,997) [5].

women attached higher importance than men to the perceived 'healthiness of food' and to the attribute 'low in calories' for food choice. In addition, there was a trend of an increasing importance with age for both, 'healthiness' and 'low in calories'. As a result gender differences in important judgments diminished with increasing age and were no longer present in over 70-year-old subjects (see fig. 2).

There were also marked gender differences in the degree of dietary restraint. Dietary restraint is the tendency to restrict food intake in order to lose weight or not to gain weight. It has very ambivalent consequences because on the one hand it is an important goal in the treatment and prevention of overweight and obesity, on the other hand it is considered as an important risk factor for eating disorders. Dietary restraint may be measured using the Three-factor Eating Questionnaire as a validated standard instrument [6]. Dietary restraint is more pronounced in women than men and men become more restrained as they become older [7] (fig. 3). Only in elderly people over 70 years dietary restraint decreases again.

Differences in dietary behavior due to weight control motivations can be found even in young school children [8]. Girls are more likely to change a variety of eating habits and food choices than boys, while boys are slightly more likely to change activity behaviors or to change their eating behavior towards weight gain or body building (see table 1). As may be seen in table 1, a substantial portion of girls are reported to use deliberate vomiting as a measure of weight control, which must be considered as a serious sign for the presence of eating disorders.

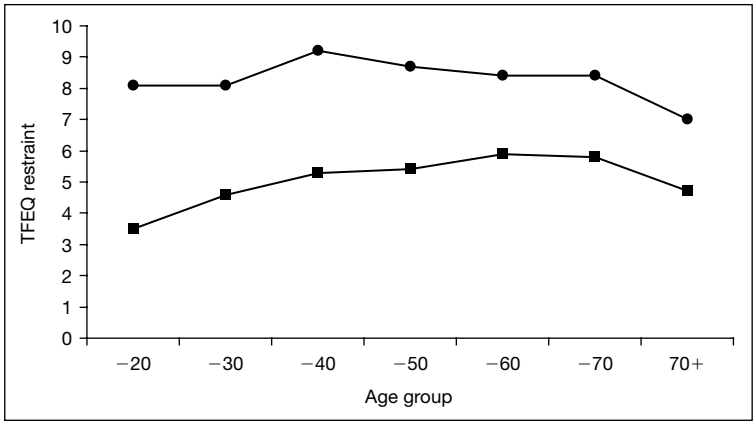

Fig. 3. Mean scores of the dietary restraint scale in the Three-Factor Eating Questionnaire [6]. Data from a representative sample of the West-German population (circles are women, squares are men, n = 1,997) [7].

Table 1. Percentage of 7–16 year old school children using different measures to influence body weight ('What are you doing to influence your body weight?' – Multiple answers allowed) (from [8])

	Boys	Girls
I eat a lot of fruits and vegetables	47.7	61.7
I exercise	55.1	45.4
I eat light products	11.3	8.9
I eat deliberately less than I want	18.0	27.5
I skip meals	11.3	27.5
I avoid products with sugar	15.2	22.7
I go on diets	9.0	20.8
I eat low fat	14.1	17.8
I vomit after eating	0.8	3.7
I eat deliberately protein rich	11.7	5.9
I eat deliberately more than I want	10.2	4.8
I do nothing	23.4	22.7

Age-Related Changes

Aging is associated with a number of physiological changes, which impact health and quality of life at least in some individuals. For example, the sensitivity of the chemosensory system, i.e. the ability to taste and smell often

declines in elderly people. This may result in changes of food selection and preferences yielding changes in energy and/or nutrient intakes. These nutritional changes then may impact body weight, body composition and nutrition-related illness [9].

While several studies support some elements of this hypothesized pathway from chemosensory changes to health status, these phenomena appear to be rather complex in real life and not as simple as often assumed.

For example, a study examined salt perception and food intake in older healthy adults [10]. Indeed, older subjects needed higher concentrations of salt in water solutions to perceive the same level of saltiness as younger adults. However, this effect was not present in chicken broth. Moreover, older subjects even preferred lower levels of saltiness in chicken broth. When actual food intake was assessed using 24-h-recalls and 14-day diet records, no age-related differences in sodium intake were found. Thus, in principle, sensitivity of salt perception appears to decline with age, but this effect seems to be limited to artificial experimental situations and does not play a major role in real foods which are known to the subjects.

In another study, sucrose taste perception was investigated [11]. Five different breakfast foods were varied in sucrose content. Again, older subjects needed higher level of sucrose to perceive the same level of sweetness as younger subjects. In addition, they preferred higher levels of sucrose. However, when they were served foods with the most preferred level of sucrose, this neither changed the amount of food consumed nor the overall pleasantness ratings for the food items.

A study by Duffy and colleagues [12] examined the role of olfactory dysfunction in women aged 65–93 years. Approximately half of them had severe olfactory dysfunction. Olfactory function was not related to body weight, body mass index and total energy intake, and dysfunction had no impact on appetite or the enjoyment of food. However, those subjects with impaired ability to smell had lower preferences for some nutritious foods and higher intakes of sweets and fats. They also reported lower interest in food-related activities such as cooking.

In an intervention study, flavor enhancers were used to increase the odor of foods (not only the flavor as the name suggests) in retirement-home residents for a period of 3 weeks [13]. This changed the food choice as compared to a three-week period without enhancers. The subjects ate more of the enhanced food, but at the same time they reduced consumption of other non-enhanced food items. As a result, there was no change in overall energy intake or diet composition. However, these findings suggest that adding intense odor to nutrient-dense food could be a means of improving the diet in older people.

Changes in sensory-specific satiety are another possible mechanism for changes in food choice in older people. Sensory-specific satiety refers to the

phenomenon that the consumption of a particular food yields a temporary reduction of the hedonic response to the taste, smell or texture of that food [14]. This increases the preference for other foods and is considered an important mechanism for promoting and ensuring the variety of the diet. A study demonstrated reduced sensory-specific satiety in older people [15]. Since findings from nutritional surveys suggest that there is a reduced dietary variety in older people [16], one could speculate that the reduction of sensory-specific satiety plays a role in the reduced variety. However, social and environmental factors may overrule the importance of sensory-specific satiety in ensuring a varied and balanced diet. For example, a study in healthy community dwelling adults found that older people with adequate income may consume a more varied diet than younger people [17].

Finally, there are some studies indicating a reduction of energy intake regulation in elderly. An experimental study used the preload paradigme to investigate energy intake regulation [18]. Yogurt preloads with varying energy content were given to subjects and subsequent ad libitum intake during lunch was measured. During lunch, older subjects showed a less precise compensation for the energy content of the preloads than younger subjects. Another study found that younger men lost excess weight after a 21-day period of overfeeding whereas older men did not [19]. Likewise, younger men regained their weights after a 21-day period of underfeeding, whereas older men again did not change food intake and stayed weight stable.

Discussion

The literature reviewed in this paper clearly indicates that age and gender dependent profiles of food choice do exist. In general, women have healthier food choices than men. These healthier food choices are largely due to more pronounced health beliefs, a higher weight control motivation and better nutritional knowledge.

Weight control motivation is an important factor of food choice in school children already. Both, weight control motivation and health orientation gain importance during adulthood. This parallels the increase of energy intake and body weight in the population. All of them, weight control motivation, health orientation, energy intake and body weight appear to peak in the age group of 50–70 year old adults.

In older people, the reduction of orosensory function and impaired sensory-specific satiety may contribute to a less varied diet and to less pleasure and reinforcement from food and eating. This decline in the reinforcing properties of food may contribute to the loss of appetite often reported in older people.

In addition, the reduced precision of energy intake regulation may promote weight problems. However, such physiological changes may be compensated in a stable social environment in which food intake and food choice are controlled by beliefs and eating habits acquired and established over the whole life-span. These may help to maintain an adequate food intake despite the age-related physiological processes.

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Diversification in Indigenous and Ethnic Food Culture

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Abstract

A diversified food supply is contingent on *underlying biodiversity* in the locality where one lives or at a distance from it, if trade routes are established. Indigenous people generally settled at the water's edge so that aquatic foods made up part of their diversified diet, with the rest of the diversity dependent on how much they hunted and gathered, on herded animals, engagement in subsistence agriculture, the ability to process and preserve food and/or food commodities traded.

The *rapid urbanization* of much of the world's population distances people from the origin of their food, the understanding of the required commodities in the human diet (e.g., aquatic food, plant foods, lean animal foods, what animals are fed, basics of freshness). At the same time, adequacy of food intake may be more reliably achieved when the food supply can continue irrespective of season, climate or distant conflict. Urban gardens partly rectify this discord between urbanization and a genuinely varied diet, replaced by purported variety where the same basic commodity is presented in many different forms (e.g., wheat grains such as bread, breakfast cereal of various kinds, pasta and baked goods). However, diversified processing may 'dilute out' health adverse techniques.

The *health benefits* of a diversified diet relate in part to the environmental integrity, which the required biodiversity provides, in part to minimizing adverse factors, which may exceed acceptable thresholds in a narrow diet, and to the need for the wide spectrum of food components, macronutrients, micronutrients and phytochemicals, which *Homo-sapiens*' physiology requires. Whilst most food diversity is attributable to plant sources, animal sources often provide significant nutritional security (e.g., fish and eggs for vitamin D, fish for n-3 fatty acids, lean meat for iron and zinc and in readily assimilable forms).

Food diversity assumes greater importance with aging populations as their physical activity usually (if not necessarily) declines and the required food component diversity of the diet increases correspondingly.

There are ways in which the required food diversity (probably 20–30 biologically different distinct foods over the course of a week) can be reduced. This is by the inclusion of more food component dense foods – like fish, lean meat, eggs, seeds and nuts.

Not only does food diversity have relevance in a public health and food policy sense, but also in individual counseling in clinical practice. Assessment of a patient's food variety can be rapid and semi-quantitative, encouraging small and consequential changes in diet. When ethnicity is taken into account, in the clinical setting, this process can be even more rewarding for the practitioner and patient.

Underlying Biodiversity

The number of different plants, animals and microbes which constitute the human diet at large is actually rather limited – some dozens of different seeds (such as grains, nuts, lentils and oil seeds), leafy plants, stems, inflorescences, and roots; and of avian, monogastric and ruminant animals, fish, crustaceans and molluscs, of eggs and milk and its derivatives; reptiles, rodents and insects; of yeasts, fungi and ferments [1].

However, the ecosystems to sustain even this level of food diversity need to be complex and resilient [2, 14], available in a host of different nontoxic environments and have a dependable water supply [7, 20]. The relationship between the ecosystem and the required energy for food production is also crucial [9]. We do not know anywhere near enough about the lower limits of biodiversity, which will allow an adequate and nutritious food supply to optimize the health of all in a sustainable way. The increasing dependence on monoculture to meet food needs with an increased population size does not always acknowledge the ecological requirements for the crop in question. Favorable eco-dynamics for crop development often require recourse to germplasm in the wild, or from institutional banks. For a dependable food supply, good governance of underlying biodiversity is necessary.

Now increasing attention is also being given to the nutritional quality of this food supply, which is dependent, in turn, on its diversity (the human species as omnivorous) and its component (nutrients and other biologically relevant factors) density; to this end there is the development of newer food crops and animal-derived foods.

Historically, the diversity of the food supply was established through evolutionary success, and then by successive forms of food acquisition (table 1). The degree of possible food diversifications (DPFD) differed with each method of acquisition and the trends in these approaches presage the eventual diversity of the future food supply.

The highest levels of food diversity, if seasons are taken into account, were probably achieved prepermanent human settlement, when various ecosystems

Table 1. Diversification in the food supply by acquisition

	Food type	Degree of possible food diversification (DPFD)
By acquisition		
Foraging and gathering (land and water)	Dominantly plant foods Fungi, algae, insects, eggs	High
Hunting (land and water)	Animals of many kinds including birds and eggs, fin fish, shellfish, crustaceans	High
Herding	Animals (flesh) and animal products	Low
Subsistence agriculture (rural)	Poultry and eggs Various crops	High
Farming (broad acre)	Tendency to monocultures or livestock of limited species	Low
Intensive animal breeding	Caged chickens Piggeries	None
Domestic gardening (urban)	Various small quantities of plant foods Poultry and eggs	High
By breeding		
A. Traditional		
• Fruits		High
• Vegetables		High
• Grains		High
• Nuts and other seeds		Moderate
• Farm animals		Moderate
• Domestic animals (e.g., poultry)		Low
B. Intensive		
Sub-categories as for 'A'		Generally lower than 'A'

were available to the one group. Once settlement was established, breeding of various plants and animals, and trade, provided the basis for DPFD.

Locality, Ethnicity and Ecosystem

To a given locality, a group of individuals would bring their food knowledge, food habits and preferences, and perhaps some *food plants or animals to propagate or breed* with varying degrees of success. Geophysical and climatic constraints and opportunities will have contributed to health status advancement,

stagnation or decline, dependent in part on the degree of food diversity achieved. There will also have been pressures on genetic polymorphisms and on gene expression, dependent on food availability [14].

For example, stone fruit which traveled with the settlers, or which grew locally would propagate by growing where discarded or excreted locally, and gather ascendancy over other local plants. If this fruit conferred health benefit, this new ecosystem would be consolidated or enhanced. It is significant that humans have created over time many new ecosystems, which are sustainable.

Migration into a community has always had considerable potential to add food diversity to the host community, as long as it did not dominate or destroy the local food culture. Australia provides an illustrative example. Early European (principally Anglo-Celtic) settlers from 1788 onwards ignored and displaced the food habits of indigenous Australians, with rare exception, to the detriment of the indigenous people and to themselves [19]. Scurvy (vitamin C deficiency) was a problem in the early days of Sydney amongst settlers, but not amongst local inhabitants who knew and used local berries, which provided adequate vitamin C. Early explorers, like Burke and Wills, perished through starvation even when amongst indigenous people who were alive and well – they could not or would not cross the food cultural boundaries.

There have been many waves of migration to Australia since 1788, but that of Asians is particularly instructive [18]. Not only were new basic commodities introduced and grown (table 2), but the whole food chain, through to domestic cooking, influenced (fig. 1) whilst affecting mainstream food habits (most Australian towns now have a Chinese restaurant; and most households have a wok and can cook the Chinese way). As a result, national food diversity is greater than it would otherwise be. But Chinese Australians and, to a lesser extent, South Asian Australians, still achieve a greater food diversity than their Anglo-Celtic peers (fig. 2).

Urbanization and Food Diversity

Urbanization may act in an opposing direction to adversely affect food diversity, but usually increased diversity prevails if prosperity is obtained.

One difficulty is that the rapid urbanization of much of the world's population distances people from the origin of their food, with less understanding of the required commodities in the human diet. However, adequacy of food intake may be more reliably achieved when the food supply can continue irrespective of season, climate or distance conflict. And this may 'smooth out' the food diversity variation, or, if technology and economics allow, enrich the potential food diversity [6].

Table 2. Asian migration to Australia after European settlement and its food consequences

Period	Nature and constituents	Food change in Australia
1850s–1880s	Gold Rush – regional Australia and major cities (Chinese)	Cultivation Catering
Late 19th and early 20th century	Market gardeners (Chinese)	Diversification of food supply
Late 19th century	Overland Telegraph (Afghans)	Information, food trade and ingredients
1950s–1970s	Asian Student Programmes	Promulgation of Asian cooking methods in Australian households
1970s onwards	Increasing travel between Australia and Asia	Cross-fertilization of food cultures

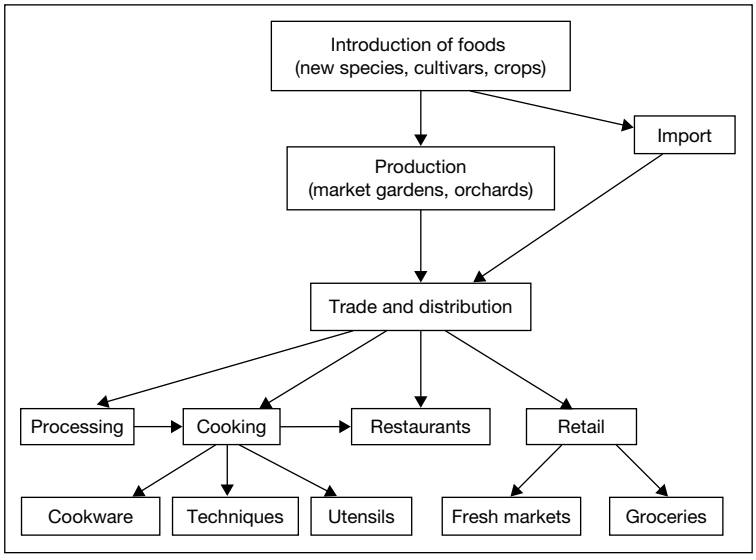

Fig. 1. Asian contributions to Australian food culture.

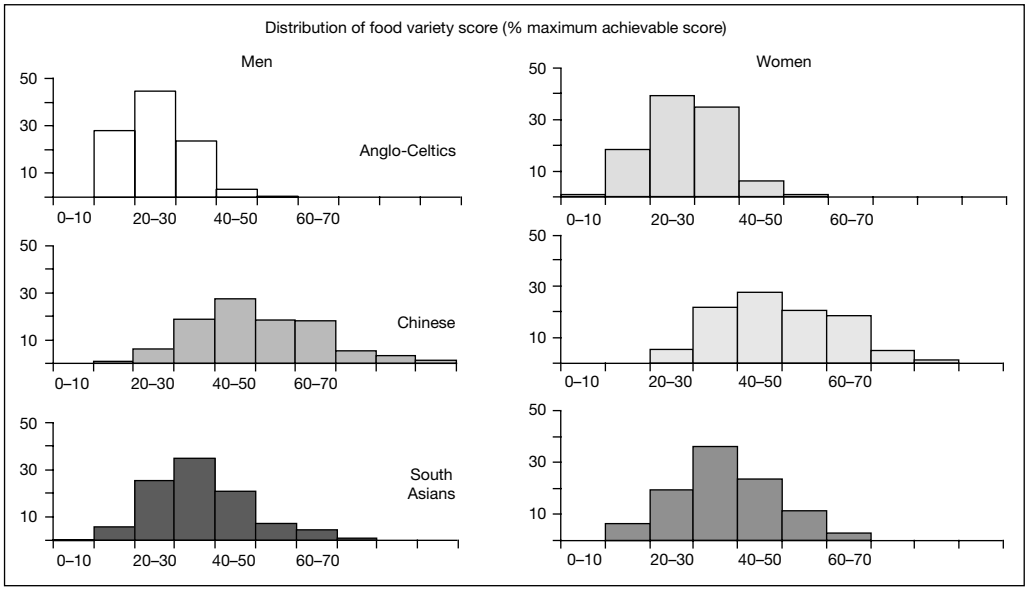

Fig. 2. Australian immigrants and food variety.

Table 3. Diversification in the food supply by place of abode

By place of abode	Food type	Degree of possible food diversification (DPFD)
Rural		
Subsistence	Local produce	High
Farms	Local produce often limited	Moderate
Towns	Local produce and traded goods	Moderate/High
Coastal/Waterway	Aquatic foods (plant and animals)	Moderate/High
	Land foods (plants and animals)	Moderate/High
Urban	Fresh food markets	High
	Processed foods	
	Traded goods	

The place of abode, whether urban or others, will have different DPDFs (table 3).

There are various ways in which available local food diversity on the one hand, and people movement (travel and migration) and trade on the other hand, may interact (fig. 3). This provides a variety of scenarios of the human condition as ecosystems (fig. 4–7).

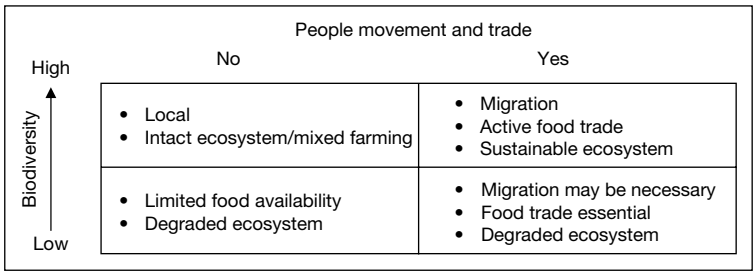

Fig. 3. The interaction of degree of biodiversity with extent of people movement and trade.

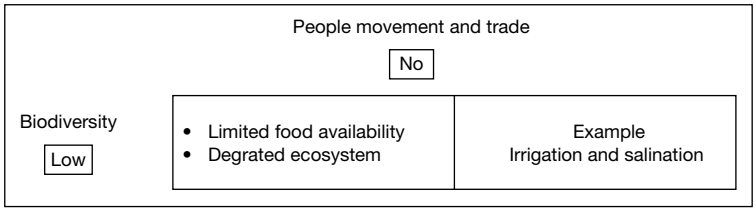

Fig. 4. The example of low biodiversity and little people movement and trade.

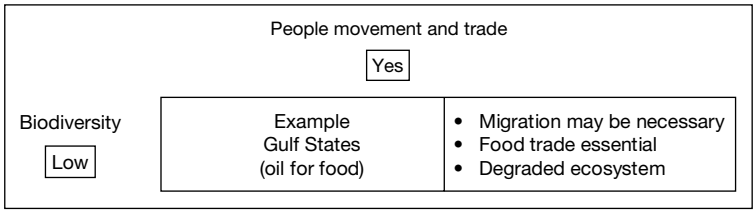

Fig. 5. Low biodiversity and significant people movement and trade.

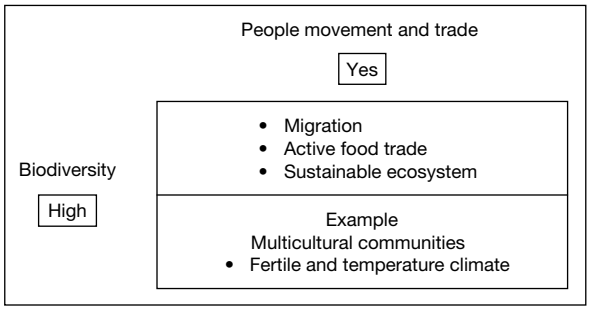

Fig. 6. The example of high biodiversity and significant people movement and trade.

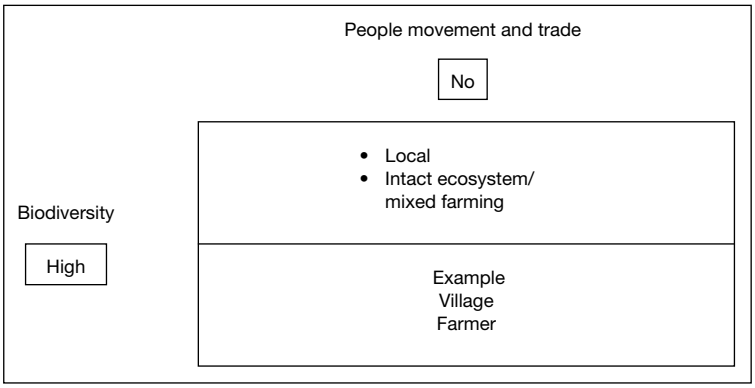

Fig. 7. The example of high biodiversity and little people movement and trade.

Health Benefits

The Health benefits of a diversified diet may be summarized as:

- the environmental integrity, which the required biodiversity provides
- minimizing adverse factors, which may exceed acceptable thresholds in a narrow diet
- the need for a wide spectrum of food components, macro- and micronutrients and phytonutrients
- providing an interest in food and the likelihood that it will be eaten
- encouraging social activity through the crossing of personal, family, community and ethnic barriers, which relate to food [5].

Survival studies which are prospective like the NHANES (National Health and Nutrition Examination Survey), FHILL (Food habits in later life) and EPIC [13] show that, not only diversity, but integrals of food intake, confer survival advantage (all cause-, cardiovascular disease- and cancer-specific survivals) along with tissue or organ-specific protection [8, 16].

Moreover, where the diversity has been formulated in a traditional setting (as in Crete by the 1960s, the basis for the Greek Mediterranean diet scores of 8–10 variables) the findings are transportable [10, 11].

The biological basis of food variety or diversity as a predictor of health probably depends in part on the fact that it captures the spectrum of biologically active food components required for optimal health in an omnivorous species. This will include phytochemicals (phytonutrients) not currently regarded as essential [4, 14].

Required Food Diversity and Its Measurement

Food Diversity Can Be Measured and Expressed as a Score

'Food variety scores quantify the number of different foods (individual foods, food mixture, food categories, or a combination of these) consumed, and are expressed over a time period or base which may be a day, a week, a month, or a year. There are no assumptions about quantity, or frequency of consumption' [4].

This, in turn, can be used for public health [15], National Nutrition Policy [3], and clinical perspectives [12].

Ideally, not only do the spectrum of food components need representation in a Food Variety Score, but also their density in food stuffs. Hence, the increasing interest not only in nutrient density but also in food component density, which relates mass of active and beneficial component to food energy value:

- Mass of nutrient or phytonutrient of food component (e.g., mg or μg)
- Energy (e.g., 100 kJ).

Food Diversity, Public Health and Food Policy – Econutrition

Food variety is interdependent with socioeconomic status (fig. 5).

In turn it relates to environmental integrity (fig. 6) and provides a platform for the concept of Econutrition.

It also serves as a basis for FBDGs (Food-Based Dietary Guidelines), as already indicated, and provides an understanding of the health benefits of cuisine [17].

For optimal health, a diversified diet needs to be combined with regular physical activity, so that energy balance is achieved.

Conclusion

The quest for food variety through biodiversity, a sustainable energy supply and trade is of the utmost importance for the health and prosperity of people irrespective of ethnicity. To this end, econutrition science must be brought.

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Organic Foods: Do They Have a Role?

