

# THE NUTRITION REPORT

**2000**  
**SUMMARY**

**GERMAN NUTRITION SOCIETY**





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**Summary**

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## Introduction

The government of the Federal Republic of Germany commissioned the German Nutrition Society (DGE) in 1968 to prepare a report concerning the nutritional status of the German population. This Nutrition Report was well received when it was submitted in June of 1969 because for the first time it provided an overview of a wide range of data that was available about nutrition in Germany. As a result the government decided to commission the DGE to prepare a comparable report every 4 years.

In addition to an analysis of the nutrition situation in the Federal Republic of Germany the Reports of 1972, 1976, 1980, 1984, 1988, 1992 and 1996 contained reviews of important aspects covering current science of nutrition. The following topics were dealt with in 1972:

- Nutrition habits in the Federal Republic of Germany
- The importance of processed food in nutrition
- Changes in food quality during storage, processing and packaging
- Nutrition education in schools
- Nutrition science and nutrition research.

In 1976 detailed information was presented on aspects of:

- Hygienic-toxicological and microbiological aspects of nutrition
- Problems of large scale food preparation and delivery
- The influence of advertisement on nutrition behaviour.

The 1980 Nutrition Report discussed:

- Nutrition behaviour
- Eating away from home
- Relationships between nutrition research and health policy.

The Nutrition Report 1984 dealt with the following topics:

- Development of the nutritional situation in the Federal Republic of Germany
- Chemical-toxicological and hygienic-microbiological aspects of nutrition
- Psychosocial evaluation of nutrition in families with children
- The development of demand for foodstuff in the Federal Republic of Germany
- Critical evaluation of alternative diets.

The 1988 Nutrition Report discussed:

- Development of the nutritional situation in the Federal Republic of Germany
- Toxicological and microbiological aspects of nutrition
- Documentation Chernobyl
- Food allergies and food intolerance reactions
- Influence on nutritional habits by federal measures
- Influences of food intake by man
- Meals eaten outside the home
- Recommendations for covering the nutrient and food energy requirements
- Research in nutrition in the Federal Republic of Germany.

The 1992 Nutrition Report presented 6 chapters:

- The development of the nutritional situation in Germany
- Toxicological and microbiological aspects of nutrition
- Selected socio-cultural influences on nutritional behaviour
- Food allergies and food intolerance reactions
- Tumourigenesis – inhibiting and promoting effects of nutritive factors
- Iodine supply and iodine deficiency prophylaxis in Germany.

The 1996 Nutrition Report discussed:

- The nutritional situation in Germany
- Development of institutional meals in the new German states (former East-Germany)
- Iodine deficiency prophylaxis in Germany
- Toxicological aspects of nutrition
- Microbiological aspects of nutrition
- Tumourigenesis – inhibiting and promoting effects of nutritive factors
- The importance of secondary plant products to health
- Malnutrition of geriatric patients
- Novel foods
- The use of information from food labels as a buying aid in the food choice of German consumers.

The Nutrition Reports provoked considerable interest both within and outside Germany. Thus it seemed appropriate to translate the summary of the 2000 Nutrition Report into English. The Report contains 10 chapters:

- The nutritional situation in Germany
- Breast-feeding and infant nutrition in Germany
- The nutritional situation in day care centres: the Day Care Centres-Nutritional-Situation-Study
- Eating habits and nutritional situation of children and adolescents
- Nutrition of elderly persons
- Toxicological aspects of nutrition
- Microbiological aspects of nutrition
- Technological aspects of food processing
- Influence of nutrition on the intestinal flora
- Prophylaxis of diseases with wholesome nutrition.

## Chapter 1: The nutritional situation in Germany

This chapter is a continuation of earlier reports on the nutritional situation in Germany. The aim of these reports is to offer – as far as possible – the most recently available, differentiated, comparable as well as valid data. Since these various goals cannot be achieved at the same time under realistic conditions data is retrieved from various information sources for the characterization of the nutrition situation, which fulfill the different aspects to varying degrees.

As an example, the strong point of the data of the *Income and Consumption Survey* (household budget survey) is the size of the sampling. For this reason, a strongly differentiating refined analysis is possible in terms of individuals. Theoretically *consumption studies* offer the most valid nutritional data since only in this manner indirect measurements of the food actually consumed by people are carried out. Both data sources are especially suitable for the evaluation of the nutritional situation in a limited period of time (cross-sectional analysis). The data of the *statistics of agriculture*, in contrast, are characterised by their special relevance to the present situation and their good comparability in the course of time. Therefore, this data source is preferably used for the analysis of trends in nutrition (time-row analysis).

All these different data are elements for the description and assessment of the nutritional situation in Germany, that is presented in the following sections.

### *Food consumption*

The *Income and Consumption Survey* 1993 provides food consumption data of 38,924 study participants. On this basis, the quantitative average consumption of approximately 100 food groups per day were calculated for each of the 16 individual states in Germany. These data were examined in a cluster analysis, to investigate the differences and the similarities of food consumption of the population in each state. This analysis showed considerable differences in the nutrition of the old (West) and new (East) states of Germany. But, there were distinct food consumption differences also among the old states, e. g. Schleswig-Holstein, Berlin (West), Bremen and Lower-Saxony differed distinctly from the remaining old states. Furthermore remarkable similarities in the average food consumption are found for the old states of Hamburg, Northrhine-Westphalia and Hesse as well as for Rhineland-Palatinate and Baden-Württemberg. In the new states, two groups evolved that had similar consumption habits. One group comprised Brandenburg, Saxony, Saxony-Anhalt and Thuringia; the other group consisted of Mecklenburg-Vorpommern and Berlin (East).

When comparing the average amounts for single food groups consumed, a higher consumption of meat, milk and milk products, cheese and soft curd cheese, confectionary, cereal products and alcohol-free beverages is notable in the old states in comparison to the new states. Conversely, higher consumption amounts of meat products and sausages, edible fats and oils (including butter), tropical and subtropical fruits as well as bread and bakery products can be found in the old states.

### *Energy and nutrient intake*

On the basis of the German Nutrient Food Code and Data Base (Bundeslebensmittelschlüssel [BLS]; version II.2) and the Income and Consumption Survey food consumption data, the mean intake of energy and nutrients for different groups of persons defined according to age and sex was calculated. As already shown in other studies, regional differences in food consumption led to only marginal differences in the energy and nutrient intake.

A comparison of the calculated intake data with the corresponding reference data for nutrient intake leads to the following results (Table 1):

The average energy intake of the adult population up to under 51 years of age was near or only marginally above the guidelines, assuming moderate physical activity (PAL-value 1.4). In the group above 51 years of age, the average energy intake was significantly above the corresponding guidelines. This indicates a positive energy balance and explains the high prevalence of overweight in these population groups.

For all male and female age groups the mean protein intake is far more than adequate, the fat consumption (especially in form of saturated fatty acids) is too high and the intake of carbohydrates (especially in form of polysaccharides) too low. Also, the average intake of dietary fibre of 20 g per day is significantly under the guideline of at least 30 g per day.