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Abstract

Nutritional quality is defined as the value of the product for the consumer's physical health, growth, development, reproduction and psychological or emotional well-being. This extended definition of nutritional quality can be divided into two terms. One term is for the effects of food determined by its substance, i.e., the sum of all ingredients, beneficial and harmful compounds and their nutritional (or biological) aspects. As a function of inherent inconsistencies ranging from soil and climate differences to effects of cultivars, seasons and agricultural practices, differences in desirable ingredients are less pronounced compared with undesirable ingredients. Where differences are detected, the higher product quality is mostly found in organic produce. A potential advantage of organic agriculture in producing healthy foods is based on higher concentrations of beneficial secondary plant substances in organically grown crops compared to nonorganically grown crops. The second term of nutritional quality covers the feelings of well-being (or indisposition) that certain foods can induce in consumers. Organic agriculture has been confirmed as environmentally sound and more sustainable than mainstream agriculture. Related to this knowledge, the consumer's well-being is based on indulgence and the certainty that by purchasing, eating and enjoying organic food, one has contributed to a better future and an improved environment. These effects with their social implications along with improved animal welfare may, in the end, be more important than any measurable contribution of balanced Western diets to individual nutritional health.

Background

Recently, the German status report on the evaluation of organic versus conventional agricultural products was published [1]. Investigations on plant

products have identified clearer differences between organic and conventional farming systems for vegetable crops than for seed crops. Compared with desirable ingredients, clearer differences indicate lower contents of undesirable ingredients in organic than in conventional products. As a function of inherent inconsistencies associated with organic agriculture ranging from soil and climate differences to effects of cultivars and seasons, differences in desirable ingredients are less pronounced but if differences were detected, the higher product quality was mostly found in organic produce. Nevertheless, nutritionally important differences relating to contents of minerals, vitamins, proteins and carbohydrates are not likely since none of these are deficient in balanced European diets, nor are common levels of pesticide residues and contaminants in products of mainstream agriculture an urgent health concern of consumers (more likely of farmers).

It is scientifically challenging to adequately assess the nutritional quality of food grown under different cultivation methods, because the final measure of nutritional quality lies in the organism that consumes the food. Human beings are individuals with individual reaction patterns, also governed by the culinary value that a product promises. In the end, the nutritional quality is determined by the value of the product for the consumer's physical health, growth, development, reproduction and general well-being. Thus, this extended definition of nutritional quality may be divided into two terms: One term for the effects of food determined by its substance, i.e., the sum of all ingredients, beneficial and harmful compounds, and their nutritional (or biological) aspect. The other term covers the psychological effects of well-being based on the knowledge related to the organic label indicating the process quality, and the ethical, environmental, social and political values.

Consumer Concerns

Organic agriculture pursues an organizational principle following a whole-farm approach with the aim of managing a (mixed) farm as far as possible as a more or less closed and integrated system (like an organism). Compared to mainstream agriculture, organic agriculture depends more on the given site conditions, which determine the choice of the crops, cultivars, animals and breeds. It is also the bovine spongiform encephalopathy (BSE)/variant Creutzfeldt-Jakob disease complex and its risk for human health that has recently made the advantages of this system most convincing. Exposure to BSE seems to be clearly limited when purchasing organic beef or dairy products. Until now, no cases of BSE have been recorded for animals born and reared in organic agriculture. Those cases of BSE that have been recorded in organic farms have always been

brought in from nonorganic sources, e.g., farms that had just completed the transition process from conventional to organic farming. Therefore, organic agriculture represents one approach to solving the BSE problem. Banning the feeding of animal protein and milk replacers to ruminants has minimized exposure via feed sources in organic farming and clearly enhanced food safety. Consequently, consumers reacted with higher purchase of beef and dairy products derived from organic agriculture in 2000/2001 when the BSE problem was heavily stressed in newspapers (and in the end resulted in the dismissal of the German Minister of Agriculture, which was the start of the so-called *Agrarwende*, i.e., 'the agricultural U-turn'). Even though the number of deaths related to BSE has been lower than feared earlier, a clear relation to human well-being is given. Consumers cite food safety as the main reason for consuming organic foods. Furthermore, concerning residues from antibiotics and knowledge of a rising resistance of salmonellae types against these pharmaceuticals (and other veterinary drugs), organic agriculture's approach is clearly able to avoid potential negative impacts on human health, which are given by mainstream animal husbandry. Generally, levels of concern are highest for residues and irradiation; the latter is not allowed in processing organic food.

Relationship of 'Outer Form' and 'Inner Formation' (Taste, Fragrance and Secondary Plant Metabolites)

Appearance and grading (including size, uniformity, freshness, color and absence of dirt or mechanical damage) can be regarded as a relic of an important attribute of food quality, i.e., related to form or shape. Correspondence between outer form, shape and quality (including desirable ingredients) is the basis for numerous daily professional and commercial validations of plant products (vegetables, fruits, spice plants and medicinal plants), and the provenance is clearly related to their value reflected by their inner composition and maintenance of form (i.e., sustainable shelf-life).

In addition to appearance, produce fragrance and taste are key factors for consumers. Reproaching conventional agriculture products for lack of taste and fragrance that is not coincident with its promising appearance is common. Shortcomings in the appearance of organic produce are often reported as counterbalanced by better taste and aroma. The negative correlation of excessive nitrogen uptake with fragrance and taste is relatively well documented. Since unbalanced nitrogen uptake is more likely in conventional production, differences between average organic and conventional products regarding fragrance and taste can most likely be found. This could only be proven if a sufficiently broad database derived from valid comparisons were available, which is currently

Table 1. Health-promoting effects of organic foods

Compound/effect	Product	Authors
More phenolic compounds	Apples	[2]
More polyphenols	Peaches, pears	[3]
Higher content of lycopene	Tomatoes	[4]
More polyphenols	Potatoes	[5, 6]
More glycoalkaloids		
More sulforaphane	Broccoli	[7]
More carotenoids	Carrots	[8–10]
More resveratrol	Wine	[11]
Higher antimutagenic effect		[12]
Higher antioxidative potential		[13]

not the case. Flavorful secondary metabolites play a key role in plants' defence against pathogens and pests, and also protect them against environmental stress such as damage resulting, for instance, from UV irradiation.

A number of studies have shown significant differences in flavor and taste for selected products (table 1). For example, in the case of sensory differences of Golden Delicious apples grown in paired organically and conventionally managed orchards, higher taste scores were given for the organically grown apples. These were also found to be firmer and to contain 18.6 percent higher contents of phenols, mainly flavonols [2]. In other studies, tomatoes of organic origin were sweeter or had higher carotenoid contents (lycopene). Potatoes were better flavored than those conventionally produced. Ten percent higher polyphenol concentrations and 27 percent higher glycoalkaloid concentrations were determined compared to nonorganically cultivated potatoes in two other valid studies. Some reports show potentially higher concentrations of beneficial secondary plant substances in organically grown crops, compared to nonorganically grown crops. These studies suggest that further research needs to be conducted. However, no clear trend can be detected concerning differences in organoleptic properties between organically and conventionally grown vegetables.

Nevertheless, there is a potential advantage of organic agriculture in producing healthy food: as a function of the organizational principle in organic agriculture, availability of nitrogen in soil is limited, having positive effects on cell size and cell wall thickness. The negative correlation of high nitrogen uptake with fragrance, taste and other sensory parameters like 'firmness' or 'crunchiness' is relatively well documented. Further documented and expected tendencies indicate improved quality of organic food with respect to health-promoting phytochemicals: organic plants, with a lower nitrogen supply, can

have a shortened vegetative growth period and an earlier onset of maturity compared to nonorganically produced plants. Since secondary metabolites are often synthesized during plant maturation, higher concentrations of these components may accumulate in organically grown foods. Furthermore, defence mechanisms based on phytochemicals might be more pronounced in organic crops than in crops in mainstream agriculture, which are protected by biocides.

A review of secondary metabolites summarizes the available studies and indicates that there are insufficient data to draw any final conclusions, but that there is evidence that organically grown vegetables will contain 10–50% more secondary metabolites than conventionally cultivated vegetables [14]. If these components are important determinants of the nutritional value of fruits and vegetables in the diet of developed countries, then products from organic farming systems would be expected to be more health-promoting than those from nonorganic.

Some decades ago, biodynamic researchers have correlated outer shape with inner formation. Inner formation is expressed by the different composition of food as a function of the influences of natural and man-made environmental factors.

Table 2 shows the model whose features of food quality are influenced by the dominance of either natural (light and warmth) or man-made environmental factors (water, humus, nitrogen). High quality is considered as realized under the balanced influence of these forces on plant composition, development and morphology. This early model combines the different aspects of quality mentioned above. Support of these general tendencies is given by the 'carbon/nitrogen balance theory' published in the early 1980s by scientific ecologists interpreting the interaction between plants and the environment in nature [18]. In its simplest form, this theory states that sufficient readily available nitrogen will force plants to synthesize compounds with high nitrogen content; when nitrogen availability is limited, the relative surplus of assimilates changes into carbon-dominated compounds like starch, cellulose and nitrogen free phytochemicals (e.g., phenolics and terpenoids). Since the carbon/nitrogen balance theory cannot explain all phenomena observed in plant composition and related morphology, the theory was developed further into the more complex growth/differentiation balance theory [19]. Both models are closely related to the model presented in table 2.

The growth/differentiation balance theory states that a plant in any given situation will access the resources available to it and optimize its investment in processes directed towards growth or differentiation. The term differentiation can be considered as comprising the increased formation of defence compounds as well as accelerated maturation and seed development [14]. It should be mentioned that results from complementary methods of quality assessment,

Table 2. Quality of produce influenced by the polarity of natural and man-made environmental factors on plant growth after [15, 16], modified and amended [17]

Parameters	Unilateral influence of ... water, humus, nitrogen	Light and warmth
Plant development	Delayed ripening	Premature ripening
	Vegetative process enhanced	Reproductive process enhanced
	Leaf metamorphosis delayed	Leaf metamorphosis enhanced
Form/morphology	Shallow, branching roots	Deep, less-divided roots
	Long internodes	Short internodes
	Large, thin elongated leaves	Small, thick, short leaves
	Rounded, uniform, softly contoured petioles	Pointed, solid petioles
Pests and diseases	Pathogenic fungi dominate	Insect pests dominate
Composition		
Dry matter content	Low ↓	High
Crude protein content	High ↑	Low
True protein content	Low ↓	High
Nitrate, amides, free amino acids	Relatively high ↑	Relatively low
EAA index	Low ↓	High
Disaccharides	Relatively low ↓	Relatively high
Monosaccharides	Relatively high ↑	Relatively low
Vitamins	Vitamin A: high content ↑	Vitamin C: high content
Enzyme activity	High ↑	Low
Fragrance and taste	Poor ↓	Rich
Keeping quality	Short shelf-life ↓	Long shelf-life
Contents of secondary metabolites	Relatively low ↓	Relatively high

so called *picture-forming methods* [1, 20] seem to be closely correlated to attributes of the inner form represented by carbon-dominated compounds and specific secondary plant metabolites or maintenance of form during shelf-life. The status report concluded that the holistic concept including complementary methods of quality assessment, followed by the scientifically based organic farming approach, should include all above-mentioned aspects [1].

Effects on Well-Being other than Physical or Chemical

The wider definition of nutritional quality given in the introductory chapter also covers the feelings of well-being (or indisposition) that certain foods

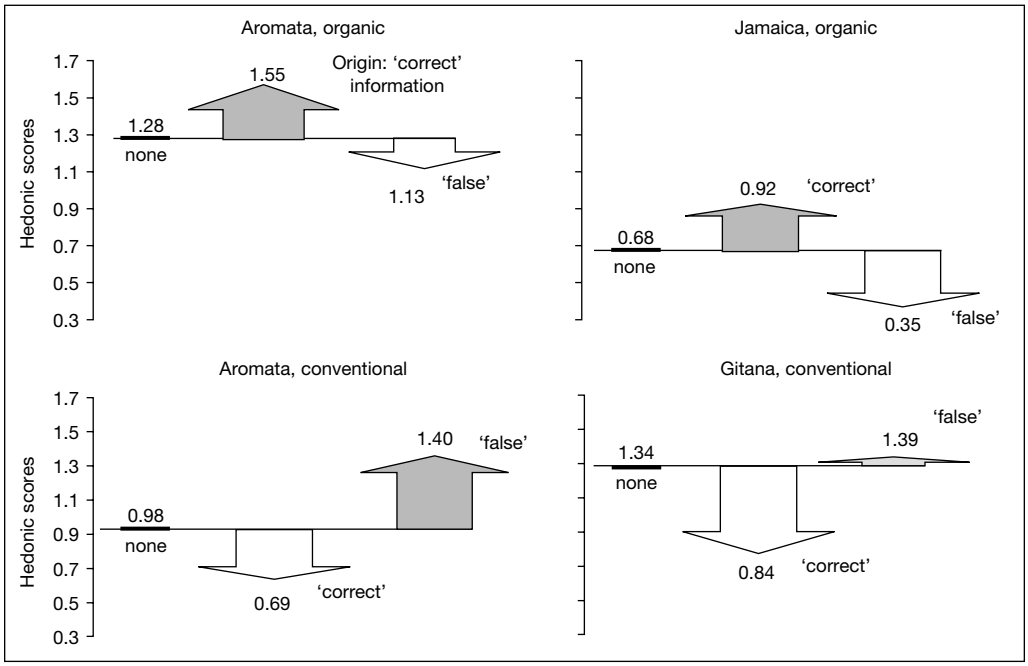

Fig. 1. Effects on well-being other than physical or chemical: preference for tomatoes affected by sensory attributes and information about growing conditions [22].

can induce in consumers. Genetic engineering is sometimes considered as an appropriate tool to improve the nutritional quality of conventional agriculture products [21]. Genetic engineering is prohibited in organic farming in order to ensure the authenticity of the produce and to follow the worldwide precautionary principle. Several polls have indicated consistent reservations of the majority of consumers against genetically modified food. Serious and valid environmental, social, ethical, economic and political concerns persist among independent scientists and consumers for several reasons. Although only very few of the relevant published studies have shown negative effects of genetically modified-organisms, again psychological effects on food security and consumer well-being are directly concerned.

Psychological components are also related to taste and aroma; both have been well documented as being negatively correlated with nitrogen uptake. For example, growing conditions and information affected consumers' preference for tomatoes, but differently for well-liked tomatoes than for less well-liked tomatoes (fig. 1). Information about samples being organically grown increased the preference for tomatoes for three out of four samples, independent of whether this

Table 3. Relative impact assessment of organic compared to conventional farming. Data are related to the agricultural area of the 'Vier- und Marschlande' (Hamburg) (5674 ha) in 1995 [23]

Impact categories		Indicators
Biodiversity	+	Arable land: clear improvement Grassland: improvement Structures (ditches and margins): improvement
Landscape image	=	No difference
Soil protection	=	No difference
Drinking water protection	+	N-surplus without ammonia emission: (from 311 t to 77 t) Pesticide use: reduction 100% (from 22.7 t) No risk of contaminating surface and ground water
Eutrophication	+	Ammonia emission: reduction 31% (from 238 t to 165 t)
Acidification	+	SO_2-equivalents: reduction 31% (from 474 t to 328 t)
Global-warming effect	+	CO_2-equivalents: reduction 37% (from 22,024 t to 13,882 t)
Abiotic resource depletion	+	Energy use: reduction 54% (from 83,000 GJ to 38,500 GJ) P-fertilizer: reduction 100% (from 81.1 t)
Human toxicity	+	Organic farmers: no risk of contamination by pesticides

+Advantage for organic farming.

information was correct or false. But information about organic growing was less important when the varieties were per se sweet and the tomatoes had a strong taste (Gitana). Different response patterns were given for the best-liked cultivar, which maintained its scores (Gitana), while the least-liked cultivar scored higher for liking when it was known to be organically grown (Jamaica).

Besides self-related factors (such as health and taste), consumers' choices can also be driven by altruistic and ethical factors. Complex life cycle assessments have confirmed organic agriculture as environmentally sound and more sustainable than conventional agriculture. Clear advantages for organic farming systems have been assessed for several impact categories by using environmental indicators showing reduced pollution of water, soil and air, and decreased global warming potential as well as reduced pressure on biodiversity (table 3). Consumer well-being is then based on indulgence and the certainty that by purchasing, eating and enjoying organic food, one has contributed to a better future environment. This type of agriculture can reduce negative impacts

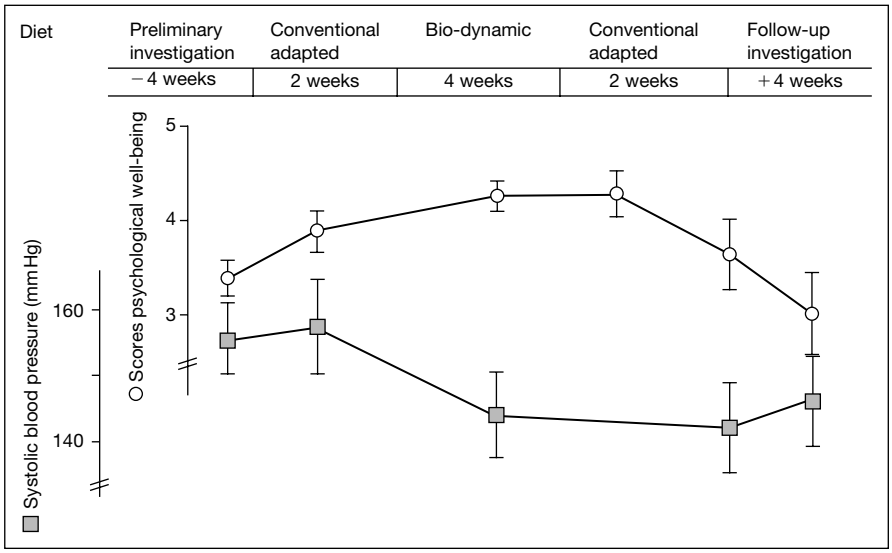

Fig. 2. Conversion from conventional to biodynamic food: effects on systolic blood pressure (mean and standard deviation) and scores of psychological well-being (mean and standard error). Reproduced with permission from Huber et al. [24].

on wildlife and biodiversity, pollution of water, soil, and air, and avoid substantial negative effects on the climate. Together, these effects with their social implications along with improved animal welfare may in the end be more important than the measurable (if at all measurable) contribution of balanced Western diets to individual nutritional health except for very rare cases of extreme deficiencies irrelevant to the average consumer.

An unpublished prospective study investigated whether the conversion from conventional to organic diet affects eating behavior, physiological and psychological well-being, immunological parameters and blood pressure. Seventeen sisters of a religious order participated in a phase of conventional food (weeks 1 and 2), biodynamic diet (weeks 3–6) and a following phase of conventional food (weeks 7 and 8) (fig. 2). All members have been informed on these different periods. Questionnaires concerning eating behavior and well-being were filled in during the whole experiment. Blood samples were drawn and analyzed in order to get an insight into the biological and immunological effects of the altered nutrition. The results shown in figure 2 demonstrate alterations in decrease in blood pressure as well as well-being, leaving the answer open which of the two components of nutritional quality have dominated these parameters, but underlining again the urgent need for human long-term studies.

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Impact of 'Functional Food'

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Abstract

'Functional Food' is not a new concept but it became more important recently due to the collapse of most social health system because 'Functional Foods' allow low cost prevention of numerous diseases. 'Functional Foods' are different from 'Neutraceuticals' which remain drug based with poor taste whereas 'Functional Foods' remain good food which could be consumed for years, but in addition have a disease prophylactic function. They are becoming particularly important for the prevention of food allergy in 'at risk' population, obesity, osteoporosis, cardiovascular diseases and particularly high blood pressure and atherosclerosis, but also for cancer prevention. The newest trend is that governments and health authorities allow food manufacturers to make health prevention related claims on mass media.

Contrary to what many people think or would like to think because they would like to have invented the concept, the idea of 'functional foods' is very old. Functional food did not start in the 1980s, some, like mineral water, are thousands of years old. Some Chinese foods were used more for therapy or prophylaxis of disease than for gastronomy or mere nutrition. Yoghurt was used in Central Europe thousands of years ago for health-promoting functions and rediscovered by Elie Metchnikoff [1] in the Pasteur Institute in Paris at the turn of the 19th century and promoted for healthy aging.

In the mid 19th century 'fortified chocolate' was on the market and Roche pharmacy together with Nestlé launched a chocolate fortified with vitamins and trace minerals during the Second World War for preventing deficiencies in children.

In more recent years, infant products were pioneers, with infant products which not only feed the baby with all necessary nutrients, but in addition prevent diseases like hypoallergenic infant formulae preventing food allergy in

'at risk' babies or infant formulae enriched with probiotic bacterias preventing diarrhea in an 'at risk' environment.

This led us to define 'functional foods' as: *'real food' having all the nutritional and organoleptic characteristics of normal food but in addition having a specific 'functional' characteristic to prevent or sometimes to cure a disease'.* This definition opposes 'functional foods' with nutraceuticals which do not have the characteristics of normal food particularly organoleptic qualities but are closer to drugs, very often proposed as pills or capsules.

There are basically two impacts of 'functional foods':

- The impact on the society and particularly on health costs.
- The impact on the consumer himself preventing or curing various diseases.

Impact on the Society

The government or health system in every country is experiencing difficulty in covering the ever increasing health care costs due to the increased sophistication and concomitant cost of care often combined with an aging population.

This is done through a politic of liberalization of OTC drugs as well as through the promotion of 'functional foods' through better nutrition. This last tendency should be considered as a positive move since it gives back to the individual the responsibility to maintain their health and at the same time emphasize the importance of a good diet and of regular physical exercise through TV campaigns. It also emphasizes the importance of prevention rather than treatment of already existing diseases, which is also a very important message. I will show the educational role of 'functional foods' and will give two examples of primary prevention of disease: allergy and obesity.

Educational Role of 'Functional Foods'

Up to about 20 years ago the only advice to mothers of babies 'at risk' of developing allergy was to breastfeed the baby and to clean the house off the most potent allergens like house dust mites, cats, birds and feather-containing pillows because there was, at that time, not much more to do.

This advice is still valid today but it has been enlarged with a lot of dietetic advice for the breastfeeding mother herself and for the baby.

We know now that the allergens eaten by the breastfeeding mothers are passing into her blood and her milk [2] and sensitize the baby. Until special 'functional food' was developed and shown to be effective [3], it was almost impossible to advise lactating mothers to avoid taking cows' milk, soya, eggs and fish because they need good quality protein, calcium, vitamins and trace minerals. Now there are special drinks developed for lactating mothers based on hydrolyzed milk protein, which brings all the necessary nutriment without the deleterious allergens.

Usually most of the working mothers have 8 weeks of maternity leave after delivery and it is very difficult for them to exclusively breastfeed the baby up to 4 or 6 months, which is necessary to prevent allergy in the baby.

Now special hypoallergenic infant formulae based on partial cows' milk hydrolysates are available to the mother to supplement or complement breastfeeding and to delay the introduction of semi-solid food. Now pediatricians can be proactive in prevention of allergy and explain to the parents everything they have to do to successfully prevent allergy including the diet of the breastfeeding mother and of the infant.

Primary Prevention of Allergy

There has been a dramatic increase of allergic manifestations in all age groups particularly in children and in all parts of the world [4] but particularly in the most affluent countries [5].

This increase is attributed to various etiologies like central heating and wall-to-wall carpets which favor the multiplication of mites, exposure to passive smoking for children as well as the large increase in the air of particles from exhaust of diesel engines, which both irritate the bronchi of infants and children and favor the penetration of pneumallergens.

It is believed that the improvement in hygiene, the immunization programme and the efficient treatment of many benign infectious diseases of infants have set the immune system of the infant toward Th2, which prones the infant toward allergy, whereas in the past the benign infections of infancy would have set the immune system toward Th1, which fight infection [6, 7].

The cost of treating the 50 million North Americans suffering from the numerous manifestations of allergy, rises to 18 billions USD per year [8]. In the UK the cost is 1 billion sterling pounds equivalent to 10% of the total cost of primary care.

Many studies [9, 10] have shown that by feeding a 'functional food', in this case, a hypoallergenic infant formula based on partial hydrolysate of whey protein, to infants with family antecedents of allergy, during the first 6 months of life, one decreases the rate of allergy in the child by 50% (fig. 1).

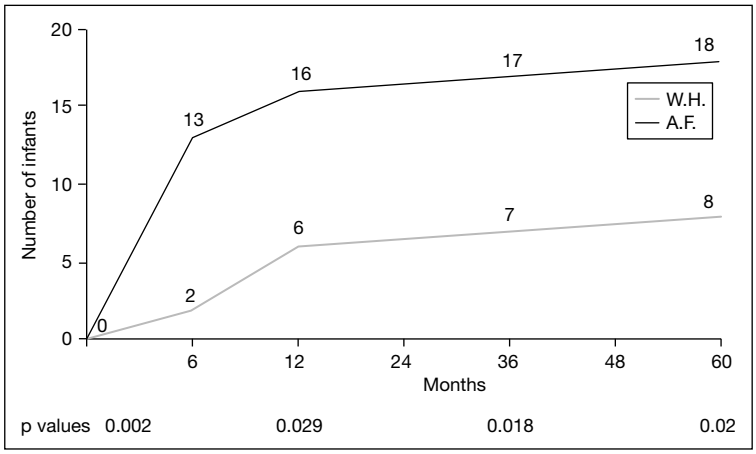

Fig. 1. Number of infants with atopic symptoms [9]. W.H. = Partial whey hydrolysate formula; A.F. = adapted formula.

Chandra [11] has calculated the economy for the health system in Newfoundland, Canada, and has shown that it reaches about 90%. The health system usually does not pay for the formula in spite of its proven efficacy for primary prevention of allergy.

The economy is very important but it is even more important to consider the role of this prevention on the well-being of the infant and of his family since it allows a break in the social isolation impairing the day-to-day life of allergic families who have difficulty eating outside or going to other houses hosting pets.