The average alcohol intake of 20 g per day for males between 25 and under 65 years accounts for nearly 6 % of the total energy intake. In females of the same age the average alcohol intake is about 12 g per day, accounting for 4 % of the total energy intake. These quantities are above the amount considered healthy and should be reduced further.

For most vitamins the average supply is sufficient for the population. This is the case for vitamin A and the majority of B-vitamins (especially thiamine, riboflavin, niacin, pyridoxine and vitamin B<sub>12</sub>) as well as for vitamin C. The supply of folic acid, however, is critical. The mean intake of folate in all age groups and in both genders is only about half of the reference values recommended. Since a sufficient folate intake with foods is linked with a decrease of elevated blood homocysteine levels, thus leading to a lower coronary sclerosis risk, an urgent improvement of the folate supply in Germany is to be attained. This can be achieved by increasing the consumption of leafy and stem vegetables, legumes, hard-shelled dry fruits as well as various breads and bakery products.

The average intake of the important antioxidant substances vitamin E and  $\beta$ -carotene falls short of or is just marginally above the valid reference values when seen under nutritive aspects. In order to achieve the postulated preventative effects of  $\beta$ -carotene in the sense of strengthening the antioxidant capacity of humans, would particularly require a further increase of the consumption of vegetables. For higher vitamin E intakes, vitamin E-rich vegetable oils must be preferred. Some fruits and vegetables as well as nuts and seeds can also contribute to an adequate vitamin E intake.

Among the minerals and trace elements, special attention is given to calcium, iron and zinc:

- The new reference values for calcium intake are not met by any of the age groups. The supply of calcium is unfavourable for children and adolescents; the average calcium intake amounts to only 60 to 80 % of the recommended quantity.
- The iron intake is again the bottleneck in the supply of women in child-bearing age. Their average iron intake is usually distinctly lower than the recommended quantity. The other groups are on average adequately supplied with iron.
- On the basis of the latest balance studies, the reference values for zinc have been corrected downwards. The comparison of the assessed zinc intake data with the reference values allows to conclude that the zinc supply in the population is adequate.

**Table 1: Average daily intake of energy and food constituents  
(in units per person and day) according to gender and age**

energy and nutrients	unit	age							
		male				female			
		19 – under 25 years	25 – under 51 years	51 – under 65 years	65 years and elder	19 – under 25 years	25 – under 51 years	51 – under 65 years	65 years and elder
energy	MJ	10,5	10,3	11,9	11,6	8,5	9,0	10,3	10,1
energy	kcal	2509,6	2466,5	2839,8	2770,4	2027,7	2141,8	2461,8	2415,2
protein	g	87,8	83,5	95,9	91,1	67,2	73,4	82,2	78,0
fat	g	100,6	101,0	118,6	117,3	79,7	87,8	101,6	99,3
fatty acids									
saturated	g	40,4	40,3	47,7	47,7	32,5	35,6	41,5	41,1
monounsaturated	g	37,2	38,0	44,6	43,8	29,5	32,6	37,6	36,5
polyunsaturated	g	16,1	16,0	18,5	18,2	12,3	13,7	15,7	15,2
linoleic acid	g	13,7	13,6	15,7	15,4	10,5	11,6	13,3	12,8
linolenic acid	g	1,8	1,8	2,0	1,9	1,4	1,6	1,8	1,7
carbohydrates	g	284,9	263,0	300,1	295,3	237,4	236,9	276,8	279,5
monosaccharides	g	51,0	42,5	44,1	41,4	41,2	38,2	42,3	39,6
disaccharides	g	95,7	84,0	99,3	103,2	80,8	77,7	94,0	99,3
saccharose	g	80,3	70,3	84,7	87,9	69,5	66,1	81,1	87,1
polysaccharides	g	131,8	125,8	145,3	141,0	111,3	115,4	135,4	136,3
alcohol	g	11,6	20,9	23,3	20,9	9,5	12,3	12,3	9,6
sodium	g	3,6	3,3	3,5	3,3	2,7	2,9	3,1	2,8
potassium	g	3,3	3,3	4,0	3,9	2,7	3,0	3,6	3,5
calcium	mg	953,0	855,0	938,2	934,3	780,9	799,3	890,9	813,6
magnesium	mg	391,7	395,6	454,4	440,0	321,8	349,7	404,8	383,8
iron	mg	15,0	14,4	16,8	16,2	12,4	13,1	15,3	14,7
zinc	mg	11,4	10,9	12,6	12,2	9,1	9,8	11,0	10,4
copper	mg	2,5	2,6	3,1	3,0	2,1	2,3	2,8	2,7
manganese	mg	4,8	4,7	5,5	5,3	4,2	4,4	5,0	5,1
phosphorous	mg	1399,2	1353,5	1548,0	1514,8	1121,1	1201,8	1354,4	1279,7
iodine	µg	94,3	95,2	111,6	112,7	75,8	84,7	101,1	93,0
fluoride	µg	668,5	635,9	726,5	699,2	557,0	557,6	643,5	633,8
vitamin A	mg RE*	1,4	1,4	1,7	1,6	1,1	1,2	1,5	1,4
β-carotene	mg	2,7	2,2	2,6	2,7	2,1	2,5	3,2	2,5
vitamin D	µg	4,2	5,1	6,4	6,9	3,7	4,5	5,5	5,0
vitamin E	mg TE*	13,3	12,6	14,7	14,9	10,7	11,3	13,2	12,8
thiamine	mg	1,4	1,4	1,6	1,5	1,1	1,2	1,3	1,3
riboflavin	mg	1,7	1,7	1,9	1,9	1,4	1,5	1,7	1,6
niacin	mg NE*	33,7	35,0	41,5	39,0	26,1	29,8	35,0	33,3
pantothenic acid	mg	5,2	5,1	6,0	5,9	4,2	4,5	5,2	5,0
pyridoxine	mg	1,8	1,8	2,1	2,0	1,4	1,5	1,8	1,7
biotin	µg	47,0	45,3	51,8	51,3	38,3	40,4	45,8	43,6
folate	µg FE*	251,5	236,4	280,2	271,0	206,1	211,1	253,7	239,8
vitamin B <sub>12</sub>	µg	6,5	6,5	7,7	7,4	4,7	5,1	6,1	5,7
vitamin C	mg	119,8	105,1	127,2	119,1	103,2	103,7	124,5	113,3
dietary fibre	g	21,0	19,8	24,1	24,2	18,3	18,8	23,5	22,8
purine-nitrogen	mg	178,0	174,5	201,9	188,7	133,3	149,6	168,1	158,0
cholesterol	mg	336,9	341,0	418,7	416,7	275,3	301,3	357,4	354,9

\* RE = retinol-equivalents, TE = tocopherol-equivalents, NE = niacin-equivalents, FE = folate-equivalents

### *Iodine supply and iodine deficiency prophylaxis in Germany*

Germany is still endemic in terms of iodine deficiency. In order to assess the present state as well as the regional differences of iodine supply and to elucidate the possibilities of improving iodine deficiency prophylaxis in Germany, the integrated study "Iodine Monitoring 1996" was carried out. This study revealed, among others, the following results:

Of the individuals interviewed, 75 % regularly used iodised salt at home. Further important sources of iodine were salt-water fish and dairy products as well as foods prepared with iodised salt. Iodine tablets were only taken by 1.3 % of the individuals interviewed.

The iodine concentration of drinking water (mean: 3.8 µg/L) showed a significant gradient from Northern Germany (6.1 µg/L) over Central (3.7 µg/L) to Southern Germany (1.6 µg/L). Since the drinking water contributes only very little to the total iodine intake no relevant regional differences result in the iodine supply.

The assessed average iodine intake of adolescents and adults amounts to 119 µg, males averaging higher intakes (126 µg/d) than women (111 µg/d). Furthermore, the average iodine intake is higher in the new states than in the old states (126 µg/d vs. 117 µg/d).

When comparing the results of the data with earlier studies, it is evident that the iodine supply of the population has markedly improved in the past 15 years. In spite of this the average iodine intake still lies far below the recommended quantities. Those especially affected by an iodine supply deficiency are new-born infants as well as pregnant women and nursing mothers that do not take iodine tablets.

In summary, the present concept of iodine deficiency prophylaxis in Germany proves to be a correct and practical approach. However, Germany is still far from its self-proclaimed commitment of 1990 towards the WHO to establish conditions for the elimination of iodine deficiency diseases in Germany.

### *Food supply away-from-home*

To evaluate the situation of food supply away-from-home in Germany, a representative survey "Nutritional habits away-from-home" was carried out in 1998. Food supply away-from-home consumption was defined as foods and beverages that are consumed outside the own home, but not taken along from home.

The survey showed that male individuals on average had food supply away-from-home more often than female individuals (8.2 vs. 6.6 meals per person and week, respectively). The most frequent away-from-home food eaters are the 19- to under 25-year-old individuals of both genders (about 12.5 meals per person and week).

Food supply away-from-home consists among others of a relatively high proportion of meat, potatoes and potato products, fresh vegetables and alcoholic beverages (for

individuals older than 19 years) as well as a relatively low proportion of milk and dairy products, domestic fresh fruit and cereal products.

Dependent on the group of persons food supply away-from-home amounts to about 5 – 15 % of the energy intake. In this respect, all groups of persons consume an over-proportionally high amount of protein and the adult group also consumes an over-proportionally high amount of purines and alcohol. For most groups of persons away-from-home food consumption was of little significance concerning the intake of dietary fibre, vitamin C, potassium, calcium (for male individuals), magnesium, copper and manganese.

#### *Trends in food consumption*

Apart from cross-sectional analysis of the nutritional situation it is also of interest which general trends are emerging in the nutrition of the population (time-row analysis). For this reason, the development of food consumption of the population since 1990 was investigated by using the data of the *statistics of agriculture*.

These data showed, for instance, that the per capita consumption of plant products such as potatoes, bananas and citrus fruits significantly decreased, whereas the consumption of vegetables significantly increased.

Among the animal products, significant decreases occurred in the per capita consumption of milk and beef or veal. In contrast, the per capita consumption of yoghurt, cream and cheese as well as poultry and fish showed a significant increase.

From the nutritional point of view, the significant decline in the per capita consumption of alcohol is to be welcomed. Mainly beer and spirits were affected by this development.

In summary, many of the observed trends point in the desired direction. It is to be expected that the nutritional situation in Germany will show further improvement middle to long term. Some trends, however, are to be classified as unfavourable (e. g. decreasing fruit consumption) and should be corrected with appropriate measures. The campaign “5 a day”, for instance, is such an approach.

#### *Mortality due to nutritionally co-dependent diseases*

Mean life expectancy in Germany for males was 74.1 years, for females 80.4 years in 1998. With that, the mean life expectancy rose by 2.1 years for males and 1.8 years for females in the time-span between 1990 and 1998. At the same time, the differences in the mean life expectancy between the old and new states of Germany have narrowed. In the new states, mean life expectancy is still 2.3 years lower in males and 1.2 years lower in females than in the old states. In the year 1990, these differences were still 3.4 and 2.8 years, respectively (Figure 1).

The rise in mean life expectancy is above average due to the lower mortality caused by circulatory diseases. Nevertheless, circulatory diseases are still the most common

cause of death in Germany. In 1997, 43 % of all deaths of males and 53 % of all deaths of females were related to *circulatory diseases*. The mean age of death for these diseases, however, is relatively high (approximately 4 years above the mean average life expectancy).

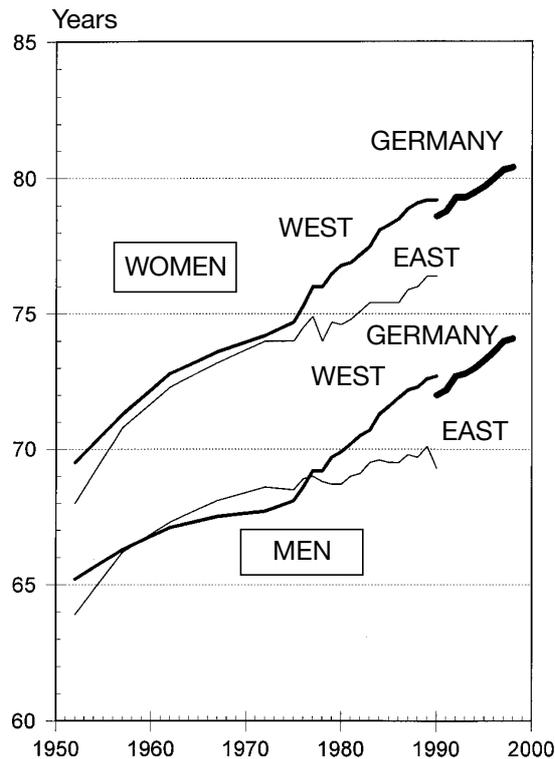
*Cancer* is the second most frequent cause of death. In 1997, 27 % of all deaths in males and 22 % of all deaths in females were caused by cancer. The mean age of death, however, for males and females is 5 and 9 years lower than respectively for circulatory diseases. Accordingly, the number of potential years of life lost (age 1 – 65, per 1000 living persons) due to cancer diseases is 1 and 4.5 years higher for males and females, respectively, than for circulatory diseases.

The observed decline in mortality due to stomach cancer in the past decades continued between 1990 and 1997. The age adjusted death rate declined by 24 % and the number of potential years of life lost declined by 22 % for men and by 30 % for women.

The development of colon cancer was less favourable. The age adjusted death rate increased slightly in males and decreased only little in females. This is mainly due to the increased mortality in the new states.

In summary, it becomes clear that healthier nutritional habits in Germany, including a lower alcohol consumption, could contribute considerably to achieve a similar high mean life expectancy as in Japan, Sweden or Switzerland.