Primary Prevention of Obesity

Obesity and overweight are the new epidemics of the 21st century, not only in industrialized countries, where it reaches more than 50% of the adult population as in the USA [12], but also in the affluent part of the populations living in the less developed countries [13].

It is even more worrying to observe the rapid increase of obesity and overweight in children [14] because at this young age there's more time for degenerative diseases to progress.

Obesity has many deleterious consequences on morbidity and cost of health but also on mortality.

The cost of obesity in the USA has been evaluated to be 75 billion US dollars in 2003, mostly through articular diseases, type 2 diabetes and syndrome X which represent about 6% of adult medical expenditures.

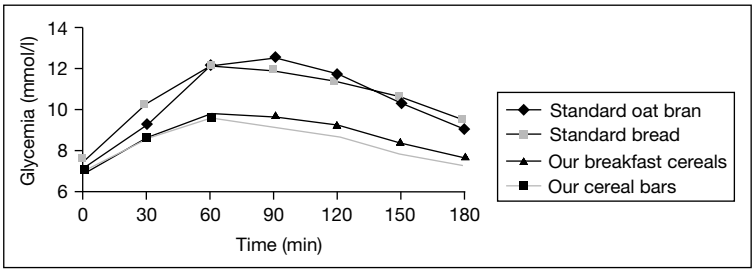

Fig. 2. Glycemic response of 16 diabetic subjects.

Here, prevention should include dietetic education and physical exercise, but functional foods can help to achieve the necessary caloric intake reduction.

The aim is to reduce energy density without reducing the volume of food and its effect on satiation and satiety and, what is very important, without reducing the hedonic quality of the food since the effort should be sustained for months and years.

Trying to prevent obesity for a child living in a family of obese parents is a very difficult task, which in the past was almost never successful. The success will depend on the acceptance by the child and also by the rest of the family that regular and sustained physical exercise is indispensable as well as a limitation of the energy intake. For the latter it was very difficult, if not impossible, to obtain a prolonged limitation of energy intake leading to a kind of re-education of food habits. Now with the help of 'functional foods' with lower energy density, but still good satiation and satiety effect and good taste, one does not need anymore to propose a very drastic and unpalatable diet impossible to carry on successfully for more than few weeks. The child should be encouraged to eat at regular intervals and preferably seated in company of others (four meals a day) and directed to vegetables, fruits, cereals, low fat dairy products and lean meat and fish. Soft drinks and fruit juices should be replaced as much as possible by plain water, but soft drinks sweetened with artificial sweeteners could be accepted.

If the child could not refrain from snacking, a list of what is permitted and what is forbidden should be made available recommending, of course, products with low energy density containing a mixture of fibers, which will create satiation like fruits, but also some of the new 'functional bars' which will help to fulfill the programme of energy intake reduction (fig. 2) [15].

If successful the child will become a model for the rest of the family and this will help the physician in charge to propose an energy reduction programme for the rest of the family accompanied with a programme of increased

physical exercise adapted to the needs and physical possibilities of the individual members of the family.

Impact on the Consumer

For individuals, functional foods are up to now mostly targeted towards the prevention of: obesity, osteoporosis, cardiovascular diseases and increase of immune defences, but new targets like cancer prevention or prevention of Alzheimer's disease are now considered.

Obesity

Light or low-calorie products, mostly dairy products, milk and yoghurts have been already available for 15 years with very little success. The reasons were that at the time the epidemic of obesity was not as prevalent as it is today and that the public health campaign of sensitization did not exist. But the other reason for failure which may be even more important was due to the poor organoleptic qualities of these low energy products.

Today everyone in the industrialized countries is aware of the long-term dangers of having a BMI above 30 and of the advantages of staying around 25, but furthermore the new low fat-low energy products are tasty and there are no more reasons to prefer a product rich in energy.

Since the theory about the predominant role of fat is now heavily discussed and carbohydrates, especially the simple ones, are the new 'villain' the new generation of solid 'functional foods' against obesity are low in simple carbohydrates, which is relatively easy to produce by replacing them by complex ones and sweetening with intense sweeteners like aspartame or newer ones which sustain heat treatment.

This is particularly important for drinks since the energy contained in drinks seems to escape the regulation system contrary to the energy contained in solid food [16].

Contrary to what many people think, fructose is not better than sucrose and fruit juices are not better energy-wise than sweet drinks. More so fructose directs liver metabolism toward cholesterol synthesis [17].

Very recently Zemel [18] suggested that calcium ion induces lipolysis and inhibits lipogenesis and promotes the usage of dairy products as an adjuvant for energy restriction in obesity [19].

Osteoporosis

Osteoporosis is one of the new epidemics of the 21st century particularly in the less developed countries. Indeed osteoporosis and its consequential

fractures of the spine, the wrist and the hip in elderly and mostly women were already frequent in the affluent countries during the last quarter of the 20th century. This prompted many practitioners to treat with synthetic hormones the postmenopausal symptoms of the majority of women. This did not erase osteoporosis and fractures, which have continued to increase and cost a lot of money to the health system in addition to being a source of mortality. Furthermore, very recent epidemiological studies [20] have challenged the innocuity of this kind of prevention.

In the mean time it was proposed that prevention should not be done only around menopause but in fact should start as early as childhood to build an optimal peak bone mass, which of course puts back the emphasis on 'functional food' rather than on drugs for a prophylaxis, which should last for decades.

Some of our colleagues [21] have been able to show that food enriched with calcium from milk, durably increase bone density in 10- to 12-year-old girls, contrary to supplementation with other calcium salts, which have only a temporary effect. By following bone density in these girls for 3 years after the supplement was discontinued, we could show a persistent increased bone density.

The RDA for calcium has been increased for adolescents but this raises the problem of bioavailability of calcium salts and the caloric load often associated with increased consumption of dairy products.

One excellent solution is to promote the regular consumption of one of the oldest 'functional food' per se mineral water very rich in well-absorbed calcium and containing no calories.

In our laboratories we were able to demonstrate a few years ago [22] that the calcium bioavailability from Contrexeville mineral water was as good as calcium bioavailability from milk which is one of the best.

Cardiovascular Diseases

Hypertension. The usage of a low-sodium diet has been recommended for decades as adjuvant for drug treatment of high blood pressure or even before drugs were available as the only measure.

However the efficacy of such a measure was always discussed and the concept of salt-sensitive and salt-insensitive hypertension genotypes was proposed. Furthermore the diet was quite unpalatable and was an eventuality only when the blood pressure was already elevated but not as a prophylactic measure.

Recently the results of a long-lasting prevention study [23] were published, which offer evidence that a reduction of sodium intake was able, at the population level, to reduce notably the average level of blood pressure.

At the time certain governments like the UK, France and Switzerland asked the food industry to progressively reduce the sodium content of the food

responsible for the highest amount of sodium in the daily intake like bread, preserved meat and delicatessen and industrially prepared food. This request raised certain problems because for bread sodium plays a role in the process of fermentation and for meat it preserves the bacteriological safety of the food, which is at stake. Furthermore a brutal reduction would have led consumers to avoid these new products or to add salt to it. A slow educational process is necessary to modify the taste preference of the consumer. Thus it was an intelligent measure to decide to conduct the decrease slowly at the rate of 5% per year over 5 years because it is preferable to achieve an important reduction in 5 years rather than make big media announcement and fail because the public would not buy the new products.

At the same time the food technology made progress and has shown that one can replace up to 50% of sodium chloride by potassium and magnesium chloride without inducing a perceivable taste modification and that it is preferable to have sodium chloride at the surface of the food and in the sauce where it is in direct contact with the taste buds rather than in the centre of the food where it is masked from taste bud perception. Many 'functional foods' based on these concepts and with reduced sodium content are now proposed to the consumer, which they taste and find good, helping them to reduce their average sodium intake from the level of 7–10 g a day, where it is now to a more reasonable intake of about 5 g a day (equivalent to about 13 g of table salt). It is foreseen by extrapolation of the results that at the population level it will reduce the percentage of the population suffering from hypertension by about 20% and thus reduce the overall cost of healthcare for a population by about 5% equivalent to many billion dollars for the US population.

Atherosclerosis. It has been demonstrated a long time ago that atherosclerosis was directly correlated to the plasma level of LDL cholesterol and inversely correlated with the plasma level of HDL cholesterol [24].

Many drugs have been developed to reduce plasma LDL but they are costly and many have serious side effects.

Dietetic measures like reduction of intake of saturated fatty acids and proportional increase of intake of mono- and polyunsaturated fatty acids have a positive effect on LDL [25] as well as reduction of fructose intake [17].

More recently addition of phytosterol and particularly sitosterol have further increased the dietetic possibilities to reduce plasma LDL cholesterol [26] and many products are now advertised in mass media with the claim to help the reduction of plasma cholesterol associated with appropriate dietetic measures.

It is interesting because it is, to my knowledge, the first example of a 'functional food' based not on reduction of usual food component (like fat or sodium…) or addition of supplement of usual food component (like

fibers, calcium, polyunsaturated fatty acids…) but of addition of a 'drug-like' component. It is interesting also that health authorities in many countries have authorized the launch of such products in regular food channels but also authorized a kind of health claim on mass media.

This will probably open the possibilities for other 'functional foods' based on the same concept in the future.

Cancer Prevention

The usage of 'functional food' in cancer prevention is still controversial but there is much epidemiological evidence that certain foods could favor certain cancers and that other food or food components would decrease the risk of other cancers [27]. There is also much experimental evidence in animals [28] as well as in humans [29] and the cost of treating cancers is so heavy on the healthcare budget that healthcare authorities will certainly review the evidence and authorize a certain number of products and claims. The first one to be authorized, but only by the FDA in the USA and in the Foshu system in Japan, was on fiber for the prevention of colon cancer. Recently such prophylactic effect was challenged [30] and lead to a more precise recommendation since all types of fibers are not equivalent in the prevention of colon cancer. Fibers from vegetable are considered being more active than fibers from fruits [31].

Other possibilities will be offered by conjugated linoleic acid or antioxidants now that we better understand the conditions within which certain antioxidants like beta-carotene could be prophylactic and others in which it could be deleterious.

What is dangerous, is to extrapolate to the whole population, without sufficient research, preliminary studies as it has been done in the past…but this is not an excuse to now reject all types of cancer prophylaxis by dietetic measures.

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The Role of Fortified Foods – Situation in Austria

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Abstract

Aims: Nutritional surveys in several countries worldwide showed an inadequate intake of some micronutrients. A possibility to challenge this development is the fortification of selected foods with micronutrients. The aim of this study was to evaluate the situation of food fortification in Austria and to elucidate to what extent added nutrients contribute to the daily nutrient intake. **Methods:** The amount of fortification was observed by inspections of supermarkets and retail outlets over a period of 4 months. The intake and contribution to the daily nutrient intake of fortified nutrients of Austrian adults (n = 1,700) was evaluated with 24-hour recalls (together with a food frequency questionnaire). **Results:** Altogether 470 fortified products have been found and classified into baby products, beverages, sweets, cereals, milk products, edible fats, and salt. Highest frequency of nutrient added was found for vitamin C (73%), B6 (43%) and niacin (37%). Calcium (23%) was the most added mineral and trace element. The contribution of fortified foods to the daily micronutrient intake was up to 40 and 10% for vitamins and minerals, respectively, for the total group. When only considering the subgroup of people who are buying fortified foods (users; n = 934) the contribution increases up to 74 and 19% for vitamins and minerals, respectively. No risk of an overdose of nutrients has been observed through food fortification. **Conclusion:** Food fortification is commonly used in Austria, although not selectively. The only one mandatory is the fortification of salt with iodine. Fortified nutrients contribute variably to the daily nutrient intake, in particular, for users of fortified products, a risk of an overdosed intake was not found.

Introduction

Efforts to combat nutrient deficiencies have centered on supplemental nutrient administration and addition of selected nutrients to the food chain in the form of food fortification. Over the past several decades, and as the association

between diet and chronic diseases became apparent, food fortification was targeted not only at risk groups for micronutrient deficiencies, but also at healthy individuals. In particular, vitamin A, iron, iodine and, in recent years, folate have been considered for fortification.

The success of a selective food fortification has been shown in several countries. Sugar fortification with vitamin A and iron increased the iron stores in the fortified communities compared to the controls [1]; furthermore, fortified foods contribute to one half of the recommended vitamin A intake in poor urban Guatemalan toddlers [2]. Obligatory folate fortification of wheat flour decreased the number of neural tube defects at birth significantly by 74% in Costa Rica [3] and by 40% in Chile [4]. Mandatory enrichment of cereal grain products with folic acid in the USA reduced the national rate of spina bifida by 20% [5] and resulted in a population-wide increase in the concentration of serum folate and a reduction in the concentration of plasma homocysteine [6, 7].

In Austria and many other countries, in particular, iodine fortification of table salt is mandatory. This fortified salt is a significant source of iodine in the daily diet and contributes to a better iodine status [8, 9].

However, despite these and several other intervention programs, the addition of nutrients to foods nowadays is focused on spread and nonselective fortification. Since data of the situation in Austria are scanty, the aim of the present paper is to summarize the situation of fortified foods in Austria and to elucidate to what extent fortified nutrients contribute to the daily nutrient intake [10, 11].

Material and Methods

The observational study consisted of two major parts.

Based on inspections of supermarkets and retail outlets over a period of 4 months, the amount of fortified products has been observed. The products were grouped into baby food, beverages, sweets, beverage powder, cereals, milk products, edible fats, salt and miscellaneous. Additionally it was observed whether the fortification is linked to a specific target group and the question on specificity should be answered.

In the second part a survey was conducted in order to evaluate the contribution of the fortified products to the daily nutrient intake with focus on adults (19–60 years), in particular, to consider the average intake and also the 'high consumer' (95th percentile) and 'user' of fortified products. All together 1,700 24-hour recalls (together with a food frequency questionnaire) from Austrian adults could be considered for evaluation.

Nutrient analyses of data from the total food consumption of the 24-hour recalls were performed with the EWP 3.2 ('Ernährungswissenschaftliches Programm 2, Dato-Denkwerkzeuge, Vienna, Austria) based on the national German/Austrian food composition database BLS 2.1. The underreporting was calculated by the ratio of reported energy intake to basal energy requirements based on the actual body weight with a confidence interval of 95% (cutoff: reported energy intake/basal metabolic rate $\leq$1.1).

Table 1. Number of fortified products and their quantitative contribution to the total amount

Product groups	n	%
Baby food	137	29.3
Beverages	97	20.7
Sweets	79	16.9
Beverage powder	50	10.7
Cereals	41	8.8
Milk products	38	8.1
Edible fats	14	3.0
Salt	10	2.1
Miscellaneous	2	0.4
Total	468	100

Results and Discussion

Totally 470 fortified products were found, the categorization into food groups is shown in table 1.

Baby food contribute the most, followed by beverages, which mainly consisted of multivitamin- or vitamin C-enriched products, energy drinks and isotonic sport drinks.

Enriched sweets are in particular bonbons, chocolate, biscuits and also marmalade. Instant tea, instant powder or chocolate powder are enriched among the beverage powders, cereal bran and granola contribute to the fortified cereals. Fortified milk products are whey products, yoghurts and other milk products, and edible fats, mainly oils and margarine. Altogether twenty-nine micronutrients were added, vitamins significantly more frequently than minerals. The number of fortified nutrients per product group is shown in figure 1. Around 10% of all enriched products contained more than ten added nutrients and around 30%, 6–10 nutrients.

In particular three of four enriched cereal products contain more than six, and around 20% of enriched milk products more than ten added nutrients.

The most frequently enriched vitamin is vitamin C (73%), whose supply is not critical in Austria [8], followed by vitamin B_1 (47%) and B_6 (43%). Folate was not enriched; vitamin D was enriched only in margarine due to Austrian regulations.

Calcium was the main fortified mineral (23%) followed by iron (16%) and iodine (9%), which is only found in table salt or in food products produced with iodized salt.

Around 45% of the products are not linked to a specific target group, 30% address parents (baby foods) and around 20% children.

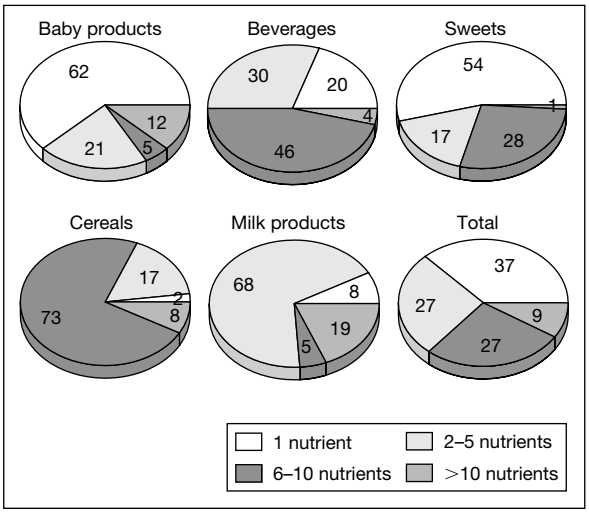

Fig. 1. Number of nutrients added in the main product groups.

These data indicate a nonselective fortification, most of the added nutrients are not based on real nutritional needs but they are used as provided by suppliers (multi vitamin B supplements, ACE, etc.).

However, if these products contribute to an additional daily nutrient intake and are quantitatively responsible for a better nutritional status their use would be justified. To give information on the latter, the nutrient intake of adults has been assessed and the share of enriched nutrients estimated.

The micronutrient intake of selected nutrients, based on all participants (n = 1,700), from fortified products is shown in table 2. The contribution of fortified nutrients for the daily requirements was assessed in reference to the dietary guidelines of the German-speaking countries [9].

In accordance to the above-described data, fortified vitamin C contributes most to the RDAs. This can on the one hand be explained by the use of ascorbic acid in food technology as an antioxidant but also due to fortification of the very frequently used ACE-beverages. In particular the group of the B-vitamins is ingested at least by 20% (B_{12}) but up to 37% (B_6). All of these nutrients are, from a nutritional point of view sufficiently supplied via nonsupplemented products, the waving of these fortified products might cause to some extent a suboptimal intake.

The intake of minerals is insufficient, with iron at 10% of the RDA supplied most, but it seems to be not enough for specific groups of low iron status such as menstruating women.

Table 2. Micronutrient intake from fortified products of adults (n = 1,700, total group)

Vitamins	% of the RDA	Minerals/Trace elements	% of the RDA
Vitamin C	40	Iron	10
Vitamin B_6	37	Copper	8
Niacin	29	Calcium	8
Vitamin B_1	27	Magnesium	7
Vitamin B_2	23	Zinc	4
Vitamin B_{12}	20	Iodine	2
Vitamin E	17	Fluorine	1
Vitamin A	11		
Folic acid	10		
Vitamin D	2		

Table 3. Micronutrient intake from fortified products when considering only users of fortified products (n = 934)

Vitamins	% of the RDA	Minerals/Trace elements	% of the RDA
Vitamin C	74	Iron	19
Vitamin B_6	71	Copper	–
Niacin	52	Calcium	14
Vitamin B_1	45	Magnesium	14
Vitamin B_2	38	Zinc	7
Vitamin B_{12}	37	Iodine	–
Vitamin E	31	Fluorine	–
Folic acid	19		
Vitamin A	11		
Vitamin D	3		

In Austria only 10% of the folate intake is covered by fortified nutrients. Since folate is important for pregnant women, some strategies for folate fortification should be discussed since it is successfully implemented in several countries [3–7].

When considering only the ‘users’ (n = 934), defined as consumers who are using fortified foods regularly, the picture is changing seriously; however, the nutrient ranking is the same (table 3). But three quarters of the vitamin C and between 37 and 71% of the vitamin B group intake is based on fortified products. Around 20% of folate is supplied by fortification, mainly based on the consumption of cereals and bran.

The effectiveness of fortified breakfast cereals in schoolchildren has been shown by McNulty et al. [12]. Their results demonstrate the potential of fortification in contributing to micronutrient intakes of schoolchildren, particularly where requirements are high (folate), or for those on marginal diets (e.g., iron) of low nutritional quality.

Data also indicate no risk for an overdose. For the 'high consumers' (95 percentile) the upper safe level of intake was reached for vitamin A; however, the contribution of fortified foods to the total daily intake is low.

Conclusion

Food fortification can be a tool in health care used to improve a weak nutritional status. In Austria food fortification is, except for iodine in table salt, which is mandatory, not selective; however, it contributes to a considerable part of the recommended daily nutrient intake. Data from this observation show no risk of fortification of the consumer.

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Attitudes of Austrian Adults to the Consumption of Fruits and Vegetables

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Abstract

Background: Epidemiological studies confirm that high fruit and vegetable intake correlates with a reduced risk of cardiovascular disease, various kinds of cancer and other disease. Based on these results authorized bodies worldwide recommend to eat more fruits and vegetables, e.g., the 'five a day' campaign. **Subjects and Methods:** Through 24-hour dietary recalls (studies 2000–02) the intake of 2,318 Austrian adults (19–65 years) were examined. 38.5% participants were male and 61.5% female. **Results:** Austrian adults consume on average 248 ± 316 g vegetables per day. The most popular vegetables are leafy, fruit and root vegetables. Pulses are seldom eaten. Women consume (252 ± 184 g) slightly more vegetables than men (242 ± 192 g). One fourth (26%) of the investigated subjects eat lower than 100 g vegetables, 21% consume amounts between 100 and 200 g and more than half (53%) eat more than 200 g daily. Approximately half of the vegetable intake is consumed fresh and the other cooked, frozen vegetables are not often used by our study subjects.

The daily intake of fruit is about 119 ± 156 g. Men consume significantly lower quantities (107 ± 159 g) of fruits than women (127 ± 154 g) ($p < 0.001$). Half (51%) of the examined adults eat less than 100 g fruit per day, 23% between 100 and 200 g and only 26% more than the recommended 200 g. Most of the fruit is consumed fresh, frozen fruits and fruits in cans are not very popular. The favorite fruits are stone fruits, followed by citrus and berry fruits. Juice of fruits and vegetables was consumed in amounts of 56.7 ± 151.3 ml/day. The daily intake of fruit and vegetable nectar is about 130.0 ± 264.9 ml. If the amounts of juice and nectar are added to the average intake of fruit and vegetables, the whole quantity of fruit and vegetable intake is satisfying. **Conclusion:** Our survey shows that the investigated Austrian adults are not far away from reaching the minimum goal of 400 g fruit and vegetable intake per day. Nevertheless, 16% consumed less than 200 g vegetables and fruit. To improve health benefits, a higher intake of varied fruit and vegetables should be achieved.

Introduction

International studies strongly suggest that a regular consumption of fruit and vegetables reduces the risk of cardiovascular disease and is inversely associated with several forms of cancer and other chronic diseases [1–4]. Already in the 1980s, Doll and Peto [5] estimated that 35% of cancer in the USA could be diet related. van't Veer et al. [6] evaluated 19% because it applies specifically to increasing fruit and vegetable consumption rather than optimizing all dietary patterns.

Diets with major health benefits are the Mediterranean and the Japanese diets, which have traditionally been rich in food of plant origin and olive oil and relatively low in consumption of red meat [7, 8].

A diet rich in fruits and vegetables is not only high in fibers, minerals and vitamins, but also in phytochemicals. The potential health benefits of fruits and vegetables have been attributed to the effects of these specific components. However, there is no agreement to what extent a higher intake of fruits and vegetables with elevated amounts of these components or the complementary reduced consumption of animal food is responsible for most of the health effects [9]. In some studies, the protective effect of vegetables has been attributed to β-carotene. But results of trials with β-carotene supplementation did not confirm the supposed positive associations [10, 11].

Furthermore, diets rich in fruits and vegetables have low calorie density and increased nutrient density; important factors in times in which obesity is a big problem.

Based on these results authorized bodies recommend to eat more fruits and vegetables [12, 13]. One of the campaigns to increase the fruit and vegetable intake is 'five a day'. These campaigns which encourage consumers to eat at least five servings of fruits and vegetables every day (two servings of fruits and three of vegetables) have been established in 18 countries. In the Dietary Guidelines for Americans reports published as early as 1980, the importance of consuming two to three servings of fruits and three to five servings of vegetables daily was explicitly advocated [14]. At an international level, the WHO at the beginning of the 1990s recommends a daily intake of at least 400 g of fruits and vegetables. The 'at least five portions a day' message has been used by an European anticancer program and adopted by several European countries and the popular media [15, 16]. Consumers are advised to eat five servings of fruits and vegetables daily to promote their health.

Subjects and Methods

In cooperation with the Austrian Krebshilfe the first survey on attitudes on the consumption of fruits and vegetables was done in 1999. Four thousand nine hundred and

ninety-five Austrian adults aged 47 ± 15 years were asked about their usual intake of fruits, vegetables and salads, as well as about their fruits and vegetables preference. As in many studies on public health, more women (76%) than men (24%) participated in the study [17].

In between 2000 and 2002, the intake of fruits and vegetables of 2,318 randomly recruited Austrian adults aged 19–65 years was examined by 24-hour dietary recalls. As in the first survey one third of the participants were male and two third female.

Statistical Analysis

All values were expressed as mean ± SD. SPSS for windows 12.0 was used for all statistical procedures. Mann-Whitney U test was used to compare sex and age groups.

Results

In the questionnaires, 20% of the investigated Austrian adults reported eating fruits 'several times a day', more than half (52.9%) reported consuming fruit 'daily' and 26% eat fruits 'only sometimes'.

Vegetables and salad were not so popular in Austria, about 48% consume vegetables and 50% salad 'every day', 48% said that they eat vegetables or salad 'not regularly'.

The main reason why study subjects consume fruits and vegetables is 'their good taste' (63 and 55%, respectively) followed by 'because it is healthy' (28 and 31%, respectively). Approximately half (51%) of the interviewed subjects recognized the 'five a day' campaign.