**Figure 1: The average life expectancy in Germany (D), in former West-Germany (WEST) and in former East-Germany (EAST)**



## Chapter 2: Breastfeeding and infant nutrition in Germany – the “SuSe”-Study<sup>1</sup>

Breastfeeding and infant nutrition in Germany were first investigated in the SuSe-Study (February 1997 to June 1998). Attention focussed on breastfeeding conditions in maternity clinics and breastfeeding habits of women on the one hand, and nutrition of infants as a whole in the first year of life on the other hand. In total, 1,717 mother-child pairs (participation rate 54.3 %) from 177 maternity clinics (82 % from the old states) took part in this study. Breastfeeding conditions were assessed according to the recommendations of the German National Committee on Breastfeeding (Table 2).

**Table 2: Recommendations for the promotion of breastfeeding in maternity clinics\***

### **1. Written breastfeeding guidelines and lactation representatives**

Written guidelines to promote breastfeeding should be available and should be mentioned in regular intervals with regard to all staff members. The appointment of a lactation representative serves the development and protection of a qualified promotion of breastfeeding.

### **2. Regular Training**

The complete staff will be trained in theory and practice in such a way, that the guidelines for the promotion of breastfeeding are filled with life.

### **3. Information during pregnancy**

The women should be informed already in the birth preparation courses and at the time of registration for birth in hospital about the health benefits and the practical aspects of breastfeeding (a.o. hand-outs of written information of the German National Committee on Breastfeeding).

### **4. Early start of breastfeeding**

If possible within the first hour of life.

### **5. Practical help for breastfeeding**

The correct breastfeeding position should be demonstrated to the mothers and she has to be advised how her milk production – even if she is separated from her child – can be maintained.

### **6. Supplementary feeding after medical indication**

For a healthy, full term new-born, who is breast-fed on demand, there is no necessity, to additionally give fluids or foods.

The indication for a supplementation of breast milk by other fluids or foods has to be decided by the responsible physician.

The nutrition of underweight, ill or pre-term children calls for an individual medical decision.

### **7. Promotion of the mother-child-unity**

By day and night rooming-in.

### **8. Breastfeeding on demand**

Breastfeeding on demand should be made possible and should be promoted.

### **9. Pacifier or nipple**

Pacifiers, teats or nipples should be avoided if possible by breast-fed children in the first weeks of life. Alternative feeding methods (e. g. feeding by cup, fingers or spoon) should be demonstrated.

### **10. Self-help**

The initiation of breastfeeding groups should be promoted and the mothers should receive possibilities of contact at the time discharge from the maternity clinic or the delivery house.

\* of the Association of Gynaecologists, the German Society for Gynaecology and Birth Assistance, the Academy of Child and Adolescent Medicine, the Academy of Gynaecologists and the German National Committee on Breastfeeding of November 2, 1998.

<sup>1</sup> Stillen und Säuglingsernährung

In 95 % of all investigated hospitals, guidelines for the promotion of breastfeeding were available for hospital staff members, however only in 33 % in written form. The mothers received breastfeeding information mainly in the birth preparation courses (87 %) and in breastfeeding discussions after birth (79 %). In 78 % of all hospitals, written information material was available. In 94 % of all hospitals it was made possible to breastfeed within the first hour after birth. For this purpose, guidance of the mother was provided for in all hospitals. Of all hospitals, 99 % reported that breastfeeding took place according to the needs of the infant and the mother. Day and night rooming-in was possible in 67 % of all hospitals, but occurred in only 10 % of all cases. Guidelines for the supplementation of mothers milk with fluid or food in the first 3 days were available in 78 % of all hospitals. In one-third of hospitals, more than average breastfeeding promoting measures were carried out and in two-thirds, such measures were carried out less than average.

During pregnancy, 54 % of all mothers had informed themselves about infant nutrition (81 % especially about breastfeeding). One-third of all mothers already had experience in this matter. Within the first hour after birth, two-thirds of all new-born infants of mothers willing to breastfeed were given the breast. Almost three quarters of the mothers received help with breastfeeding. The majority of infants (92 %) were breastfed on demand, that is not on a firm regimen. One-fourth of all mothers made use of day-and-night rooming-in, almost three-fourths practiced day rooming-in only.

Of all mothers, 91 % tried to breastfeed after delivery. At time of discharge from the birth clinic, 78 % of all infants had been exclusively or predominately breastfed, 8 % had received mothers milk and infant formula food. Of all infants, 58 % were exclusively or predominately breastfed at the end of the second month, 45 % at the end of the fourth month and 13 % at the end of the sixth month.

Breastfeeding already posed to be a problem for 40 % of all mothers in the hospital, and for 60 % 14 days after delivery. The main reason stated for not breastfeeding was over-exertion by the family. Objective obstacles were, among others, lacking motivation of mother and partner, as well as the presence of additional children. As main reasons for the short duration of breastfeeding (less than 4 months) the mothers stated problems with the breast, as well as insufficient milk quantities. This was objectively associated with a low educational qualification of the mother, additional children and single parenthood.

Within the first 3 days after birth, 56 % of all primarily breastfed infants received supplementary feeding along with mothers milk, usually carbohydrate solutions (49 %) or tea (38 %), more seldom infant formula nutrition (2.5 %). Alternative feeding methods other than bottle-feeding (97 %) were rarely practised. Around 50 % of all infants received additional fluids (mainly tea) in the first 4 months; in the second half-year of life this rose to 95 % (also increasing amounts of juices were given). At the end of the fourth month, 21 % of all infants were already receiving supplementary foods with vegetables, 13 % milk preparations and 13 % fruit-(cereal) preparations. At the end of the sixth (twelfth) month, 77 % (99 %) of all infants were receiving meals containing vegetables, 53 % (62 %) milk preparations and 51 % (95 %) fruit-(cereal) preparations. At the same time, 8 % (14 %) of all infants received meat almost daily. At the end of the second, fourth and sixth month respectively, around 70 % of all mothers stated that they had informed themselves about

infant nutrition since the last questioning. At the end of the twelfth month, this figure fell to about 50 to 60 %.

In order to fulfill the world-wide call for a 4 to 6-months duration of exclusive breastfeeding, improvements in the network of qualified breastfeeding care are absolutely essential, beginning in the hospital and carried out throughout the first year of life by midwives or professional lactation advisors, breastfeeding groups or by the public health system. This combined with a continued nutrition education, especially concerning a possible supplementation with infant formula milk and appropriately composed supplementary food that is not offered too early, would be a step in the right direction.

### **Chapter 3: The nutritional situation in day care centres: The Day Care Centres-Nutritional-Situation-Study**

In the Day Care Centres-Nutritional-Situation-Study, the food provision, the nutritional education and the food supply in day care centres with all-day care (at least 6 hours of care, including a warm-meal lunch) for children over 3 years of age were representatively investigated nation-wide for the first time. Of the 10 million children aged 3 to 14 in Germany, about every tenth child is attended to in a day care centre according to the above-mentioned definition. Special attention was paid to the location of the day care centres in the new (49 %) or the old (59 %) states, the differing provision systems and possibilities of improving the food supply. Of the 493 randomly-chosen day care centres that fulfilled the conditions of participation, 301 day care centres took part in the study between April 1997 and March 1998. These 301 day care centres take care of 14,324 children at kindergarten and after-school care centre age that were on average cared for 9.9 hours per day between 6 a.m. and 6 p.m.