One third of those interviewed strongly supported the 'five a day' program. Forty-seven percent stated that they would try to eat five servings of fruits and vegetables in the future and 19% did not support this recommendation.

The 24-hour dietary recalls show that Austrian adults consume on an average of 248.2 ± 315.7 g vegetables per day. The most popular vegetables are leafy, fruit and root vegetables. Pulses are not eaten often. Women consume (252 ± 184 g/day) slightly more vegetables than men (242 ± 192 g/day). The amounts of consumed fresh and cooked vegetables are nearly the same (fig. 1). Canned vegetables are more often consumed by men (10 ± 40 g/day) than women (7 ± 31 g/day). Frozen vegetables are not often used by our study subjects.

Younger adults eat vegetables more often than the elderly. The cooked variant is more popular in higher age (>65 years).

The daily intake of fruit is about 119 ± 156 g. Men (107 ± 159 g/day) consume significantly lower quantities of fruits than women (127 ± 154 g/day) ($p < 0.001$) (fig. 2). Most of the fruit is consumed fresh, frozen fruits and fruits in cans are not favored. Study subjects older than 65 years consume less

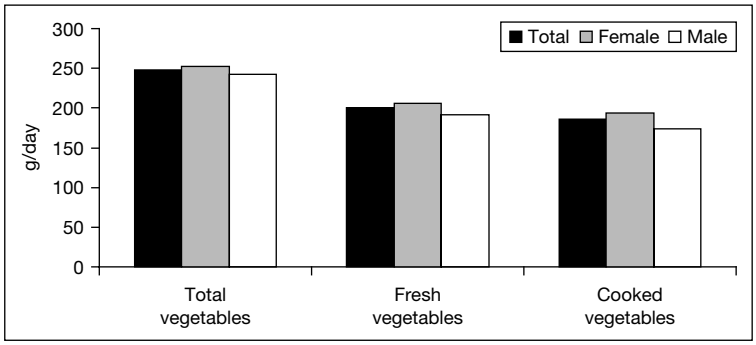

Fig. 1. Average intake of vegetables in Austrian adults (n = 2,318).

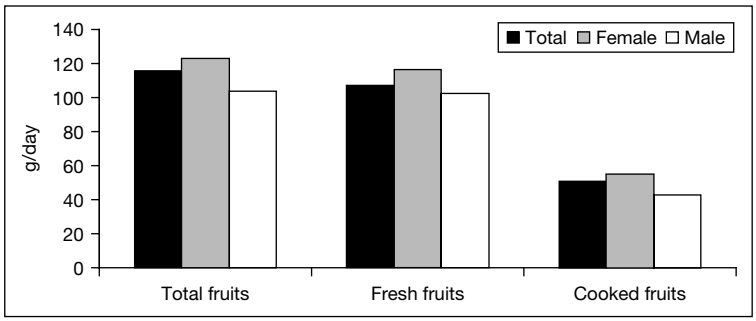

Fig. 2. Average intake of fruits in Austrian adults (n = 2,318).

fruits in all, especially fresh fruit. The favorite fruit of Austrian adults are stone fruit followed by citrus and berry fruit.

Juice of fruits and vegetables are consumed in amounts of 57 ± 151 ml/day. Elderly (72 ml/day) consume more juice than younger adults. The daily intake of fruit and vegetable nectar is about 130 ± 265 ml. Men (152 ± 294 ml) consume significantly more nectar than women (117 ± 244 ml) ($p < 0.05$) (table 1).

Fruits and vegetables contribute 10–17% to the intake of carbohydrates and 4–6% to the protein supply. The intake of dietary fiber of fruits and vegetables varied between one quarter and one third (on average: 8.3 g/day) of the average intake of Austrian adults (19.9 ± 9 g/day). This amounts to 14–21% of the recommended daily dietary fiber requirement of 30 g. Most of the dietary fibers come from vegetables (5.3 g/day).

Table 1. Intake of fruits, vegetables, juice and nectar among Austrian adults

	Mean	SD	Median	1st quartile	3rd quartile
Vegetables (g)	248.2	315.7	204.5	93	351
Fruits (g)	119.4	156.0	69.0	0	200
Juice (ml)	56.7	151.3	0	0	4
Nectar (ml)	129.7	264.9	0	0	200

The intake of vitamin C from fruits and vegetables is about 110 mg/day. Thirty-four percent of the vitamin C intake comes from fruits and 38% from vegetables. Females consume more vitamin C from vegetables, males from juice and nectar.

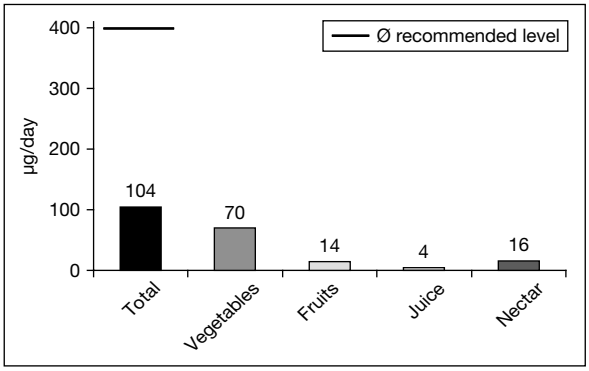

Fig. 3. Intake of folic acid from dietary vegetables, fruit, juice and nectar (µg/d).

The consumption of vegetables and fruits does not satisfy the need of folic acid in Austrian adults. Only one fourth of the recommended level of folic acid can be achieved (104 µg/day). The highest amounts come from vegetable sources (67.3%) (fig. 3).

Discussion

The 'five a day' campaign seems to be very successful because every other study participant knows it and 81% of the investigated Austrian adults strongly support eating five servings of fruits and vegetables daily or will try to do it. Ashfield-Watt et al. [18] determined in their study in New Zealand that the

'five a day' logo is widely recognized (87.5% of respondents) and understood in terms of the message to eat more fruits and vegetables.

The results of the questionnaire revealed an acceptable fruit consumption in Austrian adults. Mostly fruit was consumed as a snack; not as popular as in Mediterranean countries where fruit was consumed as dessert. Vegetables and salad were stated as regularly consumed by about 50% of the interviewees while the rest consume them only sometimes. Just 0.5, 0.4 and 0.1% reported that they do not like fruits, vegetables and salad, respectively.

The reasons for consumption of fruits and vegetables are mostly because of the good taste. Only about 30% eat fruits and vegetables because it is healthy and 10–15% because it is available (e.g., a salad as part of a meal). These results show that people are aware that fruits and vegetables are good for their health and healthy food can also be very tasty.

The two strongest factors that have been found to be correlated with higher fruit and vegetable intake include taste preferences and availability. Consequentially, interventions to increase fruit and vegetable intake need to target socioenvironmental factors such as greater availability of fruits and vegetables [19].

To obtain more detailed information on consumption of fruits and vegetables a 24-hour recall was done. At first view the results of this survey looked very satisfying. When the amounts of juice and nectar were added to the average intake of fruits and vegetables, the whole quantity of fruit and vegetable consumption reached the recommendation.

Naska et al. [20] examined fruit and vegetable availability among ten European countries (Belgium, Germany, Greece, Hungary, Ireland, Luxembourg, Norway, Poland, Spain, and the UK) and identified many low vegetable and fruit consumers. More than 50% of the surveyed population groups consume less than the recommended daily vegetable intake of three portions. In Belgium, Germany, Luxembourg and the UK more than 80% of the population were identified as low consumers. Only in Mediterranean countries, (Greece and Spain) did the mean daily population intake clearly exceed the combined fruit and vegetable recommendation.

Because of differing nutritional attributes, health and nutrition organizations decided to separate the fruit and vegetable recommendation. Thus low consumers were considered to be those with an intake of <150 g fruits or <250 g vegetables. In almost all European populations, the percentages of low fruit consumers were significantly lower than those of low vegetable consumers, indicating a preference of European populations towards fruit consumption. Exceptions are Eastern European populations where homemade pickled vegetables are rather popular. Therefore, the authors suppose that national and international recommendations may address fruits and vegetables separately [8].

Agudo et al. [21] investigated the consumption of fruits and vegetables in men and women from the centers participating in the European Prospective Investigation into Cancer and Nutrition by a 24-hour dietary recall. The centers from southern countries had the highest consumption of fruits and vegetables, while the lowest intake was seen in The Netherlands and Scandinavia. Total vegetable and fruit intake follows a south-north gradient.

In the DAFNE Report III, it is shown that in recent years vegetable availability is generally on the rise in Northern and Central Europe. Southern European countries, on the other hand, have recently recorded a reduction in household vegetable purchases. In the case of fruits, all Mediterranean countries clearly lead the way with daily availability exceeding the WHO recommendations of two servings of fruit per day [www.nut.uoa.gr].

The average intake of vegetables in Austrian adults is close to the minimum recommended 200 g per day. But one fourth (26%) of the investigated subjects eat lower than 100 g vegetables, 21% consume amounts between 100 and 200 g and 53% eat more than 200 g vegetables daily. It is reported that half of the consumed vegetables have been eaten fresh and half-cooked. The elderly eat fewer amounts of vegetables compared to younger adults. This may be due to chewing problems. A good alternative is cooked food, which is preferred by the investigated aged in our study.

In contrast, the questionnaire revealed that the consumption of fruit was not satisfying. Half (51%) of the examined adults eat less than 100 g fruit per day, 23% between 100 and 200 g and only 26% more than the recommended 200 g. Especially men eat small amounts of fruit. This could be due to the fact that men consume other kinds of snacks than women.

With the assumption that a 'decent-sized' portion of vegetables and fruits is about 80 g, a minimum of three servings of vegetables and two servings of fruits corresponds to approximately 250 and 150 g/day, respectively. Based on these factors the average intake of vegetables and fruits of Austrian adults is 3.4 ± 4.0 (mean, 1st/3rd-quartile: 2.8, 1.5/4.6) and 2.6 ± 2.0 (mean, 1st/3rd-quartile: 1.9, 1.4/3.3) servings.

Fruits and vegetables are the main sources of vitamin C, folic acid, and dietary fibers. The intake of vegetables, fruits and juice fulfils the recommended daily requirement of vitamin C very well. Garcia-Closas et al. [22] assessed that the principal food sources for vitamin C are fruits (mainly oranges) and fruit vegetables (mainly tomato and sweet pepper).

The intake of folic acid from fruits and vegetables is unsatisfactory. Austrian females consume on an average 255 ± 115 μg folic acid daily, Austrian males 284 ± 137 μg/d. The average intake of folic acid is far from the recommendations [23]. This could be improved by the increased consumption of vegetables and fruits. Broekmans et al. [24] investigated the effect of high

fruit and vegetable intake (500 g/day) and low intake (100 g/day) on plasma carotenoids, vitamins and homocysteine concentrations in 47 volunteers. The high group had higher vitamin levels, 11% lower plasma homocysteine and 15% higher plasma folate concentrations compared with the low group. A decrease in homocysteine levels is advantageous towards the risk of coronary heart diseases. By increasing fruit and vegetable consumption folic acid could be improved and the risk of cardiovascular diseases reduced.

Our survey shows that the investigated Austrian adults on an average were reaching the minimum goal of 400 g fruit and vegetable intake per day. Nevertheless, 16% consumed less than 200 g vegetables and fruits. To improve health benefits a higher intake of fruits and vegetables should be aspired to.

van't Veer et al. [6] demonstrated that increasing average intake of fruits and vegetables from 250 g/day to the recommended 400 g/day among the Dutch population carries a large public health potential.

Taking into account that the time lag between increasing intake of fruits and vegetables and the emergence of the full public health effect may span many years, already available data justify recommending higher fruit and vegetable consumption. If the increased consumption of fruits and vegetables reduces early stages of disease, it will take decades before diseases rates are affected [6].

The suggestion that antioxidant supplements instead of fruit and vegetable consumption can prevent chronic diseases has not been proved or consistently supported by the findings of published intervention trials. Further evidence regarding the efficacy, safety and appropriate dosage of antioxidants in relation to chronic disease is needed. The most prudent public health advice remains to increase the consumption of plant foods, as such dietary patterns are associated with reduced risk of chronic disease [25].

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Health Effects of Phytoestrogens

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Abstract

Phytoestrogens are naturally occurring plant-derived phytochemicals, whose common biological roles are to protect plants from stress or to act as part of a plant's defense mechanism. Although composed of a wide group of nonsteroidal compounds of diverse structure, phytoestrogens have been shown to bind estrogen receptors and to behave as weak agonist/antagonist in both animals and humans. Phytoestrogens include mainly isoflavones (IF), coumestans, and lignans. These compounds are known to be present in fruits, vegetables, and whole grains commonly consumed by humans. IF are found in legumes – mainly soybeans – whereas flaxseed is a major source of lignans, and coumestans are significantly present in clover, alfalfa and soybean sprouts. 8-Prenyl flavonoids are common in vegetables. Bioavailability of IF requires an initial hydrolysis of the sugar moiety by intestinal beta-glucosidases to allow the following uptake by enterocytes and the flow through the peripheral circulation. Following absorption, IF are then reconjugated mainly to glucuronic acid and to a lesser degree to sulphuric acid. Gut metabolism seems key to the determination of the potency of action. Several epidemiological studies correlated high dose consumptions of soy IF with multiple beneficial effects on breast and prostate cancers, menopausal symptoms, osteoporosis, atherosclerosis and stroke, and neurodegeneration. For the relief of menopausal symptoms a consumption of 60 mg aglycones/day has been suggested; for cancer prevention a consumption between 50 and 110 mg aglycones/day is considered beneficial to reduce risks of breast, colon and prostate cancer; to decrease cardiovascular risk a minimum intake of 40–60 mg aglycones/day, together with about 25 g of soy protein has been suggested. For improvement in bone mineral density, 60–100 mg aglycones/day for a period of at least 6–12 months could be beneficial.

Introduction

Menopause causes a variety of symptoms and adverse health effects that are usually dealt with hormone replacement therapy (HRT). However, fewer than one in four postmenopausal women decide to take HRT and, within

6 months, over 60% of them withdraw because of concerns over an increased risk of malignancy and other side effects. Biphosphonates, but primarily the new generation of selective estrogen receptor modulators (e.g. raloxifene) are effective alternatives to HRT in osteoporosis and cardiovascular risk prevention, although interactions with other medications typically taken in old age may limit their use in selected patients. The search of an effective and safe treatment is however still open. The report of reduced menopause complaints and reduced morbidity incidence of many hormone-dependent diseases, such as breast and prostate cancer in Eastern (e.g. Japanese) compared with Western populations [Adlercreutz and Mazur, 1997], has stimulated scientists' interest in soy isoflavones (IF), for which an estrogenic action has been demonstrated.

Phytoestrogens: A Definition

Phytoestrogens are naturally occurring plant-derived phytochemicals, whose common biological roles are to protect plants from stress or to act as part of a plant's defense mechanism. Phytoestrogen is a general definition that has been applied to '...any plant substance or metabolite that induces biological responses in vertebrates and can mimic or modulate the actions of endogenous oestrogens usually by binding to oestrogen receptors' [MAFF UK, 2003]. They are diphenolic compounds with an aromatic A ring with one hydroxyl group and a second hydroxyl group on the same plane of the A ring, structurally similar to natural estrogens (fig. 1). Although composed of a wide group of nonsteroidal compounds of diverse structure, phytoestrogens have been shown to bind estrogen receptors and to behave as weak agonist/antagonist in both animals and humans. Estrogen effects are classically mediated by their specific nuclear receptors that act as ligand-dependent transcription factors. Two specific estrogen receptors (ERs) have been identified, ERα and ERβ. ERs regulate transcription through direct interaction with specific binding sites on DNA in promoter regions of target genes. In addition, they act also at AP-1 and Sp-1 sites. The activation of the ERs regulates the activity of specific genes, thus mediating the so-called classic, or genomic, action of estrogen, an action typical of all steroids. Besides the genomic action of estrogen, various cell systems display an estrogenic response that is highly specific and very rapid, in comparison to the classical action, suggesting the existence of a nonclassic, nongenomic pathway requiring a cell surface receptor-mediated signal transduction pathway. Phytoestrogens also display both classical and nonclassical actions.

Three main classes have been identified: flavonoids, lignans, coumestans. These compounds are known to be present in fruits, vegetables, and whole

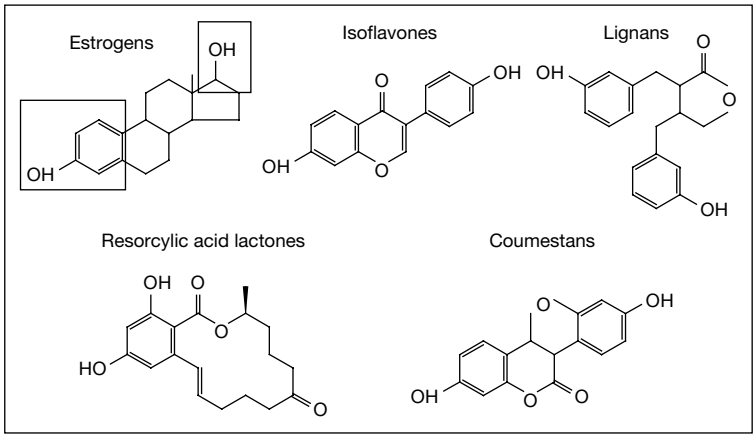

Fig. 1. Main classes of phytoestrogens. The boxes indicate the two key sites that allow binding to the ER: an aromatic A ring with one hydroxyl group and a second hydroxyl group on the same plane of the A ring.

grains commonly consumed by humans as staple foods. The main phytoestrogens recognized so far are soy IF, mainly genistein, daidzein and glycitein (mainly contained in soy germ) and their glycosides (genistin, daidzin, glycitin). Flaxseed, rye and berries are major sources of lignans, and coumestans are significantly present in clover, alfalfa and soybean sprouts. Flavonols like quercetin and its glycosylated compound rutin (quercetin-3-O-glucose rhamnose) are widely present in vegetables like onions or apples; flavanols like luteolin and apigenin, contained in black olives; flavanones like hesperetin and naringenin, contained in red orange. Lignans (lariciresinol, isolariciresinol, secoisolariciresinol, matairesinol) are mainly present in wholemeal cereals, linseed, wild berries [Mazur et al., 2000].

The evaluation of potency of the different compounds is not straightforward and two or three log differences exist according to the assay used. Even the ranking of the molecules is affected by the selection of the assay. Estrogenicity is evaluated through relative binding affinity in competition assays and in transactivation assays. However, these assays only take into account the classical actions. Proliferation assays or uterotrophic assays are also used, but they only take into account specific tissues.

Intake of IF in China and Japan is up to 100 mg/day, while it is less than 1 mg/day in the USA and Europe. It can be up to 6–10 mg/day in soy food consumers [van Erp-Baart, 2003]. However, the total exposure to flavonoids can be in the order of several hundred milligrams.

Absorption, Distribution, Metabolism and Excretion

While flavonoids are absorbed in the naturally occurring glycosidic forms [Hollman and Katan, 1998], IF glycosides need to be hydrolyzed to aglycones by intestinal beta-glucosidases.

The absorption of IF appears to occur by diffusion, through uptake by enterocytes.

IF are rapidly absorbed, with a significant increase in plasma levels at 15–30 min postingestion [Rowland et al., 1999] and a peak between 3 and 7 h postingestion [Setchell, 2001]. Lignans have a slower rate of absorption since they appear in plasma only 8.5 h after ingestion.

Following absorption, IF aglycones undergo extensive phase II metabolism via glucuronidation and sulfation in the upper small intestine. Based on genistein studies, it has been extrapolated that glucuronidation of IF occur rapidly by UDP-glucuronosyltransferases and/or sulfotransferases in the gastrointestinal mucosa and that a further conjugation happens in the liver [Zhang et al., 1999].

IF and lignan metabolism has an extensive interindividual variation. Gut bacteria operate an extensive metabolism of IF (to equol and O-desmethylangolensin) and lignans (to enterodiol and enterolactone). Equol is not produced with the same efficiency by all individuals. Rowland et al. [2000] identified about 35% of equol producers in a sample of healthy subjects. The major lignan metabolite, enterolactone, has also been found in urine but showed a lower interindividual variation than daidzein metabolites [Rowland et al., 2000]. In the same study, it was found that dietary fat intake decreases the ability of gut microflora to synthesize equol, stressing the importance of dietary habits in influencing the bioavailability of phytoestrogens.

Health Effects

Based on the structural similarities with estrogens and on in vitro studies, several health effects have been hypothesized for phytoestrogens: they can be estrogenic or antiestrogenic, antioxidative, antiproliferative, antiviral, antibacterial, insecticidal or fungistatic, cardioprotective, antiatherogenic, hypocholesterolemic, bone-maintaining, cancer protective, anticarcinogenic. In addition, several epidemiological studies correlated high dose consumptions of soy IF with multiple beneficial effects on breast and prostate cancers, menopausal symptoms, osteoporosis, atherosclerosis and stroke, diabetes, and neurodegeneration. However, only some of such effects have been substantiated by properly designed clinical trials.

Effects on Cancer Prevention

Epidemiological studies have demonstrated an inverse correlation between soy consumption and risk of prostate, breast, endometrium and colon cancer [Messina et al., 1994; Goodman et al., 1997; Adlercreutz, 1998; Messina and Bennink, 1998; Messina, 1999]. Genistein has been considered as an antiproliferative factor for its capacity to inhibit tyrosine kinase [Polkowski and Mazurek, 2000]. Genistein and other phyto-estrogens arrest the cell cycle and induce apoptosis [Birt et al., 2001]. At the same time, these compounds might be responsible for promotion of hormone-dependent cancers, as a result of estrogenic and antiestrogenic activity, depending on the timing (and dose) of the exposure. Early and continued exposure to genistein before tissue maturation reduces the risk of a tissue to generate tumors [Hsieh et al., 1998; Polkowski and Mazurek, 2000]. IF regulate DNA methylation, thus inhibiting transcription of genes. Mice fed with a genistein-enriched diet showed a positive correlation with changes in prostate DNA methylation pattern of specific genes [Day et al., 2002]. A recent study showed a reduced incidence of breast cancer in equol-excreting premenopausal women [Duncan et al., 2000].

Effects on Coronary Heart Disease

Several experiments have been conducted to demonstrate the effects of soy and IF on blood lipids. The cholesterol-lowering properties of soy have been demonstrated in hypercholesterolemic human subjects [Anderson et al., 1995] and, to a lesser extent, in normocholesterolemic and mildly cholesterolemic postmenopausal women given isolated soy protein (ISP). A study on premenopausal women showed a significant inverse association between consumption of IF-rich soy protein and plasma concentration of low-density-lipoprotein (LDL) cholesterol as well as with the ratio of total to high-density-lipoprotein (HDL) cholesterol and of LDL to HDL cholesterol [Merz-Demlow et al., 2000]. Wangen et al. [2001] showed a significant reduction in LDL cholesterol plasma concentrations and in the ratio of LDL to HDL cholesterol. A 3-month double-blind randomized controlled trial (RCT) found that ISP decreased plasma concentration of total cholesterol and of the LDL fraction, but only when the ISP contained at least 37 mg of IF [Crouse et al., 1999]. In a double-blind randomized study performed on postmenopausal women [Lucas et al., 2002], flaxseed lignans decreased serum LDL and HDL cholesterol, as well as apolipoproteins A-1 and B levels. Administration of ISP also decreases diastolic blood pressure in premenopausal [Crouse et al., 1999] and in postmenopausal women [Washburn et al., 1999]. However, as shown in Table 1, the lipid-lowering effect is almost always associated with the intake of ISP, while studies using IF only do not show a positive impact.

Table 1. Effects of isolated soy protein (ISP) and isoflavones (IF) on total plasma cholesterol

	ISP	IF
Postmenopausal women		
Normal/Sightly elevated	3+/1−	2−
Elevated	2−	4−
Premenopausal women		
Normal	1+	1−
Men		
Normal	1−	1−
Elevated	1+	1+

Source: Demonty et al. [2003].

In addition to the effects on blood lipids, soy consumption has been suggested to have a beneficial action on arterial compliance and on antioxidant status [Lichtenstein, 1998]. Effects on endothelial function have been shown by Squadrito et al. [2002], who gave 50 mg genistein/day to 60 postmenopausal women (aged 52–60 years); they observed an increase in the nitrites/nitrates ratio, a decrease in endothelin-1 and an overall improvement in endothelial function, while lipid profiles were not affected.

Effects on Osteoporosis

Most observational studies on IF and bone health have been conducted in populations with high habitual intake of IF. In premenopausal women, Ho et al. [2001] found that 30- to 40-year-old women having a 15-mg/day IF intake had greater spinal bone mineral density (BMD) than women on 1.4 mg/day intake, at the end of a 3-year follow-up period, while Mei et al. [2001] found no association between dietary phytoestrogen intake and BMD.

Out of the six observational studies carried out in postmenopausal women, four indicated better bone health in the groups with highest intake. Mei et al. [2001] found that the BMD at the lumbar spine and Ward's triangle was higher and bone turnover markers lower (serum parathormone, osteocalcin (OC), and urinary N-telopeptide) in women with mean intake of 47.4 mg/day IF than in women having 18.6 mg/day. Tsuchida et al. [1999] and Horiuchi et al. [2000] found a correlation between soy intake and BMD. Somekawa et al. [2001] found that early postmenopausal women in the highest quartile of intake (mean: 83.3 mg/day) had 7.9% higher lumbar spine BMD than women in the lowest quartile of intake (mean: 28.9 mg/day). In two studies [Nagata et al., 2002;

Kim et al., 2002] no association was found between phytoestrogen intake and BMD or bone turnover. In the four studies conducted in Western populations with low IF intakes, an association was found between IF intake and bone BMD or bone turnover only in the subgroups with the highest lifelong intakes, i.e. Asian immigrants [Greendale et al., 2002; Kritz-Silverstein and Goodman-Gruen, 2002].