Children from other cultural backgrounds were cared for in 41 % of the day care centres in the new states (East) and in 79 % in the old states (West). The cultural background was considered for the meals offered in 33 % (East) and 82 % (West) of the day care centres. Children from "socially under-privileged" families were cared for in 52 % (East) and 73 % (West) of the day care centres, and, of these, 12 % offered additional food and beverages free of charge for the children. Children that needed special meals for health reasons (e.g. allergies) were cared for in 29 % of all day care centres.

The eating conditions play an important role for shaping food and drinking habits. Shared meals of both adults and children were taken in 54 % (East) and 82 % (West) of all day care centres, the independent portioning of the foods by the children was allowed in 57 % (East) and 89 % (West) of all day care centres. Child participation in preparing meals was possible 1 to 3 times per month in 65 to 88 % of all day care centres. Child desires in meal planning were taken into account 1 to 3 times per week in 30 to 41 % of all day care centres. Children were involved in meal planning more often in kitchens in the day care centres rather than in remote kitchens<sup>2</sup> away from the day care centres (67 vs. 39 %).

<sup>2</sup> extern cooked lunch

Apart from the lunch-time meal, 15 to 29 % of all children received a further meal and for 8 to 26 % of all children, 2 or more meals were offered. Most often, an in-between meal was offered in the afternoon (25 to 37 %), followed by a first breakfast (6 to 23 %). Beverages were freely available in nearly all day care centres (93 %). In the old states, the sweetened beverages predominated with 2.8 portions per day.

Among the provisional systems for the warm lunch-time meals the remote kitchens (distribution kitchens) dominated nation-wide with a share of 52 % in contrast to the kitchen in the day care centre (preparation kitchen<sup>3</sup> 22 %, mixed kitchen<sup>4</sup> 16 %, regeneration kitchen<sup>5</sup> 8 %, “parents are cooking” 2 %). There were obvious differences between the new and old states (e.g. distribution kitchen 73 vs. 33 %). Qualification of kitchen personnel was generally higher in the remote kitchens than in the kitchens in the day care centres. The duration of warm-keeping for the lunch-time meal was 81 to 100 minutes in remote kitchens, in kitchens in the day care centres 10 to 26 minutes. (For comparison: the recommendations for ensuring very good to good quality are < 30 minutes).

The most often offered meals were meat-containing dishes. These dishes were offered 3 times instead of 2 times per week, and were therefore offered more often than recommended according to the ‘Bremer Checkliste’ (Table 3). Fish was only offered 0.5 instead of 1 time per week. Raw food was offered only every third day and, therefore, more seldom than recommended. Fresh fruit was offered as dessert once per week and, therefore, much more seldom than recommended. According to the judgement of the supervisors of the day care centres, most children were satisfied (12 to 33 %) or predominantly satisfied (44 to 59 %) with the lunch-time meal.

**Table 3: Recommendations of the ‘Bremer Checkliste’ for a “weekly meal plan” (5 days)**

<ul style="list-style-type: none"> <li>1 meat-containing meal</li> <li>1 hotpot or casserole</li> <li>1 salt-water fish meal</li> <li>1 vegetarian dish</li> <li>1 free-chosen meal (e.g. meat-containing, wholesome<sup>6</sup> or sweet main dish)</li> </ul>
<p>additionally:</p> <ul style="list-style-type: none"> <li>fresh fruit at least 2 times</li> <li>raw foods or fresh salad at least 2 times</li> <li>fresh potatoes at least 2 times</li> </ul>

The energy contents of the lunch-time meals in the day care centres were 580 kcal (remote kitchens) and 430 kcal (kitchens in the day care centres) and, thus, higher than in the Optimised Mixed Diet (400 kcal), a scientifically based as well as a practically – on the basis of meals and foods – formulated medical-preventive concept for children and

<sup>3</sup> freshly prepared food

<sup>4</sup> reheated deep frozen dishes and freshly prepared dishes

<sup>5</sup> reheating of deep frozen or chilled dishes

<sup>6</sup> meaning meat-free dishes of various kinds using whole-meal grain

adolescents. Higher levels were also found for saturated fatty acids (> 120 %) and carbohydrates, especially sugar (> 400 %). In contrast, lower levels (70 to 90 %) were found for total fats, polyunsaturated fatty acids, potassium, phosphorus, zinc, copper as well as vitamin A, vitamin B<sub>6</sub> and thiamine. Distinctly lower levels (< 70 %) were found for mono-unsaturated fatty acids, magnesium, iron, manganese and the vitamins E, C and folic acid. As far as nutritional quality is concerned, lunch-time meals in day care centres can be classified as satisfactory. However, due to the prolonged warm-keeping times in distribution kitchens, the effective intake rate of heat-sensitive vitamins is lower than calculated according to the recipes.

Possibilities of improvement include the development of quality standards for lunch-time meals in day care centres, that are lacking, the adaptation of the meal plans to the Optimised Mixed Diet, the promotion of a stronger participation of the children in meal-planning and kitchen work, the establishment of nation-wide guidelines for qualification of kitchen personnel, the coordination of information material developed by various institutions that inform about nutrition in day care centres and the participation of parents and responsible persons of the day care centres to set up a mutual day concept for child nutrition.

#### **Chapter 4: Eating habits and nutritional situation of children and adolescents**

More than 15 years after the Nutrition Report 1984, eating habits of children and adolescents in Germany aged 6 to under 17 years were studied regionally as well as representative for the population. Views about nutrition, eating and drinking, as well as food and advertising were determined by interviews.

The interest in nutrition questions has barely changed in the past 15 years. Just under 50 % of all children and male adolescents are not or not much interested in nutrition, although about 22 % of female adolescents are strongly to very strongly interested (Table 4).

**Table 4: Interest in nutritional questions – children and adolescents (in percent)**

Interest in nutritional questions	8 to under 12 years		12 to under 17 years	
	male	female	male	female
very strong	4,9	3,4	4,7	6,2
strong	9,2	12,3	9,1	15,4
interested	33,0	35,0	36,7	46,3
less	37,5	35,6	40,1	27,5
not	15,4	13,7	9,4	4,6

The assessment of foods according to their health importance shows, that nutrition education has conveyed successfully for younger children a classification in “healthy” and “un-healthy” foods. However, 20 to 40 % of the children classify foods and beverages as positive, that are considered as less favourable in nutrition education. As already shown in the Nutrition Report 1984, these food products – often restrictively handled by parents – are very popular.

In more than 50 % of all adolescents, correct nutritional knowledge can be found, with female adolescents always being better informed than their male counterparts. For example, 71 % of all adolescents assign the term *carbohydrates* to the proper foods (potatoes, bread, sugar), 66 % choose milk and/or cheese as being *calcium-rich*. The fact that especially *fat* in foods promotes obesity is known by 86 % of all adolescents. However, certain foods, especially the ones that are advertised for, are classified as positive in regard to their health effects by more than one-third of all adolescents, regardless of their real nutritional quality.