Clinical trials are more appropriate designs to demonstrate the effect of phytoestrogens. However, differences in dose, IF source, duration, time since menopause, and outcome variables do not allow pooling of the data. In short-term studies, a reduction in bone turnover was demonstrated in four studies, while two did not find significant differences. Murkies et al. [1995] showed that urinary hydroxyproline increased more in 5- to 6-year postmenopausal women given 45 g wheat flour for 3 months than in women taking 45 g soy flour. Washburn et al. [1999] found that women given ISP containing 34 mg IF had lower serum alkaline phosphatase than women given the same isolate with a lower IF content. Wangen et al. [2000] carried out a crossover RCT in 17 postmenopausal women, each going through one of three 3 month periods, with 8, 65 or 130 mg/day IF. In the high IF period the excretion of deoxypyridinoline and C-telopeptide was lower than at baseline. Uesugi et al. [2002] observed a reduction of urinary pyridinoline and deoxypyridinoline in women given 61.8 mg/day IF for 4 weeks. Scambia et al. [1999] did not show significant changes in OC levels in postmenopausal women (aged 29–63 years), supplemented for 6 weeks with 50 mg/day total IF. Upmalis et al. [2000] also failed to observe differences in serum OC or urinary N-telopeptide after 12 weeks supplementation with 50 mg/day genistein. In the single study carried out with lignans in postmenopausal women no effect was observed on biomarkers of bone metabolism [Lucas et al., 2002].

Short studies should however be challenged, since at least 12 months are required to set a new steady state in bone turnover. In such long-term studies effects on bone mass and density are studied. Eight such studies have been published, all in postmenopausal women, five of which have been conducted for 6 months and three for one year or more. A protective effect of IF on postmenopausal bone loss has been observed in six studies, while no effect has been found in two.

Potter et al. [1998] conducted a double-blind placebo-controlled RCT in 66 postmenopausal women. 90 mg of IF induced a 2.2% increase in lumbar spine BMD compared with baseline. Alekel et al. [2000] also conducted a RCT in 69 perimenopausal women comparing 4 mg with 80 mg IF intake and showed a 1.28% reduction of lumbar spine BMD in the low intake group, while the high intake group was protected. Clifton-Bligh et al. [2001] performed a double-blind study in 46 postmenopausal women comparing 28, 57 and 85 mg red clover IF

preparation containing genistein, daidzein, formononetin, and biochanin. The two higher intake groups had an increase of mineral density of 3–4% at proximal radius and ulna. Morabito et al. [2002] followed for 12 months 90 postmenopausal women, who were randomly assigned to 54 mg/day genistein, to HRT or to placebo. In the genistein and HRT group they observed an increase in BMD at femoral neck, Ward's triangle and lumbar spine, reduced pyridinoline and deoxypyridinoline excretion at 6 and 12 months as well as increased serum bone alkaline phosphatase and serum OC at 6 and 12 months in the genistein-treated group. Lydeking-Olsen et al. [2002] randomly assigned 89 postmenopausal women (age range: 41–75 years) to receive IF-rich soymilk (100 mg/day), natural transdermal progesterone (TDP, 25 mg/day), both, placebo and progesterone-free cream. Women were followed for 24 months. Lumbar spine BMD and bone mineral content did not differ from zero in the soy+ group (+1.1%, +2.0%) and TDP+ group (−1.1%, +0.4%) but loss occurred in the soy− group (−4.2%, −4.3%) and the soy−, TDP− group (−2.8%, −2.4%). No significant changes occurred in any group for femoral neck BMD or bone mineral content. Chiechi et al., [2002] compared a soy-rich diet with HRT in 187 postmenopausal women (age range: 39–60 years). The soy group had increased serum OC and reduced hydroxyproline excretion, and a nonsignificant reduction in BMD, while the control group had a significant reduction of trabecular BMD.

Kreijkamp-Kaspers et al. [2004] observed a BMD change of 1.31% in the intertrochanter region of the hip in a group of postmenopausal women aged 60–75 years given soy protein containing 99 mg of IF for 12 months, while no effect was observed in the other regions. Interestingly, the effect was larger in the youngest women. Hsu et al. [2001] carried out a study in 37 postmenopausal women with 150 mg/day IF. No effect was observed in calcaneal BMD.

Safety

A very long history of safe consumption can be reported for soy. However, this is not valid for plant extracts or for purified compounds, such as genistein. The safety profile of IF is difficult to draw due to limited sample sizes and short periods of investigation. At the moment, anyway, the upper experimentally tested limits are the following: (1) an ingestion of up to 3 mg/kg body weight of total IF as consumed by some human infants without reported clinical effects, and (2) up to 16 mg/kg body weight as used in human adults with little significant toxicity observed in any subject at any dose [Busby et al., 2002]. Long-term toxicity in Western populations at high levels of intake has not been studied. However, no significant clinical effects have been reported on human infants fed soy-based formulas [Irvine et al., 1998].

Conclusions

Phytoestrogens have an obvious interest for public health and their introduction in European diets might improve quality of life, reduce disease risk and impact health expenditure. At the same time, and partially as a result of the promising research outcomes, food and pharmaceutical industry have invested in the preparation of pharmaceuticals, supplements or food components. Although still very much a niche product, phytoestrogen supplements and phytoestrogen-rich food are being marketed and starting to conquer an increasingly large audience. There is a potential interest also for the agro-industrial sector. Phytoestrogen intake might also be increased by selecting legume or cereal varieties that maximize the content of such components, or by adopting agricultural technologies to standardize and maximize content. Despite the interest of all stakeholders, there is still caution in recommending phytoestrogens and caution in accepting them from the consumers' side. Regulators and policy makers still wonder about the real benefit to public health and consumers are either suspicious or use the available products without control.

The review of the literature indicates that soy IF can be considered a possible strategy to prevent postmenopausal symptoms, but they still cannot be recommended to the general population. IF may modulate bone turnover and may modulate vascular response. There is a large variation in response and the selection of compounds and dose has to be established. For the relief of menopausal symptoms a consumption of 60 mg aglycones/day has been suggested; for cancer prevention a consumption between 50 and 110 mg aglycones/day is considered beneficial to reduce risks of breast, colon and prostate cancer; to decrease cardiovascular risk a minimal intake of about 40–60 mg aglycones/day, together with about 25 g of soy protein is suggested. For improvement in BMD, 60–100 mg aglycones/day for a period of at least 6–12 months could be beneficial.

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Exploitation of Convenience Food in View of a Diet Diversification for Better Nutrition

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Abstract

Social and economic changes as well as technological innovations in recent years, have caused dramatic changes regarding the kind of nutrition supply observed. The provoking question now is, if a recommendable nutrition and diet diversification is possible with the convenience products available on the market at present.

Depending on the degree of cooking or preparation the following convenience steps can be differentiated: initial grade – ready-for-kitchen processing – ready-to-cook – ready-to-mix – ready-to-heat – ready-to-eat. Various preservation strategies can be applied to the food products of each step. In order to keep the nutritional and sensory quality of the food product, these necessary preservation methods should, of course, be as gentle as possible.

On each convenience-step a large variety of products exists. By separation of preparation from consumption and the therefore necessary preservation methods, these products are available throughout the whole year. Seasonal limitations are less important, which enhances diet diversification. On the other hand, an impoverishment in raw materials occurs due to the existing concentration tendencies in food production and especially in food trade.

Introduction

According to the general topic of the congress, this paper deals with the question: Could convenience food (CF) contribute to diet diversification for better nutrition.

At first an overview about the present-day situation of our food supply and its trends is given. The form of carrying out the food supply has been steadily changing throughout human history. But in recent decades, drastic changes

have occurred caused by social and economic changes as well as technical innovations.

- First of all, more and more food and meals are consumed out of home. In the USA, for example, already 46% of all food dollars are spent in this sector [1].
- Furthermore, also in private households the demand and the extent of prepared foods up to 'ready-to-eat meals' are increasing more and more [2].
- The consumer wants and can spend less time on food preparation, and their preparation competencies are also becoming less. For example, the amount of time spent on cooking meals in Great Britain has fallen from 60 minutes a day in 1980 to 13 minutes a day in 2002. On the other hand, the number of books and television programs on cooking has multiplied. But perhaps, this is not a paradox. Maybe it is because people cannot cook any more, so they need to be told how to do it [3].

To understand the modern form of food supply in industrialized countries, it is advantageous to look to the past, in order to demonstrate the principal possibilities of different forms of food supply.

- The most primitive form is gathering edible plant raw materials or hunting animals. The collected and captured raw materials are then directly eaten raw or prepared. It is not necessary to explain that in our modern society such a method is not applicable anymore.
- A very complicated form is to also cultivate and harvest raw material or farm and slaughter stock. Self-produced agricultural products have to be processed and prepared or cooked and then can be eaten immediately. This was the usual method in the beginning of the agricultural and stock-farming societies.
- Today nobody produces their own agricultural raw materials or farms their own stock, except hobby gardeners. In the course of the division of work, it has emerged within the agricultural societies that consumers buy their raw material. Partially, the raw materials had to be stored intermediately before further use, and therefore various preservation methods had to be applied. Subsequently, the agricultural raw materials were then cooked at home and consumed immediately.

In the last step of the food supply – in the phase of the industrial food processing and our service society –

- the consumers change from buyers of raw material to buyers of preprocessed products or even buyers of directly consumable ready-to-eat meals.
- the latter can be bought in the supermarket or can be consumed in the form of the 'out-of-home' catering, for example, in restaurants.
- Another possibility is the 'home delivery' of ready-to-eat meals.

We should be aware, that by all these methods between the preparing of the food and meals and their consumption a more or less long time and space distance results.

CF Definition

Starting from the raw materials, different 'degrees of processing' or 'degrees of convenience' can occur until the last step of ready-to-eat food or meals.

The terms '*convenience*' and '*convenience food*' are best characterized by the definition of the New Oxford Dictionary of English [4]: '*A thing that contributes to an easy and effortless way of life*' is convenient. And a CF is *typically a complete meal, that has been pre-prepared commercially and so requires minimum further preparation by the consumer.*

Principally, the following preparation steps or better convenience degrees can be differentiated, but a division of the various CF into each step is not always clearly possible:

Initial Grade: Covers practically all unchanged, agricultural raw materials like cereals, vegetables, potatoes, animal carcasses.

Ready for Kitchen Processing: This step includes all products, which first need kitchen preparation before they can be cooked – for example, flour, washed vegetables, presorted potatoes and meat pieces.

Ready-to-Cook: Products in this step can be cooked directly without further preparation, like dried pasta, dried vegetables or raw frozen vegetables.

This category also includes all foods, which have been precooked and only need short cooking, for example, precooked rice or wheat.

Ready-to-Mix: Products, from which ready-to-eat meals can be produced by simply adding other 'ready-to-mix' components or water. A cooking process is not necessary anymore. This category includes principally all instant products like instant noodles and mashed potato powder.

Ready-to-Heat; Heat and Eat: Preserved ready-to-eat meals or menu components, which are ready to be prepared by warming up at any time; like precooked pasta, frozen bread, vegetable tins.

Ready-to-Eat, Ready Prepared Products: They are the highest processing step and highest degree of convenience. Ready-to-eat meals can either be consumed cold or warm. The oldest products to be consumed cold are bread and bakery goods, cheese and sausage. This category includes all direct consumable products or ready-to-eat meals of the 'out-of-home catering' in restaurants or on the street (take-out, take-away, food-to-go, street-food), as well as of the home delivery.

During the production of CF, an important fact has to be considered. The higher the processing degree, and longer the time between preparation and consumption

- the lower is the shelf-life of the food and
- more the shelf-life-increasing measures that have to be applied.

The lowest is the shelf-life of ready-to-eat meals. This was no problem, when the food or meal was consumed directly after preparation. But, as already mentioned, between the production of 'ready-to-eat meals' in an industrial scale or out-of-home and the consumption, nowadays, there is a more or less a long time and space distance. This gap is becoming always longer and wider caused by the existing trade and distribution structures. Therefore, in addition to cooking or combined with it, appropriate preservation methods have to be applied.

In order to preserve the nutritional and sensory quality of products, these necessary preservation methods should of course be as gentle as possible. In the opposite case, quality losses are inevitable.

But for the advantages of a long shelf-life, fast and comfortable handling and preparation (convenience), an accordant 'price' has to be paid. If this price is not expressed in more money, in order to use high-quality raw materials and gentle and more expensive processing and storage methods, then these advantages have to be accepted for quality losses.

Modern food technology has tried for a long time – with great success – to develop and apply such gentle preservation methods. In the last 150 years, more preservation methods have been developed than in the 1,000 years before. Figure 1 shows the possible preservation strategies, which are available at present. Within the different degrees of convenience, all these preservation strategies and methods can be applied.

Ready-to-Eat Meals

It is impossible to describe all convenience products on the market. Therefore, only the products with the highest convenience degree – the ready-to-eat meals – shall be discussed in more detail regarding their suitability to contribute to a diet diversification.

Ready-to-Eat Meals for the Retail Market

Within ready-to-eat meals a limitation to certain preservation strategies and systems is necessary. Figure 2 shows an overview of the most common preservation methods for prolonging the shelf-life of 'ready-to-eat meals' for

- Preservation of the biological functions
  [animal breeding, CA-, MA-storage or packaging (CAS, CAP, MAP)]
- Inhibition of enzymes, MO and pests
  - Decrease of the water activity:
    evaporation, freezing, drying, addition of substances
  - Cooling
- Inactivation or killing of enzymes, MO and pests
  - Addition or formation of inhibiting or inactivating substances:
    addition or formation of alcohol or acid
    addition or chemical preservatives
    curing, smoking
  - Effect of thermal energy:
    blanching, pasteurization, sterilization
  - Effect of electromagnetic energy:
    microwaves, UV-, X-, β-, γ-rays; high-pulsed electric field
  - Effect of mechanical energy:
    high pressure (pascalization), ultrasound
- Mechanical removal of MO
  microfiltration, centrifugal sterilization (bactofugation)
- Elimination of negative environmental influences
  addition of antioxidants; vacuum, gas exchange and active packaging

Fig. 1. General strategies for preservation of foods.

1. Freshly prepared meals

   cooking ⇒ eating

2. Dried ready-to-eat meals

   cooking ⇒ drying ⇒ distribution ⇒ storage ⇒ rehydrating ⇒ heating ⇒ eating

3. Pasteurized or sterilized ready-to-eat meals

   cooking and pasteurizing or sterilizing ⇒ storage ⇒ distribution ⇒ heating ⇒ eating

4. Frozen ready-to-eat meals

   cooking ⇒ freezing ⇒ distribution ⇒ frozen storage ⇒ thawing ⇒ heating ⇒ eating

5. Chilled ready-to-eat meals

   cooking ⇒ chilling ⇒ distribution ⇒ cold storage ⇒ heating ⇒ eating

Fig. 2. Strategies for preservation of ready-to-eat meals for the retail market (household systems).

home consumption. In the following, the advantages and disadvantages of these methods are discussed in more detail.

Freshly Prepared Meals

Naturally, the consumption of meals immediately after their preparation would be definitely the ideal way. But because of the reasons mentioned, this method has become less feasible nowadays.

Dried Ready-to-Eat Meals

The drying method is limited to a specific area and products like dry soups and all instant products. A disadvantage of convenience is that those products need to be rehydrated before consumption.

Conventional drying has a rather strong impact on the food matrix, which means that losses concerning nutritional quality – for example, vitamin losses – could arise. With the use of gentle drying methods – like freeze drying, drying with hot carbon dioxide instead of air and other new technologies – the quality of the end products can be improved a lot.

Each society has its preferred preservation methods. Dried ready-to-eat meals are especially favored within the Asian cultures in the form of many ready-to-eat soups, for example. For these 'instant soups' a special drying method to prepare instant noodles has been developed in Japan. It is a fry drying of cooked noodles in hot fat.

Pasteurized and Sterilized Ready-to-Eat Meals

Cooking and preservation are undertaken here in one step. The convenience value is very high, because a long shelf-life is possible at very simple storage conditions. Before consumption the products only need to be warmed up.

The partially bad image of 'tins' is surely right for cheap products, where the packaging is more expensive than its content. But there are also many products, which satisfy high-quality demands. If this method is applied appropriately and carefully – that means using high-quality raw materials, application of high temperature/short time regimes or nonthermal processes – there are not many differences regarding nutritional quality to other preservation methods.

During the so-called high temperature/short time processes it is an advantage that microorganisms are inactivated 10-fold after increase of temperature, while, for example, vitamin destruction is only increased 2-fold. The necessary extent of the inactivation of microorganisms is therefore achieved at high temperatures, while valuable nutrients are only destroyed little. All aseptic bottling methods and direct steam injection work according to this principle. Using the direct steam injection method, heating time of only one or 2 s are possible.

Beside pasteurization and sterilization by thermal energy input, more and more nonthermal methods are used, especially for pasteurization. These include food irradiation, high-pressure pasteurization, also called pascalization, or the application of pulsed electric field.

Frozen Ready-to-Eat Meals

One of the gentlest processes for preparation of ready-to-eat-meals is freezing. A long shelf-life with minimal nutrient losses can be achieved. But here also, it has to be said that the longer the shelf-life, the higher the nutrient losses.

Freezing is the favored method in the USA. Also in the 'out-of-home catering' freezing is used to a large extent; therefore, the advantages and disadvantages will be explained at that point in more detail.

Chilled Ready-to-Eat Meals

This form of distribution of ready-to-eat meals is rather new in the retail market. Due to the short shelf-life of maximum a few days, high logistic and packaging efforts are necessary, which also can be often realized in the price of such products. Maybe this is one reason why this method is the most widely used in France, England and Northern Europe.

The advantages and disadvantages of this method are explained in more detail under the 'out-of-home catering systems', where this method is much more important.

Ready-to-Eat Meals for Out-of-Home Catering

In the 'out-of-home catering' the following systems are used in particular (fig. 3):

Cook – Serve

Like in the household kitchen, here the ready meals are more or less immediately served. Of course, this system has to be regarded as optimal. But due to organizational reasons, it is seldom possible in canteens to serve immediately after preparation. In order to keep hygienic risks between preparation and consumption low, the meals have to be kept hot by appropriate methods. But this hot-keeping period decreases drastically the quality of the meals regarding nutritional and sensory properties. Reasonably, with this method the period between preparation and consumption can only be increased by some hours.

Cook – Chill

The prolongation of the shelf-life between preparation and consumption of the meals is achieved by cool storage. But the storage time can be maximum

1. Cook/serve

cooking ⇒ hot keeping and distribution ⇒ serving ⇒ eating

2. Cook/chill

cooking ⇒ chilling ⇒ distribution ⇒ cold storage ⇒ heating ⇒ eating

3. Cook/freeze

cooking ⇒ freezing ⇒ distribution ⇒ frozen storage ⇒ heating ⇒ eating

4. Cook/freeze/thaw/chill

cooking ⇒ freezing ⇒ frozen storage ⇒ thawing ⇒ distribution ⇒ heating ⇒ eating

5. Vacuum cooking (la cuisson sous vide)

vacuum packaging ⇒ cooking ⇒ chilling ⇒ cold storage ⇒ distribution ⇒ heating ⇒ eating

6. Vacuum cooking/freeze

vacuum packaging ⇒ cooking ⇒ freezing ⇒ storage ⇒ distribution ⇒ heating ⇒ eating

7. Cook/pasteurization/chill (NACKA process)

cooking ⇒ packaging ⇒ pasteurizing ⇒ cold storage ⇒ distribution ⇒ heating ⇒ eating

Fig. 3. Strategies for preservation of ready-to-eat meals in catering systems (out of home catering).

5 days [5]. The microbial risk of cook-chill is the highest of all catering systems [7]. This also applies for the later-mentioned ‘sous vide’ process.

For a long time there was the opinion that if foods are kept cool they are microbial safe. But after the realization that some groups of microorganisms can also grow at the low temperature of the refrigerator, this opinion had to be revised [7]. Chilled foods have a good and safe image from the consumers’ point of view, so the risk of storing them longer than the possible shelf-life is often given [8].

The loss of vitamins and nutrients occurs according to the principal reaction of kinetic basics. This means that depending on the temperature during a defined time, corresponding reducing rates are found. The lower the storage temperature, the higher the advantages will be. As the temperature cannot be lowered as much as in the freezing process, the storage losses are much higher in the same time.

In chilled meals the so-called warmed over flavor (WOF) is formed rapidly, in particular in meat meals [9]. It is characterized by a loss of the typical 'fresh' aroma of meals and is caused by oxidation reactions of fats and other sensitive nutrients. Therefore, it is only after a few days that unacceptable changes of the sensory properties occur during chilling and in presence of oxygen.

Cook – Freeze

The meals are frozen immediately after preparation and can be kept in this form without serious quality-loss for several months.

Although microorganisms are hardly inactivated by freezing of food, they cannot grow anymore or only very slowly in frozen food. At the usual storage temperature of −18°C an increase of microorganisms can be excluded totally [10]. Therefore, in contrast to the chilling processes, no shelf-life limitation exists regarding microbial risk.

The faster the food is frozen and the lower the storage temperature, the better the nutrients are kept. Due to these reasons, regarding conservation of nutrients, freezing is better than all other preservation methods.

A great advantage of the freezing process compared to chilling is that the WOF can be avoided to a great extent. The explanation why the WOF is not formed so much in frozen food can be found in the enormous decreasing of the reaction rate due to the very low temperature.

The convenience properties of frozen meals are very good due to a long shelf-life. Also regarding meals, there is hardly any limitation of this method.

Cook – Freeze – Thaw – Chill

During this system frozen meals are thawed to 2–3°C and stored for some days at this temperature until consumption. The advantages of this method are that a longer storage at freezing temperatures can take place decentralized and it is easier to reach distant markets [11]. The final distribution is then done in a thawed, but chilled state. This method tries to combine the advantages of the long storage time of frozen food with the easier distribution of chilled food. It is used very seldom so far.

Vacuum Cooking (*Sous Vide*)

The 'sous vide system' was developed from various previous systems at the beginning of the 80s. The raw materials are packed under vacuum into flexible plastic bags and then cooked within these bags. The advantage is that, already during cooking oxygen is excluded as much as possible. Unwanted changes due to oxidations reactions, like the formation of the WOF, are minimized in the subsequent chill storage at 1–8°C, and so the shelf-life is increased to a maximum of 42 days [12, 13].

Leaching losses during cooking are avoided, of course, by the previous packaging. Oxidation losses of sensitive vitamins (ascorbic acid) and other nutrients (unsaturated fatty acids) are minimized by exclusion of oxygen [13].

The generally high microbial risk of chilled ready-to-eat meals is even increased by the specific conditions of the 'sous vide process'. Although during cooking within the packaging the microorganisms are more or less inactivated, depending on the used time-temperature regime, spores are not inactivated under these conditions and can, therefore, germinate during storage [14–16].

The greatest advantage of the 'sous vide' products is their extended shelf-life. But this is expressed in higher costs due to several factors:

- Recipes have to be adapted accordingly, which requires great experience. Not all raw materials are suitable for this method.
- Specific cooking equipment with reliable control adjustments is necessary.
- A cookable and mechanically stable packaging material is absolutely necessary.
- Rapid cooling has to be ensured.
- The cold chain has to be kept more accurately than the freezing chain.

Although the sous vide method has been developed once for the catering area, such products can also be found in retail markets of some European countries.

Vacuum Cooking – Freeze

In order to use the 'sous vide process' regarding sensory properties, but avoid its disadvantages regarding hygienic risk and the rather low shelf-life, a combination of this process with freezing was suggested [17]. This system is still at the beginning of its development, but it could be used much more easily in the retail market than the 'sous vide process' alone.

Cook – Pasteurization – Chill

One of the first preservation systems in the catering sector was the so-called 'NACKA' process. In order to increase the microbiological quality, an additional heating step is carried out after packaging for pasteurization. It is obvious, that each additional heat treatment damages sensitive nutrients of food in an undesired way. Subsequently, the products are chilled rapidly and stored cool.

The advantage of this process compared to the normal 'cook-chill process' is the extended shelf-life of up to 21 days.

General Quality Aspects of CFs

The preparation of meals in a large technical scale is done using the same cooking processes as within the household. In a large technical scale these

processes can be controlled even better. There are several reasons why the quality of ready-to-eat meals often does not meet the quality of fresh cooked meals in the household:

- As already mentioned, meals in the household are consumed directly and do not have to be preserved for later consumption. A fundamental problem of convenience products, which are 'ready-to-eat', is the so-called WOF. As already mentioned, this WOF is present in meat meals in particular, and is caused by oxidation reactions, which especially affect aroma substances and fats. A decreased formation is possible only by strict exclusion of oxygen during cooking and storage and eventually by the addition of antioxidants.
- The second problem is the spicing of the meals. Each household uses its individual spices, which also explains the specific taste of 'mother's cuisine'. For industrially produced 'ready-to-eat meals' this individual spicing is not possible. Furthermore, it is often necessary to use too much spicing in order to compensate for storage losses.
- A further fact is that, producers and the retail trade try to extend the shelf-life as much as possible. The possible expiration date for each preservation method is, therefore, extremely exploited. But it has to be clear, that during storage a slow quality loss of the food occurs during all preservation processes. It would, therefore, generally be advisable not to exploit the possible shelf-life.
- And last but not least, we should be aware that behind the enormous variety of food products in our supermarkets a tremendous decrease in biodiversity occurs. Today we face the grotesque situation where more and more foods are produced from fewer and fewer raw materials.

About 250,000 different seed plants exist all over the world. Although 4,000 of these are potentially accessible for human nutrition, only a very small number is actually used. About 30 plants account for over 90% of our nutrition energy, and half of the total nutritional requirements are met by only three cereals (wheat, maize, rice).

Modern agriculture and food technology have replaced the diversity of raw materials by a diversity of products. This loss in biodiversity cannot be regarded as a positive development. A diversification would be desirable both from an agricultural and a nutritional point of view.