The results substantiate the hypothesis, that health-related arguments are picked up by children, but have no long-lasting influence on nutritional behaviour. If about 40 % of all children and adolescents who are not very interested in nutrition questions any how, during the interview directly admit that they are rather not motivated to consider the health effects of nutrition, then the reference to health in nutrition education should be reassessed and replaced by other needs concerning eating (taste, life-style).

It has been proven, that the health-related attitudes of children concerning nutrition does not have a very clear relationship to body weight. For 8- to under 12-year-olds, that report to watch for “healthy foods”, only about 6 % in all are less overweight than those that do not claim this. Children that pay less attention to “healthy foods” are somewhat more overweight on the one hand, but on the other hand also more often underweight.

It is encouraging, that 87 % of all boys and 93 % of all girls up to under 8 years of age take a breakfast along to school. The break-time snack consists of a bread sandwich and fruit (brought along from home) and a mixed milk drink or fruit juice. Sweets and soft drinks play a more minor role. When asked for their wishes, schoolchildren would rather like to eat more sweets and would more often like to drink juices or soft drinks. Also, 98 % of the 8- to under 12-year-old schoolchildren bring a break-time snack, and 28 % additionally bring money. In the same age-group, 84 %, as well as 73 % of the adolescents reported they already had breakfast at home. The most important meal for children and adolescents is lunch. Most children and adolescents (about 55 %) have the highest appetite at lunch-time.

More than 50 % of the children reported that formal criteria at the table are very or quite important for their parents such as “sitting properly at the table” or “using knife and fork properly”. For only under 10 % of all parents, “no left-overs on the plate” is still important, whereas in the Nutrition Report 1984 this aspect was still important for 40 % of all mothers.

An essential criterion for the evaluation of the nutritional status is the body weight. Dependent on whether the body mass index was chosen using the standard tables

of ROLLAND-CACHERA or whether the reference tables for the body weight from the Nutrition Report 1984 as a measure of comparison was chosen, different prevalence changes regarding under- and overweight result. When using the classification boundaries of ROLLAND-CACHERA for the corresponding age groups, there is a rise in the incidence of obesity. Of all boys and girls, 12 to 14 % would have to be classified as obese. The classification boundaries of ROLLAND-CACHERA, however, are based on French studies carried out years ago. Since longitudinal growth has further increased (acceleration), the question is whether these children are truly obese, or whether they are only taller and therefore heavier than the French collective in the comparable age group.

On the basis of the reference weights of the Nutrition Report 1984, no significant increase in the total prevalence of obesity for boys and girls between the ages of 6 and up to under 17 years can be noted in Germany. When observing certain sub-groups, however, significant changes in the past 15 years can be shown: the prevalence of obese girls between 6 and up to under 10 years of age has increased from 3 to 7 %, likewise in boys from 5 to 10 %. Underweight in girls under 13 years of age decreased from 17 to 3 %, in boys from 5 to 3 %.

About 50 % of the 12- to under 17-year-olds are content with their body weight. However, 35 % of all female adolescents would like to lose weight (median: about 5 kg). Nevertheless, 61 % of all male adolescents wish to have a slim girlfriend (vice versa it is about 59 %) (Table 5).

**Table 5: Assessment of the personal body weight by 12- to under 17-year-old adolescents (in percent)**

Views about personal body weight	12 to under 17 years	
	male	female
I should lose a lot of weight	5,9	6,6
I should lose some weight	16,5	28,7
I have about the right weight	55,3	51,2
I should gain some weight	12,9	5,4
I should gain a lot of weight	1,7	0,3
I do not care	7,7	6,9
I do not know	0	0,9

The amount of daily television viewing of children and adolescents shows a significantly positive correlation with body weight. Overweight children spend more than 2 hours a day watching television, non-overweight children about 1.5 hours a day. The question of the causal relationship is not clear, as it can not be clarified whether children watch television

due to their obesity, or because they have an overweight because they watch too much television.

Furthermore, it was studied whether television advertisement has a possible influence on the specific eating habits of children. About half of all children and adolescents have a television of their own in their room. Children with their own television watch significantly more television (134 minutes vs. 98 minutes per day). During this time, countless advertisement clips are presented that, among others, advertise food, meals and beverages especially for children.

The most frequently advertised food groups for children and adolescents as the target audience in the recording phase of 580 television hours were: cereals, followed by chocolate products, bars and chocolates. Taste and enjoyment were the most frequent advertising arguments. As more than 30 % of all 6- to under 8-year-olds would like to try the advertised products at least from time to time (10 % even "often", whereas the frequency falls off with increasing age), it can be assumed that food commercials in television have an effect on eating habits of children and adolescents.

Children and adolescents recognise commercials from photographs well and can correctly classify these commercials with these products. At the same time children with good commercial identification watch 130 minutes per day television (42 % have a television in their room); children with rather poor commercial identification have a television in 22 % of all cases and watch television 94 minutes per day. Even so, the study does not give any evidence of children and adolescents invariably consuming higher amounts of foods that are advertised particularly frequent on television when they themselves watch television more frequently and intensely and when they can identify commercials more appropriately. When comparing children and adolescents that could only identify 1 or 2 proper categorisations out of 12 commercials with children and adolescents that could identify 11 or 12 proper categorisations, one can conclude on the basis of the obtained results, that children and adolescents that can recognise advertisements extremely well do not consume significantly higher amounts of advertised foods and beverages in comparison to the total values. As advertised products are consumed in similar amounts by children and adolescents that can barely identify commercials, other influences (the offer itself, eating habits of friends etc.) must have a stronger effect than the actual television commercial itself.

## **Chapter 5: Nutrition of elderly persons**

In a representative-designed study, the nutritional situation of  $\geq 65$ -year-old German citizens living in private households that could handle every day tasks independently, was investigated. Nutritional status, nutritional habits and food selection, energy and nutrition intake were analysed and assessed in order to arrive at specific recommendations for the nutrition behaviour of this target group.

The total study was structured into a regional survey (in the city of Euskirchen near Bonn) and in a nation-wide survey; these were carried out in succession. The objective of the

nation-wide survey was to test the degree of generalisation capability of the regionally assessed data. Sampling was conducted in both parts of the study by an age-differentiated random selection. For the regional study (May 1997 to January 1998), 1,200 senior citizens were contacted by mail. Of these, 361 individuals (144 men, mean age  $75.1 \pm 7.4$  years and 217 women, mean age  $77.4 \pm 7.4$  years) were interviewed on the basis of standardised questionnaires about their nutrition and life-situation. Information about food frequency consumption was given by 339 individuals (frequency protocol). In a second interview, 330 individuals answered questions concerning health, physical fitness, activities and smoking habits. An usable 3-day dietary recall was recorded by 276 participants. For the nation-wide survey (May 1998 to June 1998), 4,020 senior citizens were contacted by mail. Of these, 1,550 individuals (645 men, mean age  $74.3 \pm 7.4$  years and 896 women, mean age  $76.8 \pm 8.0$  years; after weighting 576 men, mean age  $72.2 \pm 6.1$  years and 975 women, mean age  $74.2 \pm 6.9$  years) answered questions concerning their nutrition and life situation in a standardised interview; 1,372 filled out an usable 3-day dietary recall. By weighting the data of the nation-wide part of the study, an adaptation of the groups of participants to gender distribution and age structure in Germany was achieved.