Conclusion

Finally it can be stated, that by appropriate application of gentle preservation methods without extremely long storage times the nutritional quality of CF

does not differ very much from freshly prepared meals. By their easy availability at any time and the broad range of products they can significantly facilitate and support diet diversification. Thus, CF produced and used in the right manner can contribute to a better nutrition in a great extent.

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Adulteration of Foodstuffs: From Misleading to Poisoning

Experiences of a New EU Member State (Hungary) on the Threshold of Market Economy

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Abstract

The increasing number of food producers, and the outstanding amount of import foodstuffs enables the producers to mislead and cheat consumers. To differentiate those who take advantage of legal rules from the ones who commit food adulteration is very difficult. The consciousness of consumers would be crucial. However, how can we expect consequent behavior from them regarding controversial issues emerging day by day? In addition, ignorance and unfair market behavior may endanger consumer health and misleading can lead to poisoning. So we need sanctions and judicial penalties with an adequate restraining force to halt this process.

According to the Consumer Communication Centre (2003) [1], food producers are testing our watchfulness day by day, appearing in the market with products and packaging variations that are new or just seem to be new. In the 90s there have been serious socioeconomic changes in Central Europe including the switch from planned economy to market economy and law harmonization procedure due to the forthcoming European Union (EU) accession; therefore strict rules and authorization procedures have been abandoned. The increase in the number of food producers resulted in the appearance of thousands of micro and small-scale food industry enterprises. Moreover the ignorance, inexpert behavior, desire for quick profit, deterioration of moral and ethical standards, the outstanding amount of import foodstuffs and the huge increase in the product selection enabled producers to take advantage of and mislead and cheat consumers.

How many consumers are aware that brown bread is not necessarily made of rye, that yellow pasta is not always made of egg, that honey is not just the natural nectar produced by honey bees, that the red color of the traditional Bologna (Párizsi) sausage is not necessarily coming from the original meat color, that the sweet taste of wines is not always the result of the original grape sugar content? When buying fruit yoghurts, we can face products flavored with aromas and ones made of fruit pulp or fruit pieces. If we buy coffee there is a big difference between real coffee, blend of coffees and coffee substitute. Frying oils are also diverse as we can choose cold-pressed or refined products. Consumers rarely suspect that they pay the same price for products of different weight. For example, 85 and 100 g chocolates are sometimes at the same price. In the case of dairy products such as kephir, yoghurt and sour cream, we do not pay much attention to the declaration of weight, even if it is 175, 180 or 200 g. Examples should be categorized whether it is 'only' just misleading consumers within the framework of the current food legislation or whether it has to be considered as adulteration of foodstuffs.

People dedicated to a healthy diet often choose brown bread, which contains malt. Is it not a misleading of consumers who are more conscious in order to live healthier, making the bread with coloring agents instead of using the components expected by the consumers? The same event happens when β-carotene – that is authorized otherwise – is added to pasta instead of egg. Meanwhile, in this latter case β-carotene is listed as an ingredient, so consumers are informed, but breads under 500 g weight do not need to be labeled. The examples above illustrate how difficult it is to differentiate those who take advantage of the legal rules and the ones who commit food adulteration. The example of the brown bread and the yellow pasta shows that food producers can threaten consumers' interest while complying with the rules.

According to the current Hungarian food legislation, producers no longer require the so-called product sheet – that describes composition and the quality parameters of the product – approved by the competent authorities. The product sheet itself remains compulsory, but its content is up to the producer. This recent amendment, which was necessary to meet the requirements of the EU, increases the producers' freedom, opportunities and responsibility. Judgment of these cases is very difficult both from the point of view of legality and the fairness of market competition, since misleading consumers is forbidden by the food legislation as well (table 1). The methods of food adulteration frequently applied to mislead consumers – in the previous century – can be seen in table 2. Food adulteration has been known for ages. Before the appearance of refined white sugar and white rice in the market, brown sugar was mixed with sand in order to increase weight. Flour was mixed with chalk-dust, and the end product was called 'wartime bread' (1939–45). Cheap chalk-dust was added in order to increase calcium content as well.

Table 1. Adulteration of foodstuffs

Adulteration of foodstuffs:
Intentional
Threatening the consumer
Threatening/endangering consumer health
Threatening/endangering consumer interest
Misleading consumers

In Victorian England [2], sugar was mixed with powdered glass, flour was mixed with white lead and tea leaves with red lead. Tea leaves were dried, dyed and recycled again. Hallucinogen materials were added to beer and rum, cupric sulfate to pickles, ferrous sulfate to the tea and beer, turmeric to Chinese tea, cupric carbonate and lead sulfate to candy and chocolate, lead to wine and cider. Red lead caused the 'healthy' reddish hue of Gloucester cheese, meanwhile flour and arrowroot gave the rich thickness to cream. Innocent ignorance and evil greed has caused the death of many people during these centuries. These old methods of food adulteration have changed. There has been a substantial decrease in the amount of adulterants and components that threaten consumer health. Today, adulterators are more motivated by greed rather than ignorance. The higher the unit price is of a foodstuff with high added value (e.g., pressed ham) or the bigger the consumption is, the higher profit can be expected by the substitution of raw materials with cheaper and less valuable components (e.g., meat-water, meat-soybean and skin).

There are several ways of misleading consumers: besides the change in composition, inaccurate or insufficient denomination, promotion or packaging that is easily mixed up. For example, chocolate doughnuts and chocolate croissants are made with cocoa or cocoa mass instead of chocolate. In these cases, the labeling is misleading. Consumers can also be mislead when some parts of the labeling are over-emphasized and some are hidden (different letter size), like the graphic orange symbol on the 'orange taste' soft drinks. It is also misleading when products of different quality are packed in similar packaging material with similar names, like 'milk' and 'morning drink'; sour cream called 'tejföl' in Hungarian and similarly pronounced 'frissföl' (substitute product of sour cream containing fat of vegetable origin in a very similar packaging); cognac cherry and 'alcoholic cherry dessert'. These aforementioned products are very different in terms of composition. However, they are all legal according to the current legislation. But is it not misleading consumers, that morning drink is not milk and frissföl is made of vegetable fat instead of milk fat.

Table 2. Ways of food adulteration that mislead and threaten the consumer

Source (foodstuff)	Ingredient applied for adulteration
Fruit spirit (pálinka)	Aroma
Smoked Bologna sausage (párizsi)	Smoke aroma
Red pepper	Paint containing lead, Azo-based paints (RED1, RED3, talnin red)
Chocolate doughnut, chocolate croissant	Cocoa mass (instead of chocolate) (authorized in another denomination)
Dried pasta	β-carotene (authorized)
Brown bread	Malt (not regulated by the Hungarian Food Code)
Whipped cream	Fats of vegetable origin instead of milk fat (authorized)
Apple juice	Sugar, water, flavoring
Olive oil	Canola oil
Maple- and sorghum syrup	Corn syrup
Honey	Corn syrup
Hams	Water
Milk	Water
Cream	Gelatine
Spirit drinks	Methyl alcohol
Chocolate	Wax
Easter chocolate products	Cocoa mass (instead of chocolate) (authorized in another denomination)
Orange juice	Corn syrup, beet sugar
Horseradish	Potato starch
Vinegar pickles, wine	Cupric sulfate
Salmon	Trout
Ginseng (dietary supplement)	Sawdust
Black pepper	Dried papaya seed
Chilli powder	Brick powder, sawdust
Cereals: wheat, rice	Mud, grit, soapstone
Cream	Flour, arrowroot
Rum, beer	Strychnine (hallucinogen)
Flour	Chalk-dust, white lead-dust, ground bone-dust
Brown sugar	Sand
Tea	Mahogany shavings, red lead
Sugar	Powdered glass
Turmeric	Colored chalk-dust
Scallops	Water, sodium tripolyphosphate (STP)

Legal or Illegal?

Production and Distribution of Adulterated Foodstuffs Is Prohibited

Foodstuffs are considered to be adulterated if their quality is modified intentionally in a way that threatens consumer health and interest or misleads the consumer [3]. If the intention and endangering of consumer health and interest are not proven, it is hard to prove the adulteration. It is hard to define what threatens or endangers consumers, particularly their interest. Their limit should be determined by judicial practice, although cases of food adulteration are seldom brought to justice. I will illustrate with concrete examples how difficult it is to separate the intentional misleading of consumers from the endangering of their interest.

The Hungarian Food Act and its decrees contain many directions concerning the safe production of foodstuffs, the food producing plant, raw materials and additives. The use of raw materials, endangering human health or resulting end products, which do not comply with the regulations, is prohibited. Food processing plants can only be established if the requirements concerning the building, equipment, machinery, architecture, technology, environment protection, public health, veterinary hygiene and food hygiene are met. The determination of the public health and food hygiene conditions – if we are aware of the microbiological, chemical and physical factors – is relatively easy. But quality requirements are hard to define, as compositional, nutritional and sensory (taste, smell, texture) traits have to be taken into consideration. Foodstuffs, produced in authorized food processing plants for public consumption, are expected not to endanger consumer health and be safe. Market competition, watchful consumers, active civil consumer protection organizations make life harder for manufacturers making them act within the framework of fair market competition and comply with the regulations.

Food labeling must indicate the origin and every kind of special treatment, otherwise consumers can be misled and their interests are endangered. Endangering or cheating consumers with intention delivers a more serious fine than before. Distribution of inferior quality products, fake certification of quality, fake labeling of goods and misleading consumers (table 3) all belong to criminal law [4]. The acts of fraud and cheating customers in general are punishable and considered to be an infringements of lawful rights.

A product – regulated by the national standard – is considered to be of inferior quality, if it does not even comply with the lowest quality requirements. Fake certification of quality is committed, when false information is declared in the quality certification about a product of substantial quality or value. Fake labeling of goods is committed if a product is produced – without the approval of the market competitor – with specific appearance, packaging or denomination that reminds the consumer of the product of the market competitor.

Table 3. Crime, offense and contravention – infringement of rights according to the current legislation

Distribution of inferior-quality products
Fake certification of quality
Fake labeling of goods
Misleading consumers
Cheating consumers
Fraud

Labeling of products usually includes the use of a trademark. The Act on the protection of trademarks and geographical names restricts the issue of trademarks to distinctive characters of the product or service [5].

Fake identification misleads consumers thus depriving market share from the manufacturer and distributor of the original product, and providing advantages for the fake product by saving the costs of marketing and product launch. Fake labeling of goods can cheat consumers that may mix up products due to their similar appearance, thus buying a product not identical with their original intent. However, crime can be established without misleading and cheating consumers, even if consumers were aware that the product is not identical with the original brand product. This penal act intends to protect the interests of market competitors against fake products. The 57th Act in 1996, about unfair market behavior and the ban of competition restriction, unanimously declares that consumers must not be misled in the economic competition.

According to the act consumers are misled if:

1. false information or true information that may be misleading about significant features of a product – particularly composition, use, health and environmental impact, its treatment, origin, way and source of purchase – is provided, or the product is provided with features that may be misleading;
2. it is concealed that the product does not comply with the regulations or other requirements, and if its use requires substantially different conditions;
3. false information is provided concerning the conditions of product distribution that influences consumer decision;
4. false illusion of a bargain is suggested.

The Food Act contains the most important requirements concerning the production and distribution of foodstuffs intended for public consumption in Hungary. According to this act the labeling of foodstuffs must not declare or suggest that it prevents, treats, cures diseases or possesses specific features, if it is not scientifically justified. The 9th annex of the decree [1/1996 (I. 9.) FM-NM-IKM joint decree] of the Food Act accurately determines the conditions when certain nutritional statements (e.g., sugar-free, low cholesterol, reduced salt or sodium content, rich in dietary fiber, rich in vitamins) can be used [6]. If someone misleads others for profit and thus cheats people, he commits fraud.

Misleading means the behavior when false facts are declared as truth or real facts are altered. The law makes a difference between fraud and cheating customers. Reducing product quality during distribution of goods to consumers is considered to be a crime. Reducing the quality means that goods of the same kind, but different quality, are mixed or diluted, then sold as better quality products. Cheating consumers is a subsidiary crime; therefore, it can only be pointed out when more serious crimes (e.g., fraud or misleading consumers) are not committed. Deteriorating food quality, according to the Government Decree 218/1999 (12. 28) on certain contravention, belongs to consumer protection offences.

This law regulates that the production and distribution of adulterated foodstuffs or the distribution of foodstuffs – that do not comply with the quality parameters of the labeling or the regulations – as good quality products, is considered to be a crime.

Misleading or Poisoning?

There is a more serious type of adulterating foodstuffs, which falls within the competence of the penal code, that is, intentional endangering, and it represents a food safety threat. According to the standpoint of the National Food Safety Advisory Board (ÉBTT), issued in November 2002, this can be terrorist action, threat, market rivalry, individual extortion, revenge, consequence of food adulteration and individual action of an insane person. The opportunity of intentional endangering through foodstuffs came into the limelight in the past one to 2 years. According to the standpoint of the Board, the government can/could decrease the threat of both the intentional and accidental infections by means of effective monitoring and surveillance systems. So an efficient food control network is required including the coordination between individual institutions. A unified management system is necessary. Lack of consistency, efficacy, unified interpretation and application of law is still a weakness. The efficient exclusion of manufacturers that cheat consumers and the exclusion of products that threaten consumer health – in the case of hazardous products, even more frequent – examination with appropriate number of samples would be necessary. The data, collected by different authorities, is not uniformly processed and analyzed even nowadays; therefore, the strategies are different, causing further difficulties.

Food legislation offers further opportunities such as geographical denominations and protection of designation of origin for the market and legal protection of certain foodstuffs. The system in the EU, especially in the Mediterranean (France, Spain, Italy) provides institutional protection for traditional foodstuffs

with registered place of origin, by the means of registration and limited denomination.

According to Brussels estimations [7], EU producers suffer billions of losses every year due to the illegal use of attractive geographical denominations in other parts of the world. Hungarian producers strive to achieve the system of origin protection to cover Gyula sausage, Szeged salami, Kalocsa pepper and many other foodstuffs, even those that are not certified, because these well-known products possess significant market value.

The Hungarian Food Code (Codex Alimentaruis Hungaricus), a special element of Hungarian food legislation enables this kind of protection for products listed in its second volume, which contains optional directives and recommendations. If manufacturers produce the aforementioned products, they have to comply with the prescribed quality parameters and technological steps. The Decree of the Food Act determines that products with nominations listed in the second volume of the Hungarian Food Code can only be produced and distributed as prescribed there. This protects the interest of consumers, since products with these nominations (e.g., Bologna sausage type meat product) have to be of the same composition and quality, valuable ingredients must not be substituted with cheaper components (e.g., meat with soybean) to a higher extent than it is regulated in the directives. Fair market competitors and control authorities regard the Hungarian Food Code as a standard for production and law courts might use it in their legal debates in the future too.

Chemists or Attorneys?

We can face larger and smaller food infection and poisoning cases – following the consumption of contaminated or deteriorated foodstuffs – day by day, but only a few of them become well-known nation-wide or reverberates in the press. Therefore, only a small number of food adulteration cases trigger national scandal.

In the past years wine and red pepper adulteration became widely known in Hungary. The ‘pepper enriched with lead’ and ‘plastic can wines’ directed customers’ attention to the fact of food adulteration that seriously threatens consumer health. Red pepper is one of the most typical elements of Hungarian cuisine. Foreign travelers described goulash soup flavored with pepper as ‘glowing embers’. National emotions directed public attention towards national customs and red pepper has become a typical Hungarian spice during the 19th century. The method of coloring inferior-quality red pepper with minium can be considered intentional poisoning. Minium, a paint with high lead content, increases heavy metal content of pepper one thousand times, causing chronic poisoning. This ‘pepper issue’ resulted in fierce debates in the parliament,

Table 4. Social and economic factors enabling adulteration of foodstuffs and misleading consumers

Switch-over from 'planned economy' to market economy
Rapid increase in the number of food manufacturers
Structural differentiation of food producers (predominance of micro and small-scale enterprises)
Deterioration of moral and ethical standards
Change of legislation (e.g., presentation, instead of product sheet authorization) due to harmonization of legislation to that of the EU
Lack of lawful behavior
Change of roles among the authorities (approval instead of direct authorization)
Lack of uniform interpretation of legislation at the authorities[1] (on organizational and regional basis at the place of production)
Lack of active civil consumer protection organizations (NGO)
Nonuniform judicial practice
Increase in the number of products in the market, thus intensification of market competition
Rapidly widening selection of imported foodstuffs
Development of technological procedures
Development and distribution of foodstuffs with new composition (e.g., fruit juices – more difficult identification)
Spread of enriched foodstuffs (vitamin and mineral products)
New adulteration techniques
Appearance of products of new origin – exotic products
Lack of continuous conversation between food manufacturers and control authorities
Development of analytical methods

[1]In the Hungarian food control system responsibility is shared. Food producers and distributors are controlled by the Veterinary and Food Control Stations – one in the capital and one in each county (19) – belonging to the Ministry of Agriculture and Rural Development; by the National Public Health and Medical Office Services – one in the capital and one in each county (19) – belonging to Ministry of Healthcare, Social and Family Affairs; by the General Inspectorate for Consumer Protection belonging to the Ministry of Economy and Transport and similar county-wide organizations belonging to the Ministry of Internal Affairs.

where pepper was declared as one of the five things coming to the mind of a foreigner when they think about Hungary [8]. Therefore public indignation concerning the issue is reasonable, as on the one hand it is for food adulteration, causing serious damage to consumer health. The past 15 years of political and economical transition increased consumers' opportunities and freedom of producers. Liberalization of trade in the Central- and East-European region and new regulations provided increasing opportunities for producers and merchants, which sometimes led to confused circumstances, offering ground for unfair manufacturers and distributors.

There are food producers who do not possess appropriate food safety systems or do not apply it properly. The lack of uniform interpretation of legislation and judicial practice leads to further difficulties. Differences in the law enforcement of certain authorities or regional organizations enable unfair market behavior. Consumers can be further misled because producers are more and more defenceless, due to the low accounting prices – that sometimes hardly even cover production costs – of influential hypermarket chains. This latter can lead to the use of cheap raw materials and the production of low-quality products (table 4).

Besides the adulteration of Hungarian pepper, we could face similar scandals: wine was mixed with antifreeze in Austria, production of cheap 'plastic can wines' in Hungary. Meanwhile the adulteration of pepper and wine primarily endangered consumer health, the adulteration of honey – followed by intense media coverage in the previous years – threatened consumers' interest. Hungarian food legislation prohibits the addition of foreign materials to honey. Warming honey in order to have a consistent texture, then selling blossom honey, for instance, as more valuable acacia honey, is considered to be misleading with intention or adulteration. Besides misleading consumers, their health is endangered as well, when hydroxymethyl furfural accumulates in poisoning amounts during exaggerated intake. Ignorance and unfair market behavior may seriously threaten consumer health. Thus misleading can lead to poisoning.

To prove food adulteration or intentional modification of composition, appropriate analytical methods and sufficient number of examinations are necessary. The appearance of new techniques (e.g., sous vide, genetically modified organisms), increases the risk of food safety and food adulteration and justifies more examinations. The case of genetically modified foodstuffs 'deserves' a distinct study. Food processors and consumers are more and more eager to know the origin and composition of the raw materials. From the middle of the 19th century, as chemistry developed, simple food adulteration cases could be investigated. In the case of new and more precise techniques, we need rapid methods that enable the analysis of a high number of samples in a short period of time with the highest possible sensitivity and accuracy. To imposes sanctions against unfair market behavior, we need judicial penalties that possess proper restraining force.

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Macro- and Micronutrients in a Traditional Greek Menu

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Abstract

Background/Aims: The traditional Mediterranean diet is frequently being considered as a prototype for dietary recommendations. We have investigated a weekly menu typical of the Greek variant of the Mediterranean diet to examine the compatibility with the nutritional recommendations of the Scientific Committee for Food of the European Commission, concerning macronutrients and certain micronutrients. **Methods:** A typical weekly traditional Greek Mediterranean menu was chemically analyzed and certain food constituents, like flavonoids were theoretically estimated. **Results:** The evaluated typical menu meets all the dietary recommendations for macronutrients. The daily energy intake is derived from dietary lipids (40.3%) and carbohydrates (41.4%). The ratio of α-tocopherol per gram of polyunsaturated fatty acids in the Mediterranean diet under investigation is around 0.4 mg, indicating a well-balanced diet. With respect to microcomponents, with existing recommendations of the Scientific Committee for Food of the European Commission, such as inorganic constituents, the investigated menu meets all the requirements. **Conclusion:** The diet that the Mediterranean populations developed many years ago, without any scientific input, appears to meet current dietary recommendations.

Introduction

The traditional Mediterranean diet is frequently being considered as a healthy diet [1–3]. Recently it was found that a diet that adheres to the principles of the traditional Mediterranean one is associated with a significant reduction in total mortality, even though no strong associations with mortality were evident for each of the individual components of this diet [3]. The health benefits of the Mediterranean diet cannot be attributed to a single component,

but are probably associated with a complex combination of favorable nutritional elements.

The composition of the Mediterranean diet and particularly the traditional Greek diet favors plant foods with antioxidant potential [4], which are considered to provide protection from coronary heart disease and cancer [5, 6]. The high phytochemical intake in conjunction with the sufficient intake of macronutrients and inorganic constituents may account for the health benefits observed in the Mediterranean basin.

We have analyzed a weekly menu typical of the dietary pattern of the Greek variant of the Mediterranean diet to examine whether it meets the nutritional recommendations developed by the Scientific Committee for Food of the European Commission.

Materials and Methods

A traditional weekly menu was developed based on the Greek dietary guidelines, which refer to the traditional Greek diet [7]. The pictorial presentation of these guidelines is presented as the traditional Mediterranean Pyramid (fig. 1). The weekly menu under investigation is given in table 1. The generated weekly menu refers to adults of both genders. The menu is compatible with the tradition, which has religious roots, of avoiding foods of animal origin every Wednesday and Friday. Portion sizes were defined according to Greek market regulations. The portion size of composite and primary foods refers to edible parts. Specification of the raw ingredients as well as detailed information on the preparation of recipes, salads and beverages are available [8].

After the preparation of each daily menu, all the weighed food portions (composite and primary foods) were homogenized forming a uniform mass, placed in a food bag and deep-frozen (−20°C). The homogenization procedure was performed using a household multimixer (Braun K600). Once all daily menus were prepared, the seven food bags (one for each day of the week), were defrosted, mixed and homogenized (Braun K600) forming the sample for analysis (weekly diet). This sample was then prepared for freeze-drying using a Martin Christ Alpha1–2, c/n 100200 freeze-dryer.

The liquid ingredients of the weekly menu (wine, coffee and tea) were not included with the solid ingredients in order to avoid dilution of the sample. They were mixed and kept separately, stored in deep freeze until distribution of the samples for analysis. Although the consumption of more than one liter of water per day is recommended, the water is not included in the liquid sample since its contribution to the nutrient content of the diet is negligible. The specific gravity of the liquid sample at room temperature was also determined.

Reference analytical methods for total diet samples do not exist. Any available method may be used provided that it is capable of providing reliable data at the required level of sensitivity. For the purpose of the current project, the following analytical methods were used for the determination of the macro- and micronutrients of the menu. The determination methods for nitrogen, fatty acids and inorganic constituents are accredited by the Hellenic Accreditation System S.A. (ESYD), while the determination methods for total lipids, dietary fiber and ash are accredited by the United Kingdom Accreditation Service.

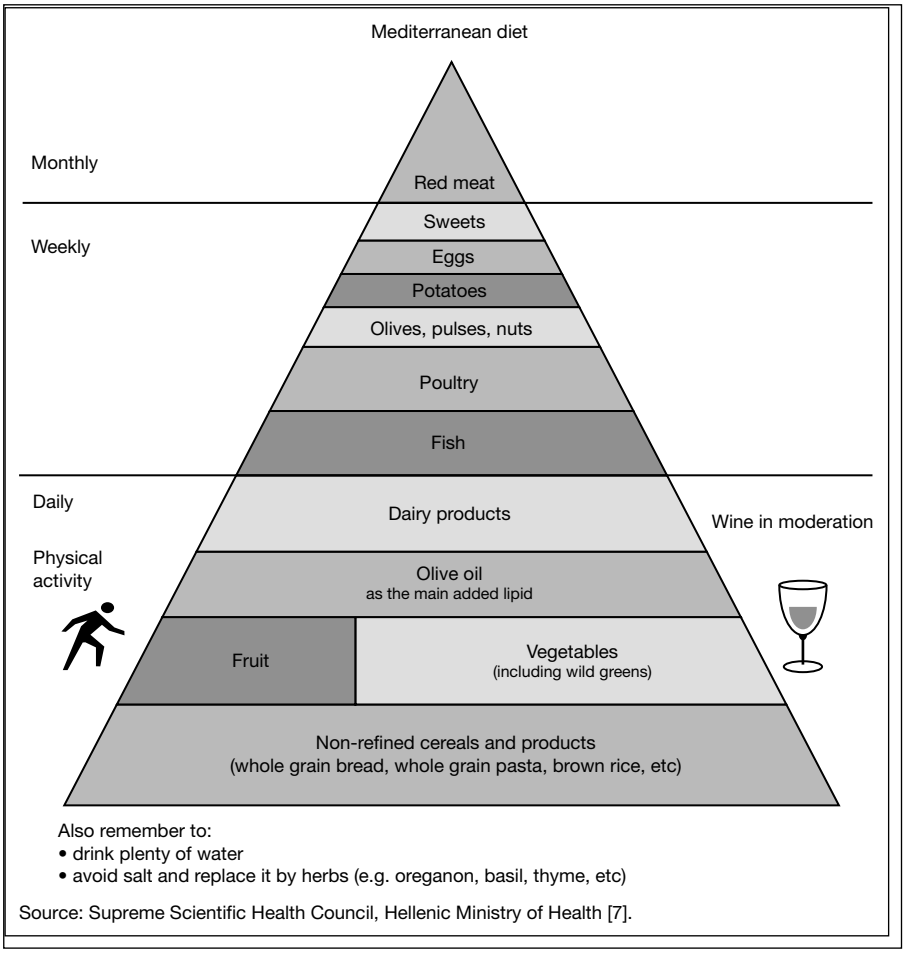

Fig. 1. The traditional Mediterranean diet pyramid depicting dietary guidelines for adults in Greece.