Both groups of participants are distinguished by the high proportion of women (regional survey 60 %, nation-wide survey 63 %), the number of widowed individuals (40 % vs. 44 %) and single-living individuals (38 % vs. 47 %). About one-half of all senior citizens reported to be in very good or good health. The majority of all senior citizens (about 80 %) reported to have a good or even very good appetite. Physical handicaps with negative effects on eating, for example chewing, swallowing or cutting of food was seldom (under 8 %). Altogether, the good conformity between participants of the regional and the nation-wide study was conspicuous. Differences were only found in educational level, profession and physical activity (higher in the nation-wide survey).

The nutritional status of the participants was assessed on the basis of the body mass index (BMI). Data obtained of body height and weight were available for 307 (regional survey) and 1,261 (nation-wide survey, not weighted) individuals. The average BMI of men and women was one unit more in the regional survey ( $27.6 \text{ kg/m}^2$  compared to the nation-wide survey (men  $26.6 \text{ kg/m}^2$ , women  $26.4 \text{ kg/m}^2$ ). Half of all participants had levels between 24 and  $29 \text{ kg/m}^2$ , which is the normal range for senior citizens as suggested by the National Research Council (USA) (regional survey without gender differences, nation-wide 62 % of the men and 44 % of the women). BMI-values  $> 29 \text{ kg/m}^2$  in the regional survey were found in 34 %, in the nation-wide study in 22 % of participants. With increasing age, lower values were found for body height, weight and BMI both regionally as well as nation-wide.

In terms of meal behaviour, almost all senior citizens (98 %) conformed to tradition and ate 3 main meals per day, with mostly regular eating times. In-between-meals were preferably taken in the afternoon (about 50 %). Six meals per day were seldom eaten (8 % regional, 2 % nation-wide). Of less than 3 meals per day reported also only a few participants (1 % regional, 4 % national). A warm meal was eaten by almost all participants (98 % regional, 96 % nation-wide) daily or almost daily. Only 2 % (regional) and 5 % (nation-wide) of the senior citizens interviewed seldom ate warm meals. The majority of senior citizens (77 % regional, 80 % nation-wide) felt capable of preparing a complete warm meal

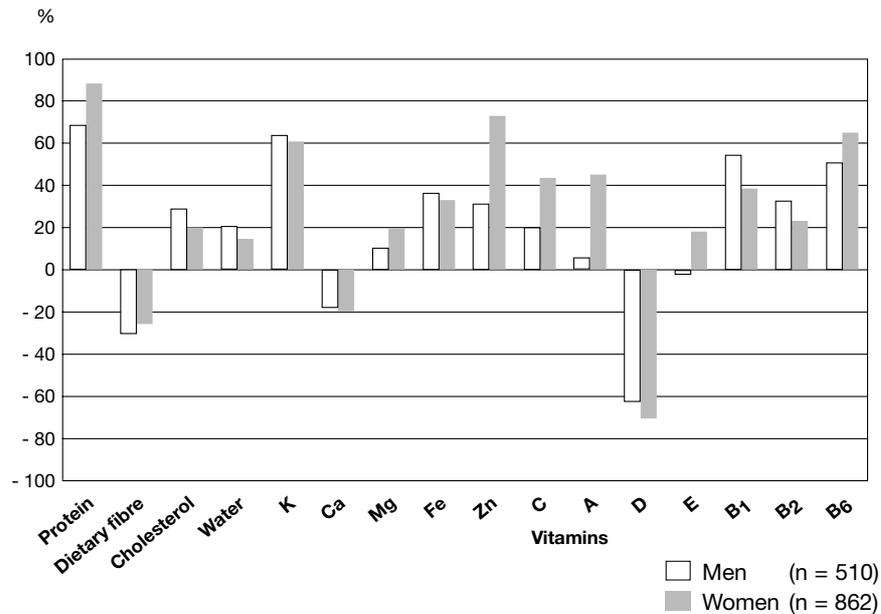
independently; this competence, however, was only practised by 55 % (regional) and 70 % (national) of all senior citizens. "Meals on wheels" was only received by 2 % (regional) and 3 % (nation-wide) of those interviewed. Furthermore, the regional survey showed that away-from-home food consumption had no importance.

In the regional part of the study, the consumption frequency and amounts of 45 foods of 134 men and 205 women interviewed made clear, that the majority of senior citizens fulfill the desirable minimum nutrition requirements and consume daily fruits and vegetables, milk products and starchy side dishes, more mixed bread and whole-grain bread rather than white bread, and more than 1 litre of fluids per day with beverages. However, divergent from the recommendations, many senior citizens on the one hand eat too much meat (19 % eat at least 1 portion per day), sausages (54 % of the men and 38 % of the women have at least 1 portion per day) and eggs (11 % have at least 1 per day). On the other hand, they show a low consumption of fish (11 % of the men and 20 % of the women eat no fish at all), vegetables (only 7 % consume 3 portions daily) and fruit (only 15 % of the men and 27 % of the women eat at least 2 portions daily). On the basis of these results, senior citizens, especially men, should be advised to increase the amount of foods high in nutrient density in their diets.

In the nation-wide part of the study, data concerning energy and nutrient intake of 111 men and 165 women were collected and assessed using a standardised dietary history over 3 consecutive days on the basis of the German Nutrient Food Code and Data Base (version II.2). The presentation of the results is expressed as medians of food intake amounts and nutrient density separate for each study part (regional or nation-wide), gender and age-group. Additionally, the percentage of achieving the reference values for the nutrient intake is depicted gender-specific. The mean daily energy intake for both study parts is in the range of the age and gender-specific guidelines (9.1 to 9.2 MJ for men and 7.9 to 8.3 MJ for women). The nutrient intake (in percent of the energy intake) is too low, however, for carbohydrates (42 to 45 %), and too high (36 to 39 % and 17 %, respectively) for fats and protein. For alcohol, the maximum amounts given in the reference values are surpassed by 33 % (regional) and 42 % (nation-wide) of the men and 30 % of the women. The guideline values for intakes of dietary fibre are reached to only 75 %, for water to only 70 %. For the majority of the studied micro-nutrients, the intake medians achieved or surpassed the reference values. The intake of vitamin D, calcium and folic acid with the diet was not sufficient. On the basis of these data follows the advice of the recommendations regular exposure to ultraviolet light and for an increased consumption of milk products and green vegetables. On an absolute scale, women ingested lower amounts of most nutrients than men, due to the lower intake of energy. When relating to the reference values, and also, when taking the nutrient density into account, women did better for zinc and the vitamins A, C, E and B<sub>6</sub>. For the highly-aged ( $\geq 85$ -year-olds), the situation for some nutrients has to be judged as somewhat more unfavourable.