The moisture content of the solid sample was evaluated during the freeze-drying procedure by difference, while the moisture of the liquid sample was determined by the oven method. Carbohydrates were calculated 'by difference' through the equation: *Carbohydrate % = 100 – moisture % – lipids % – proteins % – ash % – dietary fiber % – ethanol %,* where ethanol was estimated. The values reported correspond to available carbohydrates. The energy value of the samples was calculated from the amount of protein, total lipids, available carbohydrates, dietary fiber and ethanol by the application of the general Atwater energy conversion factors 4–9-4–2-7, respectively [9].

The analytical methods performed were the following: *Nitrogen determination* – The determination of nitrogen was carried out using Kjeldahl-in house methodology based on the standard ISO/DIS 8968 –2 method [10]. Protein was calculated by using the standard nitrogen conversion factor of 6.25. *Lipid determination* – Total lipids of the samples were determined

Table 1. The Mediterranean menu under investigation

	Monday		Tuesday		Wednesday		Thursday		Friday		Saturday		Sunday	
	Food	Serve g	Food	Serve g	Food	Serve g	Food	Serve g	Food	Serve g	Food	Serve g	Food	Serve g
Breakfast	Herbal tea	165	Yogurt	200	Herbal tea	165	Herbal tea	165	Herbal tea	165	Herbal tea	165	Herbal tea	165
	Sugar	5	Honey	40	Sugar	5	Sugar	5	Sugar	5	Sugar	5	Sugar	5
	Feta	50			Black olives	30	Feta	50	Black olives	40	Feta	50	Feta	50
	Bread	60			Bread	60	Bread	60	Bread	60	Bread	60	Bread	60
Morning Snack	Grapes	150	Apple	160	Apple	160	Apple	160	Apple	160	Apple	160	Apple	160
Lunch	Green beans	250	Fried wet salted cod	150	Lentils with tomato	350	Chicken casserole	180	Eggplants casserole	250	Baked vegetables	250	Roast lamb	110
	Feta	50	Chicories salad	290	Green olives	40	Rice (pilaf)	150	Fish roe salad	50	Feta	50	Baked potatoes	150
	Bread	90	Bread	90	Bread	90	Bread	90	Bread	90	Bread	90	Bread	90
	Red wine	120	Red wine	120	Red wine	120	Red wine	120	Red wine	120	Red wine	120	Red wine	120
	Apple	160	Pear	160	Orange	200	Pear	160	Orange	200	Pear	160	Orange	200
					Lettuce salad	140	Mizithra	10					Lettuce salad	140
							Cabbage salad	120						

Afternoon Snack	Raisins	60	Olive oil cookies	40	Semolina cake (halvah)	65	Pasteli, sesame bar	30	Semolina cake (halvah)	65	Raisins	60	Olive oil cookies	40
	Greek coffee	86	Greek coffee	86	Greek coffee	86	Greek coffee	86	Greek coffee	86	Greek coffee	86	Greek coffee	86
	Sugar	6	Sugar	6	Sugar	6	Sugar	6	Sugar	6	Sugar	6	Sugar	6
Dinner	Cheese pie	150	Spinach rice	250	Potatoes casserole	250	Feta	50	Spinach pie	155	Fried potatoes	115	Chilopites (pasta)	250
	Greek salad	200	Feta	60	Lettuce salad	140	Greek salad	200	Greek salad	200	Greek salad	200	Cabbage salad	120
	Bread	90	Bread	90	Bread	90	Bread	90	Bread	90	Bread Fried egg	90 56	Bread Mizithra	45 10

by the Soxhlet method after acid hydrolysis based on The Feeding Stuffs (Sampling and Analysis) (Amendment) Regulations 1985 SI No. 1119 and BS4401: Part 4 1970. *Fatty acid determination* – The determination of fatty acids was carried out using capillary column gas chromatography-in house methodology based on the preparation of methyl esters of fatty acids: ISO 5509:1978 (E) [11] and the analysis of methyl esters of fatty acids: Regulation of European Community 2568/91 (Appendix XA-General Case) [12]. *Sterols determination*: The determination of sterols was carried out using capillary column gas chromatography, based on the Regulation of European Community 2568/91 (Appendix V) [13]. *Tocopherols determination*: High performance liquid chromatography was used [14, 15]. *Dietary fiber determination* – Dietary fiber content was determined by the AOAC procedure (985.29) [16]. *Ash determination*: The determination of ash was performed by the oven method, based on The Feeding Stuffs (Sampling and Analysis) Regulations 1982 and BS4401: Part 1 1998. *Inorganic constituents' determination*: The microwave-assisted acid hydrolysis and analysis of elements by inductively coupled plasma–atomic emission spectroscopy was used for the determination of inorganic constituents. This method is based on the EPA method 200.7 Revision 4.4 (1994) and applies to aqueous samples, but is also considered appropriate for food samples. *Total carotenoids determination*: The determination of total carotenoids was carried out using the spectrometry method based on the prEN12136: 1997 standard method [17].

All analyses of the composite food sample were carried out in duplicate. Moreover, nitrogen and fatty acid determination were externally validated through reference material used in quality control testing conducted by the Food Analysis Performance Assessment Scheme [FAPAS-Ministry of Agriculture, Fisheries and Foods (MAFF) of the United Kingdom] and the International Olive Oil Council, respectively.

Results

The daily intake of macro- and micronutrients of the traditional Greek menu are presented in table 2, derived from the analysis of samples, solids and liquids consumed within the week. The high intake of total lipids, in particular, monounsaturated fatty acids (MUFA) lipids is characteristic of Mediterranean diet as is the relative high intake of dietary fiber and several metals. The results of this study have been evaluated based on the relevant recommendations of the Scientific Committee for Food of the European Commission [18]. The recommendations are expressed per person per day, conceptually representing the average intake over a period of time, while the values are proposed for groups of healthy people (table 3). It is clear that the Mediterranean menu is fully compatible with recommendations of the Scientific Committee for Food of the European Commission.

The Mediterranean menu under investigation is based on an average daily energy intake; therefore, wherever recommendations were expressed separately for males and females, an averaged value was used. The energy requirement proposed by the Scientific Committee for Food of the European Commission [18] for adults (average) with desirable physical activity is 10 MJ/day. The daily

Table 2. Daily intake of macro- and micronutrients of the Mediterranean menu

Component	Daily intake
Protein	74.5 g
Total lipids	110.7 g
Dietary fiber	29.8 g
Carbohydrates	255.8 g
Ethanol	14 g
Energy value	2,473 kcal
Fatty acids:	
SFA	29.8 g
MUFA	63.8 g
PUFA	9.9 g
TFA	1.4 g
Total sterols	256.8 mg
Total carotenoids	65.7 mg
α-tocopherol	4.3 mg
Inorganic constituents	
K	1,774 mg
Fe	14.9 mg
Na	2,632 mg
Ca	696 mg
Mg	234 mg
Zn	10.3 mg
Cu	3.80 mg
Mn	3.51 mg

energy provided by the Mediterranean menu under investigation is 2,473 kcal/day or 10.4 MJ/day.

It is evident from table 2 that the energy of the Mediterranean menu can be attributed to the following components: proteins (12%), dietary lipids (40.3%), carbohydrates (41.4%), dietary fiber (2.4%), and ethanol (4%).

Discussion

The traditional diets of Mediterranean countries are based mainly on fruits, vegetables, fish and seafood, legumes, cereals and olive oil. In the Mediterranean menu under investigation, energy is isothermically provided by lipids and carbohydrates. Our results are in accordance with earlier findings that indicate that total lipids correspond to 40% of total energy intake in Greece [19].

Table 3. Daily intake of inorganic constituents of the Mediterranean menu and European Commission daily recommendations

Inorganic constituents	Daily intake	Recommendations*
K	1,774 mg	1,600 mg Lowest threshold intake
Fe	14.9 mg	14.4 mg Average requirement
Na	2,632 mg	575–3,500 mg Acceptable range
Ca	696 mg	550 mg Average requirement
Mg	234 mg	150–500 mg Acceptable range
Zn	10.3 mg	6.5 mg Average requirement
Cu	3.8 mg	0.8 mg Average requirement
Mn	3.5 mg	1–10 mg Acceptable range

*Source [18].

The distribution of lipid-generated daily energy of the menu is: saturated fatty acids (SFA; 10.8%), MUFA (23.2%), polyunsaturated fatty acids (PUFA; 3.6%) and trans fatty acids (TFA; 0.5%). The predominant added lipid in the Mediterranean menu is extra virgin olive oil. Consequently, the highest proportion of lipid-generated daily energy comes from monounsaturated fatty acids while the contribution from TFA is low.

Our results are compatible with the findings of the TRANSFAIR study [20], where SFA were found to provide on average between 10–19% of total energy intake, with the lowest contribution in Mediterranean countries. TFA intake ranged from 0.5–2.1% of energy intake. The TFA intake was again found lowest in Mediterranean countries. Moreover, in the Mediterranean countries more than half the intake of TFA is derived from milk and ruminant fat.

Certain PUFA (essential fatty acids) cannot be synthesized by the human body and must be supplied with the diet to avoid deficiency. It appears prudent, however, to avoid extremely high dietary intakes of PUFA because of potential untoward side effects of excessive consumption, such as lipid peroxidation, immunosuppression and bleeding. It is recommended that intakes of total PUFA should not exceed 15% of dietary energy [18]. In our study, PUFA intake corresponds to 3.6% of energy.

The PUFA requirements proposed by the Scientific Committee for Food of the European Commission [18] for adults (average) are: average requirement of 3.3 g/day and population reference intake (PRI) of 6.5 g/day. PRI is the intake that is enough for virtually all healthy people in a group. The daily PUFA intake of the traditional Greek menu under investigation is 9.9 g, which meets the lowest requirement and does not exceed the upper limit of 15% of energy.

With high dietary intakes of PUFA, it is essential to ensure that the intake of vitamin E is adequate because an increased intake of PUFA raises the need for vitamin E to prevent unwanted oxidation. Therefore a logical approach is to make dietary recommendations for vitamin E in terms of the dietary PUFA intake. There is, however, no general agreement about what the ratio in mg of α-tocopherol equivalents per gram of PUFA should be, but about 0.4 seems adequate in a normal diet [18]. The ratio in mg of α-tocopherol per gram of PUFA of the Mediterranean diet under investigation was exactly 0.4, indicating a well-balanced diet.

With respect to proteins, the physiological requirement of an individual is that the lowest level of dietary protein intake will balance the losses of nitrogen from the body in adults maintaining energy balance at modest levels of physical activity. The requirements proposed by the Scientific Committee for Food of the European Commission [18] for adults (average) are: average requirement 41 g/day and PRI 52 g/day. The daily protein intake of the traditional Greek menu under investigation is 74.5 g, consisting mainly of plant protein. This value meets the requirements set above. An intake value equal to or greater than the PRI indicates that every individual will almost certainly be provided for adequately. This high but not excessive protein value ensures sufficient amino acid requirements. Excessive animal protein intake may be associated with health risks, but the level of animal protein in the traditional Greek menu is far from excessive.

The Mediterranean menu under investigation meets all requirements with respect to inorganic constituents, as shown in table 3. Recommendations refer to average requirements or acceptable ranges, with the exception of potassium. For this element, the lowest threshold intake is indicated. Below this level, on the basis of current knowledge, all individuals may not be able to maintain metabolic integrity. The values proposed for iron are the intakes needed to cover the requirements based on a bioavailability of 15%. With respect to zinc intake, it is considered unwise to exceed a daily zinc intake of 30 mg in adults, while an upper limit of 10 mg/day is proposed for copper intake [18].

It is worth noting that, except for potassium which has a PRI of 3,100 mg/day, the Mediterranean menu meets the PRI of the other inorganic constituents such as calcium PRI: 700 mg/day, zinc PRI: 8 mg/day and copper PRI: 1.1 mg/day.

With respect to carotenoids there is as yet insufficient evidence to recommend the consumption of any specific amount of β-carotene, or carotenoids in

general, beyond what is needed to supply vitamin A. Until further findings emerge, the Scientific Committee for Food of the European Commission found it unwarranted to make any recommendation other than to encourage the consumption of vegetables and fruits. Sterols are considered to cause reductions in plasma cholesterol concentrations. Their habitual concentration in the daily diet amounts to 150–400 mg [21]. The daily intake through the Mediterranean menu under investigation is 257 mg/day.

In addition to the chemical analysis of the traditional Greek menu, a theoretical determination of the menu's flavonoid content was implemented using mainly the USDA [22] and VENUS [23] databases [24]. According to the calculations, the daily average flavonoid intake through this traditional Greek menu was 118.6 mg/day, of which flavanones contribute 32% (38.5 mg/day), catechins contribute 28% (32.7 mg/day), flavonols 22% (26.4 mg/day), anthocyanidins 9% (11 mg/day), flavones 8% (8.7 mg/day) and isoflavones contribute 1% (1.3 mg/day).

Oranges were found to be the main source of flavanones (98%), with the principal flavanone being hesperetin, the intake of which was assessed at 28.6 mg/day (74%). The daily average catechin intake was calculated at 32.7 mg/day. In the traditional Greek menu the main contributors to catechin intake were apples and red wine. The majority of the flavonol intake refers to quercetin (85%), which is considered the most widespread flavonoid, as it is present in over half the ingredients in the Mediterranean menu. The primary source of anthocyanidins was red wine, while the primary source of isoflavones was brown bread (94%). With respect to isoflavones, the calculated daily average intake is 1.3 mg/day. The majority of the flavone intake is derived from apigenin (77%). Common herbs of the Greek culinary culture such as parsley are a good source of apigenin. The major contributor to the total flavone intake is parsley (74%), followed by black olives (18%) [24]. Herbs such as parsley and dill, which are commonly used in traditional Greek dishes, although added in small quantities, significantly contribute to the overall flavonol and flavone intake because of frequent consumption. Typical Mediterranean foods such as olives and red wine also contribute substantially.

The above-presented data are merely indications of the flavonoid content of a typical plant-based Mediterranean menu since seasonal variation of diet as well as flavonoid concentration of foods could not be taken into account. Current estimates of flavonoid intakes vary considerably because food composition information with respect to flavonoids is incomplete [25]. However, in spite of the reservations involved in the theoretical determination, the indications show that the traditional Mediterranean diet has high flavonoid content. The inclusion of herbs and spices in the traditional Greek cuisine significantly contributes to the flavonoid content of the diet.

The nutritional value of the Mediterranean diet, and in particular, the traditional Greek diet, has been presented through the investigation of different typical traditional weekly menus [26], which demonstrates that the health benefits are not due to individual food items but to the traditional Mediterranean dietary pattern. Although the Mediterranean diet and lifestyle were shaped by climatic conditions, poverty and hardship, rather than by intellectual insight or wisdom, it seems as if some superior force lead the Mediterranean populations to a prudent diet by exploiting, to the utmost, the gifts that nature abundantly favored them with. The diet that the Mediterranean populations developed many years ago, without any scientific input, meets current dietary recommendations and is considered a diachronic, well-balanced, healthy diet.

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Vegetarian Diets: What Are the Advantages?

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Abstract

A growing body of scientific evidence indicates that wholesome vegetarian diets offer distinct advantages compared to diets containing meat and other foods of animal origin. The benefits arise from lower intakes of saturated fat, cholesterol and animal protein as well as higher intakes of complex carbohydrates, dietary fiber, magnesium, folic acid, vitamin C and E, carotenoids and other phytochemicals.

Since vegetarians consume widely divergent diets, a differentiation between various types of vegetarian diets is necessary. Indeed, many contradictions and misunderstandings concerning vegetarianism are due to scientific data from studies without this differentiation.

In the past, vegetarian diets have been described as being deficient in several nutrients including protein, iron, zinc, calcium, vitamin B_{12} and A, n-3 fatty acids and iodine. Numerous studies have demonstrated that the observed deficiencies are usually due to poor meal planning. Well-balanced vegetarian diets are appropriate for all stages of the life cycle, including children, adolescents, pregnant and lactating women, the elderly and competitive athletes. In most cases, vegetarian diets are beneficial in the prevention and treatment of certain diseases, such as cardiovascular disease, hypertension, diabetes, cancer, osteoporosis, renal disease and dementia, as well as diverticular disease, gallstones and rheumatoid arthritis.

The reasons for choosing a vegetarian diet often go beyond health and well-being and include among others economical, ecological and social concerns. The influences of these aspects of vegetarian diets are the subject of the new field of nutritional ecology that is concerned with sustainable life styles and human development.

Introductory Remarks

In the past, the key questions about vegetarian diets were about risks and dangers, that is, about its disadvantages rather than its advantages. Today,

Table 1. The major groups of vegetarians [1]

Classic vegetarians	New vegetarians*
Lacto-ovo-vegetarians	Low meat eaters
Lacto-vegetarians	Almost vegetarians
Ovo-vegetarians	Semi-vegetarians
Vegans	Pesco-vegetarians
Raw food eaters	Pollo-vegetarians
Fruitarians	Pudding-vegetarians

*With/without grain/milk products.

nutritionists realize that the time has come to point out the advantages of vegetarian diets or even the advantages of vegetarian lifestyles. The reason for this dramatic shift is due to an increasing number of publications with sound data on the subject that show advantages on several levels. These advantages are currently of interest not only to vegetarians and nutritionists, but also to law makers, politicians and society as a whole. An indication of this interest are the number of professional and lay journals dealing with vegetarian diets and the frequency with which this topic is presented on the front page of international magazines such as *Newsweek* and *Time*. That is, vegetarian diets have become an important issue.

Definitions

There are at least three major reasons why scientific data on vegetarian diets have not always been convincing in the past and even to this day:

Firstly, there is not one homogeneous group of vegetarians, but a wide variety of people eating mostly or exclusively foods of plant origin. Actually, vegetarians are a nightmare for scientists because of their different food patterns. The deviating eating habits of vegetarians explain part of the many controversial conclusions about the risks and benefits of vegetarian diets. The necessary differentiation in truly homogeneous groups was, and is, often lacking. The more important groups as quoted in the scientific literature show remarkable differences in their food preferences (table 1).

Secondly, there are a number of different reasons why people decide to be vegetarians and to follow a vegetarian lifestyle (table 2).

These reasons are determining factors for the food that vegetarians will actually eat. A person who eats plant food for health reasons will know that

Table 2. Reasons for a vegetarian life style [1]

Health	Religion
Performance	Ethics
Economical causes	Animal rights
Environmental issues	Cosmetics
Hygiene/Toxicology	Social influences
Often more than one reason	

foods of high nutrient density, such as whole-meal cereal products, legumes and nuts should be included in a wholesome vegetarian diet. Persons who are vegetarians for ethical reasons will omit foods of animal origin, but continue to eat what is left of the usual diet. This can lead to nutrient deficiencies.

Thirdly, the lifestyle of a vegetarian has to be taken into account. This is a rather individual matter, but it is known that alcohol consumption, cigarette smoking and physical activity are decisive factors for the well-being of a person. Allowing for these three influencing factors on the nutrition and health status of vegetarians will lead to reliable data and a solid basis to decide about the impact of vegetarian diets. In addition, there have been changes in the beliefs about the healthiness of meat in Western societies in the recent years [2].

Recommendations for Nutrient Intake

Before listing major findings of studies with vegetarians, some basic information will be helpful to understand the determining factors defining the requirements of nutrients for healthy people. Due to the worldwide prevalence of obesity, the recommendations for energy intake are equal to the average requirement of a population.

The recommendations for nutrient intakes, however, are two standard deviations above the average requirements of a population. This recommendation assures that 97.5% of a population receives enough nutrients. It also means that 97.5% of the people are actually oversupplied with nutrients, which is not seen as a problem, however. When calculating nutrient data from questionnaires used in population studies, an intake below the recommendation does not automatically mean a deficient supply; even with two or three standard deviations below the recommendation, the intake may be sufficient for a particular individual.

Another complicating factor is the difference in recommendations for the same nutrient in various countries. For example, the recommended dietary intake of vitamin B_{12}, often seen as the most critical vitamin for vegetarians, varies 10-fold (table 3).

Table 3. Recommendations for vitamin B_{12} intake*

Institution	Region	μg/day
D.A.CH	Central Europe	3
NRC/NAS	North America	2
WHO	worldwide	1
Victor Herbert		0.3

*For healthy adults.

This implies that a person with an intake of 1 μg of vitamin B_{12} per day is adequately supplied by WHO standards, grossly undersupplied by the D.A.CH reference value and oversupplied by the recommendation given by Victor Herbert.

In addition, the bioavailability of a nutrient needs to be considered. Our studies with vegetarians show that their average intake of 1.8 μg vitamin B_{12} in comparison to a 3-fold higher intake of meat eaters (5.6 μg) leads to plasma concentrations that are only one third lower than those of meat eaters [3].

Health Advantages of Vegetarian Diets

In recent years there have been a number of studies with vegetarians showing considerable benefits compared with nonvegetarian control groups on standard Western diets. The Oxford Vegetarian Study with 3,277 Western adults showed a body mass index of 22 for vegetarians versus 25 for the controls, a 10% lower serum cholesterol level and a reduced mortality from ischemic heart disease by 25%. The mortality rate ratios for vegetarians compared with nonvegetarians of different, but not all cancer sites, was significantly reduced. In addition, there was a reduced risk for constipation, diverticulosis, gallstones and appendicitis. The authors came to the conclusion that vegetarian diets could prevent 40,000 deaths from ischemic heart disease in Britain [4].

Studies with type 2 diabetics led Jenkins et al. [5] to the conclusion that whole grain cereals appear to reduce the risk of developing diabetes. The authors further expect that viscous fiber, soy plant sterols, nuts and plant proteins will have significant metabolic benefits in the treatment of diabetes.

In an extensive overview considering the major studies over the last years, Hu [6] evaluated the impact of plant foods on the prevention of cardiovascular diseases (CVD). He found that there is substantial evidence indicating that plant-based diets (whole grain, unsaturated fats, fruits and vegetables,

n-3 fatty acids) can play an important role in the prevention of CVD. On the basis of the data analyzed, he concludes that plant-based diets deserve more emphasis in dietary recommendations, especially since it is known that such diets have additional health benefits, including the prevention of other chronic diseases.

The health benefits of fruits and vegetables are amongst others due to additive and synergistic combinations of phytochemicals with antioxidant properties [7]. There is a strong position by professionals in nutrition that antioxidants are best acquired through whole food consumption and not in the form of food extracts or pills with isolated substances.

The Value of Whole Foods

The consumption of whole foods is important in vegetarian diets, but has not always been understood or was subject to misinterpretations. The idea behind the concept of whole food is that almost any kind of food processing leads to a destruction or loss of nutrients, with the exception of the preparation of fermented foods. Some examples will indicate the influence of food processing:

The milling of whole grains to white flour that dominates the flour market with about 80%, leads to a loss of minerals, vitamins, phytochemicals and dietary fibers between 75 and 95%. Whole grain products contain an almost ideal combination of nutrients to meet human needs, except for calcium and vitamin C.

The processing of potatoes to potato chips shows the dramatic increase in energy content due to the fat employed – which usually is not of high quality – and the decrease in nutrients (table 4).

Another example of the dramatic loss of beneficial ingredients in foods is the concentration of quercetin by processing of apples (table 5).

Even the much-praised nutrient conservation of frozen food has to be looked at very closely, since 20–30% of the nutrients are washed out by bleaching the products before deep-freezing. As long as the products are kept frozen the nutrients are preserved rather well. When heating frozen food, certain additional nutrient losses do occur.

Critical Nutrients for Vegetarians

In addition to vitamin B_{12}, iron is considered to be a critical nutrient for vegetarians. This view is supported by the finding that there are foods or their

Table 4. The nutrient changes in processing potatoes (per 100 g)

	Potatoes boiled in its skin	Potato chips
Energy, kcal	70	540
Fat, g	0.1	40
Vitamin C, mg	14	7
Mineral content, %	100	60
Salt content	Very low	Very high
Costs per unit	Low	High

Table 5. Quercetin loss by processing apples

	Quercetin, mg/kg
Apple	150
Apple peelings	145
Apple juice	<5

Table 6. Food components that influence the absorption of nonheme iron, if consumed concurrently [8]

Enhancers	Inhibitors
Meat	Phytic acid
Poultry	Polyphenols (coffee)
Fish	Tannins (tea)
Ascorbic acid	Soy protein
Retinol	Egg
Carotenes	Ca and P salts
Acetic acid	Antacids

components that enhance iron absorption, which are mostly foods of animal origin, and there are foods that inhibit iron absorption, which are mainly foods of plant origin (table 6) [8].

The data in the scientific literature does not indicate that the reduced bioavailability of iron has any functional consequences in Western countries with varied and abundant food supplies. Vegetarians tend to have lower iron stores than omnivores, but they appear to have no greater incidence of iron deficiency anemia. The effectiveness of iron supplementation of vegetarian diets has not been demonstrated. On the contrary, possible competitive

Table 7. Homocysteine, cobalamin and folate status in German vegans [14]

		Strict vegans (n = 86)	Moderate vegans (n = 45)
Homocysteine, umol	♂	11.2	10.3
	♀	17.3	14.3
Cobalamin, pmol/l	♂	138	199
	♀	113	151
Folate, nmol/l	♂	36	36
	♀	33	30
Inadequate cobalamin status: 28% Hyperhomocysteinemia: 38%			

interactions between minerals should be considered [9]. Even though several billion people worldwide are iron deficient, vegetarians in Western countries are no more affected than meat eaters. Vegans show either no significant differences in the prevalence of low iron status to omnivores [10], or a higher rate of iron deficiency than meat eaters [11]. But it is well known that many meat eaters are oversupplied with iron, increasing the risk of CVD and cancer.

In recent years, homocysteine has emerged as an independent risk factor of CVD [12]. Several studies show that vegetarians [13], especially female vegans [14] do have elevated plasma homocysteine values. Although 38% of the vegans showed hyperhomocysteinemia, no clinical signs were observed in the participants of the studies. The authors came to the conclusion that the cobalamin status of strict, especially female, vegans needs to be improved in order to minimize the risk of hyperhomocysteinemia. In addition to homocysteine, the plasma concentrations of folate and cobalamin were measured. As expected, the vegetarians and vegans had somewhat higher folate values than the controls, since food of plant origin is a good source of folate.

The plasma concentrations of vitamin B_{12} were also determined. Lacto-vegetarian nuns had a plasma concentration only one half of the controls [13] and the vegans showed even lower values [14]. Again, the plasma concentrations of female vegans were lower than that of male vegans. In the vegan study, the participants were divided into strict vegans and moderate vegans (minimal amounts of milk in coffee or tea and minute amounts of eggs in mayonnaises and sauces). The differences in plasma cobalamin values were pronounced (table 7).

Table 8. Accompanying substances of animal and plant foods [16]

Animal foods	Plant foods
Saturated fatty acids	Unsaturated fatty acids
Cholesterol	Dietary fibers
Purines	Phytochemicals
Salt, phosphate etc.	Water

Life Expectancy of Vegetarians

The question whether vegetarians live longer than meat eaters do is of interest. Since there are only few data, the answer is not very robust. A comparison to the animal kingdom shows that some typical plant eaters (e.g., turtles, elephants) are not only stronger and more endurant, but also have a longer lifespan than some typical meat eaters (e.g., cats, dogs), which are quicker and more dangerous. However, the data with vegetarians are not consistent. In a review of the subject, it is concluded that current data from prospective cohort studies of adults raise the possibility that a very low meat intake is associated with greater longevity. An adherence to a vegetarian diet of over two decades contributed to a significant increase in life expectancy of 3.6 years [15].

Considering that many vegetarians chose this diet for health reasons, it is noteworthy that they do live as long as meat eaters. The fact that long-term vegetarians live even longer is remarkable. To assess the true impact of vegetarian diets on life expectancy, a differentiation between lifelong vegetarians and those that started the vegetarian diet for health reasons has to be made.

Advantages of Plant Foods

A distinct advantage of plant foods in comparison with foods of animal origin are the substances that are either considered more favorable or less favorable for a sedentary society (table 8) [16].

Vegetarian Lifestyle and Nutrition Ecology

Many vegetarians prefer a vegetarian or vegan diet not only for health reasons, but also follow a vegetarian lifestyle. This includes abstinence or moderation in the consumption of alcohol, other stimulating substances including nicotine and participating in regular physical activities. The question can be

Table 9. Position statement of the ADA and DoC [17]

- Appropriately planned vegetarian diets are healthful, **nutritionally adequate**, and provide health benefits in the prevention of certain diseases.
- Well-planned vegan or other types of vegetarian diets are appropriate of **all stages of the life cycle**, including during pregnancy, lactation, infancy, childhood and adolescense.
- Vegetarian diets offer a number of **nutritional benefits**, including lower levels of saturated fat, cholesterol and animal protein as well as higher levels of carbohydrates, dietary fiber, magnesium, potassium, folate and antioxidants such as vitamins C and E and phytochemicals.

Table 10. Vegetarian diets and the prevention and treatment of diseases [17]

Obesity	Renal disease
Cardiovascular disease	Dementia
Hypertension	Diverticular disease
Diabetes	Gallstones
Cancer (colon, prostate)	Rheumatoid arthritis
Osteoporosis	Appendicitis

asked whether it is the vegetarian lifestyle rather than the vegetarian diet that accounts for the health benefits. There is much agreement that all these factors have an influence, but also that the vegetarian diet has the greatest effect.

In addition, the vegetarian lifestyle in many cases includes ecological, social (ethical, moral, philosophical) and economical concerns. The new discipline of *nutritional ecology* deals with the local and global consequences of food production, trade, processing, transportation and consumption. It takes this holistic approach with the goal of a sustainable development. This implies that current global needs should be fulfilled without diminishing the possibility of future generations to meet their own needs.

Concluding Remarks

The advantages of vegetarian lifestyles have been recognized by a number of professional organizations. This recognition has led to position statements, for example, by the American Dietetic Association and the Dieticians of Canada. The position statement is shown in table 9 [17].

The position statement affirms that vegetarian diets are beneficial in the prevention and treatment of a number of widespread diseases (table 10) [17].

The current database of vegetarian studies convincingly show that plant-based diets have numerous health benefits, including the prevention and therapy of many chronic diseases. Since vegetarian diets are sustainable in terms of environmental and economical concerns, they deserve more emphasis in dietary recommendations [16].

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Food Safety and Consumers' Attitude in a New EU Member State

A Case Study of Hungary

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Abstract

Food safety problems are gaining importance throughout Europe. National food safety strategies are required and in the center of these strategies are consumers. The aim of our study was to analyse the behavior of Hungarian consumers and their food safety-related knowledge based on cluster analysis of principal component scores. We have identified five clusters: 'uncertain curios', 'optimistic technocrats', 'indifferent', 'distrustful' and 'incoherent' consumers. The name of each group is reflecting the most characteristic feature of the cluster. Furthermore, their socio-economic and educational background was dominant, as well. Consequently, our most important aim should be to strengthen the efficiency of risk communication towards consumers relating to food safety issues if we want to preserve their fragile confidence.

Introduction

During the last ten years, the number of publications on food safety has increased rapidly, but the overwhelming majority of these studies analyzed the consumer behavior mainly in the developed countries [1–3]. However, in the Central and Eastern European countries, the food safety problem is gaining importance too. This can be attributed on one hand to the general problems of food systems (e.g., increasing import and complexity of the food chain, risk of innovations and novel technologies) of the developed countries, on the other hand to the transition from the centrally planned economic system to market economy, based on private ownership (e.g., fragmented agricultural production, increasing number of small- and middle scale retail outlets).

Under these conditions, the formation of a long-range, complex and coherent national food safety strategy is a question of essential importance for Hungary. This strategy should be built on a sound knowledge of the current situation. Our knowledge on consumer values and attitudes regarding food safety is especially limited, as opposed to food production and trade, where the regular inspection of the competent governmental authorities gives the possibility to the decision makers to have a general overview of the actual situation. The aim of this study is to summarize the results of a direct-question survey aiming to map out food consumer values, attitudes and behavior in the field of food safety.

Methods and Procedure

Focus group interviewing was the method used to study consumer experience regarding the safety of foodstuffs. Topics were selected in advance but actual questions were not precisely specified. Based on the results of the interviews, we developed multi-item scales, following standard psychometric scale development procedures. To determine the attitude system of consumers, we have utilized Likert-type interval scales. In general, for these surveys, 1–7 scales are preferred but in Hungary from elementary school to universities, the 1–5 scales are in use (5-excellent… 1-unsatisfactory). For this reason the questions about attitudes were scored on a five-point Likert scale, with options as follows: 5 strongly agree, 4 basically agree, 3 uncertain, 2 rather disagree, 1 strongly disagree.

The survey was based on the analysis of more than 600 questionnaires. The sample was representative from the gender point of view. In our sample people with higher qualification and village dwellers as well as the younger respondents were over-represented. This is not a practical problem for the interpretation of the results because the relatively younger, highly qualified respondents can be considered as trend-setters. The knowledge gained on their way of thinking shed light on the future attitude system and consumer behavior of Hungarian consumers as a whole. The statistical analysis was accomplished by the SPSS 11.5 integrated statistical software. The significant differences between groups investigated were analyzed by Schaffé test [4].

It is well known, that factor analysis attempts to identify underlying variables or factors that explain the pattern of correlations within a set of observed variables, but the utilization of the factor analysis for quantities, determined on an interval scale is rather biased. The categorical principal component analysis procedure simultaneously quantifies categorical variables while reducing the dimensionality of the data. Like in the case of the classical factor analysis, there is a possibility to determine the component scores for each respondent. Based on the score-values, city-block method of cluster analysis, based on Euclidean-distance measure was used. The quasi-optimal number of principal components and factors has been determined by heuristic methods, based on the experts' opinion.

Table 1. The attitudes of food consumers to the food safety-related statements, determined on a 1–5 point Likert-type attitude scale in decreasing order of average values

Statement	Average	Standard deviation
If the health of others depends on you (e.g., you have children) you must do all in your capacity to supply them with safe food.	4.839	0.512
It is very important for the consumers to be continuously informed on food safety issues.	4.559	0.785
I want to know more on how to defend myself and my family against food-borne diseases.	4.358	0.897
One has to pay special attention to food-borne risks.	3.948	1.070
I am ready to pay more if I can get a serious guarantee of the safety of the food product.	3.840	1.270
Food quality and safety has increased as a result of technical progress and the improvement of food-processing technologies.	3.817	1.038
The globalization of the food trade threatens food safety. The safety of imported food products is lower.	3.761	1.182
The consumers do get so much, sometimes contradictory, information on food safety that average consumers hardly get their bearings.	3.597	1.294
Food consumption is a dangerous thing with its own threats. One should not care too much about this problem.	3.568	1.288
Food products in the Hungarian trade are safe and do not mean any threat to consumers.	3.460	0.879
Food safety in Hungary is well regulated and guaranteed by severe government control.	3.408	1.098
The main cause of food-borne diseases is the carelessness of the consumers.	3.285	1.253
The import of foreign products increases the danger of food-borne diseases. One has to buy food with great caution.	3.239	1.231
In the era of our parents and grandparents food was much safer. The modern industrialized food production is more hazardous.	3.016	1.388
Hungarian consumers have access to a wide range of reliable pieces of information on food safety.	2.969	1.037
The quality of Hungarian food products has increased as a result of foreign direct investments into the Hungarian food industry.	2.936	1.072
In accordance to the opinion of my relatives and acquaintances, I am too meticulous on food safety-related questions.	2.604	1.291
In the era of our parents and grandparents, the food safety issue got much less emphasis, but they were in a good health condition. This is an overemphasized topic nowadays.	2.514	1.311
I have no time and energy to pay special attention to when and what I eat.	2.484	1.319
I have many more important problems in my life. I do not worry about the food safety problem.	2.157	1.258
This food safety issue is the problem of yawning housewives.	1.636	1.076

Results and Discussion

In the first phase of our investigation, we have determined consumers' attitudes regarding food safety (table 1) in general.

From the analysis of the results of the attitude system of Hungarian consumers regarding food safety, it is obvious that the overwhelming majority of consumers consider food safety as a problem of primary importance. The 'provocative' statements such as, the negligence of the food safety problem, were denied practically. Although consumers in the information era are overburdened by different sources of information, the majority of respondents – according to their self-evaluation – were ready to get more knowledge on food safety-related problems. This fact emphasizes that even the 'average' consumers are unsatisfied with the often superficial, contradictory pieces of information.

Results of investigations on consumer behavior in the developed countries emphasize the importance of food safety, as a major attribute in the consumer decision-making process. In Hungary, as a consequence of the considerable income differences and the relative low level of income, the acceptance of the statement relating to the willingness to pay more for the safe product was rather low, but with a high level of standard deviation. The respondents in general were rather unsatisfied with the safety of the Hungarian products and were skeptical about the reliability of the food safety system.

Analyzing the differences of acceptance of the statements regarding the food safety issue, it is obvious that the women respondents were much more sensitive to food safety and food-borne risks than men. This is in harmony with the results of other investigations, analyzing the general attitudes to risk between men and women [5, 6]. Contrary to our preliminary expectations, the older respondents did not accept the nostalgic statements on the food safety topic. The results of ANOVA analysis emphasize that they are willing and able to get more information on the food safety problem. This group of consumers has higher confidence in the Hungarian food safety system.

There were considerable differences in the level of acceptance of different statements according to the qualification of respondents. For those consumers with lower qualification, it is much more difficult to orientate themselves in the flow of information than for the more qualified consumers.

The analysis of the averages of scores hides considerable differences between the different groups of respondents according to socio-economic brackets and that is why as a next step, the results of the attitude-questions have been analyzed by the analysis of variance. Based on the categorical principal component analysis, it was possible to determine the stochastic relations between the different groups of statements (table 2). The principal component analysis has been proven as an efficient tool to detect the hidden

Table 2. Results of principal component analysis

Statement	Dimension					
	1	2	3	4	5	6
Food products in the Hungarian trade are safe and do not mean any threat to consumers.	0.136	**0.572**	0.142	−0.296	0.013	−0.009
The import of foreign products increases the danger of food-borne diseases. One has to buy food with great precaution.	0.034	0.110	−0.032	0.104	**0.645**	0.021
Food quality and safety have increased as a result of technical progress and the improvement of food-processing technologies.	0.057	**0.666**	0.162	0.011	−0.077	−0.183
The main cause of food-borne diseases is the carelessness of the consumers.	0.134	−0.056	0.249	0.236	0.342	0.188
The consumers do get so much, sometimes contradictory information on food safety that average consumers hardly get their bearings.	0.050	−0.114	0.063	−0.012	0.410	**0.591**
Food safety in Hungary is well regulated and guaranteed by severe government control.	−0.115	**0.729**	−0.125	0.058	0.157	0.119
If the health of others depends on you (e.g., you have children) you must do all in your capacity to supply them with safe food.	−0.138	0.116	**0.748**	−0.148	0.065	0.053
It is very important for the consumers to be continuously informed on food safety issues.	−0.087	−0.021	**0.767**	0.175	−0.029	−0.048
Hungarian consumers have access to a wide range of reliable pieces of information on food safety.	−0.023	**0.646**	−0.055	0.160	−0.054	0.026
Food consumption is a dangerous thing with its own threats. One should not care too much about this problem.	0.207	0.148	−0.038	−0.027	−0.088	**0.715**
The quality of Hungarian food products has increased as a result of foreign direct investments into the Hungarian food industry.	0.120	0.506	−0.026	0.108	−0.321	0.316

Table 2. (continued)

Statement	Dimension					
	1	2	3	4	5	6
I have no time and energy to pay special attention to when and what I eat.	**0.815**	−0.032	0.072	0.024	−0.037	0.095
I have many more important problems in my life. I do not worry about the food safety problem.	**0.839**	0.038	−0.093	−0.086	−0.081	0.076
One has to pay special attention to food-borne risks.	−0.190	0.022	0.447	0.497	0.192	−0.082
I want to know more on how to defend myself and my family against food-borne diseases.	−0.219	−0.042	**0.508**	0.468	0.198	0.022
In the era of our parents and grandparents, the food safety issue got much less emphasis, but they were in a good health condition. This is an overemphasized topic nowadays.	**0.598**	0.076	−0.171	−0.210	0.198	0.103
This food safety issue is the problem of yawning housewives.	**0.610**	0.012	−0.321	−0.016	0.096	0.061
I am ready to pay more if I can get a serious guarantee of the safety of the food product.	−0.232	0.032	0.094	**0.708**	−0.041	0.261
In accordance to the opinion of my relatives and acquaintances, I am too meticulous on food safety-related questions.	0.091	0.106	−0.040	**0.772**	0.100	−0.181
In the era of our parents and grandparents, food was much safer. The modern industrialized food production is more hazardous.	0.208	−0.270	−0.071	0.097	0.473	0.322
The globalization of the food trade threatens food safety. The safety of imported food products is lower.	−0.058	−0.064	0.133	−0.022	**0.722**	−0.065

Table 3. Typology of Hungarian food consumers – the five clusters

	Fantasy-names of different segments				
	Uncertain curious	Optimistic technocrat	Indifferent	Distrustful curious	Conservative cautious
Typical respondent of the cluster	Middle-aged respondent, who is living in a middle-scale country town. Her/his highest qualification is secondary school. Her/his qualification or work is not in the food chain.	Food industrial specialist with college or university degree.	Young respondent living in the capital having no children yet. Higher qualification or work not in the food chain.	Elder small town or village resident, with college or university qualification not in the food production. Or town dweller with small children.	Respondent at least accomplished high school, elder (45+), living in small town or village, with an above averag income level.
The safest sources of food procurement	Self-produced fruits and vegetables (4.11); meat of self-fattened animals (3.97); bio-market, bio-shop (3.92).	Self-produced fruits and vegetables (4.15); expensive restaurants (4.08); super- and hypermarkets (3.85).	Self-produced fruits and vegetables (3.90); expensive restaurants (3.87); super- and hypermarkets (3.68).	Self-grown fruits and vegetables (4.37); meat of self-fattened animals (4.02); bio market, bio-shop (3.80).	High-level restaurant (4.14); bio-market, bio-shop (4.05); self-grown fruit or vegetable (4.00).
The most risky sources of food	Salad-bar, (2.94); moving vendor (2.45); street corner snack bar (2.17).	Agricultural producer on the market (2.64); moving vendor (2.10); street corner snack bar (1.86).	Exotic restaurants (2.87); moving vendor (2.27); street corner snack bar (2.17).	Exotic restaurants (2.78); moving vendor (2.11); street corner snack bar (1.88).	Salad-bar, (2.83); street corner snack bar (2.28); moving vendor (1. 88).
The most important food product attributes	Shelf life (4.57); price (4.42); organoleptic value (4.41).	Shelf life (4.84); readability of food label (4.65); organoleptic value (4.57).	Price (4.29); shelf life (4.15); price (4.12).	Shelf life (4.79); price (4.35); readability of the food label (4.32).	Shelf life (4.79); price (4.44); readability of the food label (4.36).

Table 3. (continued)

	Fantasy-names of different segments				
	Uncertain curious	Optimistic technocrat	Indifferent	Distrustful curious	Conservative cautious
The less important food-related attributes	Bioproduct (3.20); energy content (3.18); TV promotion (2.48).	Brand name (3.27); bio product (3.17); TV promotion (2.32).	Aesthetic packaging (3.32); bioproduct (2.95); TV promotion (2.80).	Aesthetic packaging (2.93); brand name (2.78); TV promotion (1.99).	Energy content (3.27); aesthetic packaging (3.19); TV promotion (2.50).
Attitude to food labels	Each ingredient should be indicated even when they are not understandable to the consumers.	Each ingredient should be indicated; this is not confusing to the consumer.	The indication of the ingredients has not much importance, but they do not disturb consumers.	Each ingredient should be indicated; this is not confusing to the consumer; shelf life.	The indication of each ingredient is of primary importance. For him/her the information dumping is not disturbing.
The most important food-related risks	Chemical residues from environmental production (4.52); agro-chemical residues (4.42); mildew and mycotoxins (4.23).	Chemical residues from environmental production (4.69); mildew and mycotoxins (4.55); microorganisms (4.46).	Agro-chemical residues (4.25); chemical residuals from environmental production (4.17); residuals of natural toxicants (4.15).	Agro-chemical residues (4.78); antibiotic residues in meat or milk (4.17).	Chemical residues from environmental production (4.79); mildew and mycotoxins (4.68).
Main sources of food safety-related knowledge	TV (3.52); domestic experiences (3.30).	University, college studies (3.75); social life (3.00).	Domestic experiences (3.50); TV (3.38).	Social life (3.70); studies in the secondary schools (3.40).	University, college studies (3.40); domestic experiences (3.32).

relations between different attributes relating to food safety. For the first dimension the highest factor loadings are associated with the statements about the playing down of the food safety problems. This fact emphasizes that the estimation of the importance of food safety is a basic dividing line in the separation of statements. For the second dimension the most important components are associated with the statements regarding the confidence in the safety of Hungarian foodstuffs and the reliability of the food safety system. Statements having high loading in the third dimension are that of the personal responsibility of consumers. The fourth dimension emphasizes the importance of consumers' willingness to pay higher price for high-quality products. In the fifth dimension the risk of imported products, in the sixth one the statements regarding the risk-perception have the highest values of loadings.

Based on the cluster analysis of principal component scores, we were able to form relatively homogenous **clusters of respondents** (table 3). A summarizing name has been given to the different clusters mirroring the most important characteristic feature(s) of the given cluster of consumers. From analyzing the table it is obvious that there are considerable differences between the five separated segments. Based on these differences there is a possibility to formulate a **differentiated communication strategy** with the purpose of increasing or upgrading the food safety-related knowledge of consumers.

A high proportion (40%) of consumers can be grouped into the category of **'uncertain curious'** consumers. They are 'amateurs' in the field of agricultural production and food processing. But in most cases they are the decision makers when purchasing food for the family. They are lost in the 'ocean of information' on food safety-related problems, but they are open to any new piece of information. The **'optimistic technocrats'** are consumers with a sound background on food-related activities. They have a solid knowledge and can play a role as opinion leaders, but their share in the sample was not more than 2.5%. The members of the **'indifferent'** consumer group are extremely vulnerable because they underestimate the importance of food safety. The traditional sources of mass communication are not suitable to reach these consumers because they neither read 'serious' newspapers nor watch state-sponsored TV channels. The utilization of new channels of information via Internet or indirect ways of communication (e.g., via 'soap-operas') can be useful tools for the formation of opinion of this consumer segment. This is a strategic question because the share of this segment is more than 15%. The '**distrustful**' consumers (17%) accept the opinion of the authorities, which is why independent scientists can be very important sources of information for them. The **'conservative'** consumers are rather reluctant to accept the application

of novel food technologies, but they highly esteem the traditional products and technologies. For them this should be emphasized in the communication. Their proportion is high (25%) in the sample, but their importance is decreasing in the long term.

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Making the Healthy Choice an Easy Choice

From Nutrition Science to Consumer Action

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The WHO strategy to address the increasing global prevalence of non-communicable diseases has been much debated in various stakeholder groups. Their 'wake-up call' has stirred the private sector to review their positions and to seek ways on how to steer towards a strategy compatible with public health. It is the WHO stance that the various parties should recognize their responsibilities. Indeed, the alarming statistics on overweight and obesity and the impact this has on global health is of great concern. The question is what has to be done by whom to curb this negative health trend. Clearly, the issue is complex but requires simple solutions. The WHO calls for 'innovative partnerships' but who are the partners and what are they expected to deliver?

The *consumer* is at the heart of the problem. Being well aware of the health impact of e.g. fruits and vegetables, fat, and alcohol the consumer is unable to practice his knowledge and despite good intentions and concerns about lifestyle consumer behavior is still rather poor. If we wish the consumer to take appropriate responsibility for their actions then they have to be given the means to gather the necessary knowledge on healthy eating and to put it into practice by means which are simple, understandable and above all easy to adopt.

The *food industry* today is increasingly focussed on the societal aspects of the health issues related to overweight and obesity. Consequently, many have chosen to become part of the solution and are making nutrition and health an integral part of their strategy. This is reflected in their efforts in providing healthier options, their moves towards informative labeling as well as responsible marketing practices that enable the consumer to make informed choices.

The key challenge for the food industry today is to combine health and nutrition with taste, convenience and enjoyment to bring to market 'better for you' options, which are attractive to the consumer.

Governments have a variety of instruments available through information, education and regulation and are in ideal position to take a leadership position. However, in contrast to the rightfully strong actions taken to discourage smoking, many authorities do not have improved dietary behavior and physical exercise high on the agenda. It would be prudent both on a European and national level to create a social and regulatory environment, which facilitates consumers to adopt a healthier lifestyle.

Academia have an important contribution to make through resolving the complex relationship between diet and health. Their focus should be on diet-health hypotheses and plausibility of nutrient benefits. The scientific advances together with the identification of novel ingredients should provide the stimulus for new product formats that meet consumer needs and requirements for health.

The strategic options to combat the public health issues we are facing today require innovative partnerships and genuine commitment of all involved. Only in this way we might be able to effectively respond to the challenges facing us. All partners need to provide the necessary means to put consumer interest in diet, health and well-being into effective action.

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Diversification and Food Choice: The Consumer's View

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Changes in dietary and lifestyle patterns have been identified as contributing to the prevalence of chronic diseases, such as obesity, diabetes mellitus type 2, cardiovascular disease (CVD), hypertension and stroke, and various forms of cancer, which are of increasing concern to society.

Consumers recognize the connection between their lifestyle and health and they are increasingly looking for preferred food choices for their everyday health and well-being. Furthermore, advances in nutrition sciences and technology lead to new insights into the effects of food ingredients on physiological functions and consequently generate interest among science experts, health professionals and consumers.

Therefore, consumers are more than ever interested in the origin, features, characteristics, quality and nutritional properties of the food they purchase. For many products labeling has become the only tool to get this information. This shows the need to provide for more and better information by means of labeling and by other means where this would be appropriate.

Consequently, comprehensive labeling is more necessary than ever, as the nature of food production becomes increasingly complex.

However, the label can only play an educating role towards the consumer if the basic understanding is right. Consumers therefore need clear, accurate and meaningful information about the nutritional content of their diet and must be able to judge the information. Claims made on food must correspond with the truth.

Firstly, the label must provide information to make informed choices, and secondly, labels may never have the potential to mislead consumers.

The perception and interpretation of labels differs depending on consumers' demographic characteristics, such as age, sex or education, as well as their psychological characteristics, such as knowledge, experiences or beliefs.

Unfortunately, the educational status of European population with regard to diet and nutrition is sometimes rather poor.

Education should therefore start as early as possible. Nutritional experiences are gained in early life and transferred to dietary habits in later life. It is therefore important to carry out educational work with and for young children in order to give them, at an early stage, the taste for ‘eating well’.

The development and funding of a research agenda focusing on behavioral determinants of poor dietary patterns, including the impact of marketing practices is important to contribute to improving health and diet and should be promoted.

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