**Figure 2: Energy and nutrient intake – deviation from the reference values (in percent) (expressed as median)**

Nation-wide part of the study



In summary the nutrition situation of the investigated senior citizens is not critical. However, to meet the demands of an adequate nutrient supply, elderly individuals can profit from a wholesome diet with a higher proportion of whole-grain products, vegetables, fruit and milk products and a lower proportion of foods of animal origin.

It should be noted, that these results pertain only to senior citizens that are mostly independent and mobile with an interest in nutrition issues. The study results do not allow similar conclusions for elderly persons living in private households, in homes for senior citizens and geriatric patients, that are in need of care. There is still a great need for research for these groups of persons.

## Chapter 6: Toxicological aspects of nutrition

Toxicological aspects of nutrition deal with the presence of undesirable substances in foods and their importance for the health of humans. The data concerning pesticide residues in fruits and vegetables as well as organochloride compounds in foods of animal

origin are updated. Data concerning pharmacologically active compound residues of substances in foods deriving from animal sources and environmental contaminants in human milk are exemplary listed. The musk compounds belong to the environmental contaminants and can be detected only since a few years ago.

In Germany, 1,113 *pesticides* were authorised on the basis of 276 active substances (January 1999). Total sales were 34,647 tons of active substances in 1997; somewhat less than half of these were herbicides. According to reports of the official food surveillance, the exceeding maximum levels for domestic fruit and vegetables (23,000 samples) were 0.7 and 1.4 % and for imports 5.9 and 4.6 %, respectively, in the time between 1994 and 1997. About 40 % of the domestic and imported fruit samples did not contain any detectable residues. This was also true for nearly 70 % of the domestic vegetables and a little more than 50 % of the imported vegetables. Results of the nation-wide food-monitoring programme carried out in 1997 that need to be emphasised are the exceeding maximum levels for imported grapes of 14 % (250 samples) and about 10 % each for iceberg salad (40), broccoli (225) and zucchini (241). For strawberries from domestic fields for self-picking harvesting, as well as kohlrabi, kale and cucumbers, no exceeding maximum levels were detected. The most frequently as residues occurring substances in fruit and vegetables were fungicides such as iprodione, procymidone, vinclozolin, dithiocarbamates and dichlorfluanid. In 1996, 2.5 % exceeding maximum levels (27,000 samples) were found throughout Europe. Of the investigated apples, strawberries, grapes, lettuces and tomatoes, 64 % did not have any provable residues.

In the framework of the monitoring programme between 1995 and 1997, residues were investigated of organochloride compounds and polychlorinated biphenyls (PCB) in herring (sample size: 379), saithe (523), eel (237), wild boar fat (209), pig flare fat (303), pork liver (207), lamb liver (276), sheep's milk cheese (243) and butter (456). The high proportion of DDT in eel (670 µg/kg fat), as well as the PCB indicator substances 138, 153 and 180 (39 to 52 µg/kg fresh weight) were conspicuous.

The residue situation in foods of plant origin has not significantly changed in the last years. The hangover of residual pollution of organochloride compounds including PCBs in foods of animal origin have reached very low concentrations that lie far below the upper limits. The preventive health protection of the consumer is comprehensively ensured by the legal guidelines.

In the EU Residue Control Directive, effective since 1998, a supervision is prescribed for the unlawful use of illegal substances with anabolic effects, e.g. clenbuterol, the use of allowed *animal medicines*, e.g. chloramphenicol (antibiotic) and the contamination with impurities such as pesticides, PCB, heavy metals, mould toxins and other *environmental contaminants*. According to this guideline, 0.4 % of all cattle, 0.05 % of all pigs and sheep, and, according to necessity, horses all slaughtered the previous year must be inspected. The use of clenbuterol and other β-agonists is forbidden in Germany since June 1997. Residues of clenbuterol were found in 5.5 % (1995), 3.7 % (1996), 3.3 % (1997) and 0.7 % (1998) of the examined calves. Antibiotics in horses revealed positive results in 2 to 8 %, in calves in 1 to 2 %, and for other animals under 1 % of the examined cases in 1995 to 1998.

Although the use of chloramphenicol was forbidden since 1994, it was still used. After an initial decline of the positive results, a new rise was noted in 1998. Substances with hormonal effects were not employed illegally in amounts worth mentioning for fattening purposes. Among the heavy metals, contamination with cadmium is the highest.

Since 1995, at least 1 sample per 200 tons of slaughtered poultry (turkey, broiler chicken, laying hens/boiling fowls, ducks and geese) were examined in Germany. The forbidden use of chloramphenicol was still detectable between 1995 and 1998, most frequently in broiler (0.7 %). In 1998, a higher rate of sulphonamide- (1.7 %) and tetracycline-positive (1.3 %) turkeys was apparent. As of 1998, at least 1 sample per 100 tons of a yearly fish production (especially carp and trout from aquacultures) must be examined. In 3.2 % of the samples, inhibitors (three-plate test) were found in 1998. Likewise, rabbit, game, milk, eggs and honey are to be monitored according to uniform guidelines set up by the European Union. Positive results were only found in single cases (e.g. 2 cases of chloramphenicol in milk).

The residue findings for the years 1995 to 1998 generally do not give evidence for acute risks for consumers. The revision of the Residue Control Directive and the inclusion of not yet registered foods are further steps towards a better consumer protection. Beyond that, an improved exchange of data is mandatory for a better assessment of possible endangering of the consumer.

For many years, the amount of insecticide-effective organochloride compounds, PCB and polychlorated dibenzodioxines and dibenzofuranes, has been decreasing in foods deriving from animal sources, and hence, a declining contamination in human milk. Therefore, in 1995, the German National Committee on Breastfeeding recommended exclusive 4- to 6-month breastfeeding for infants.

In 1996, around 8,000 tons of synthetic musk scents were industrially produced worldwide. Of these, 70 % belong to the polycyclic compounds HHCB and AHTN, 25 % to the nitrobenzol compounds musk xylol and musk ketone. The *nitro-musk compounds*, that reach the aquatic ecological system from household waste water, and that were first analysed in human milk at the beginning of the 1990s, do not play a significant role for the contamination of humans from the food chain. According to present knowledge, the *polycyclic musk compounds*, that have found an increased use in the last years, accumulate according to the present knowledge in fish and in human fat tissue and then in human milk.

The amounts of synthetic musk scents in human milk mentioned in the literature from 1991 to 1999 for Germany and Switzerland show that musk xylol leads to significantly higher concentrations in human milk due to its stronger lipophilic properties, than musk ketone. These nitrobenzol compounds, however, are still surpassed by the polycyclic compounds. Extreme values are regularly observed for no obvious reason. Differing nutritional habits do not have an influence. The magnitude of contamination with musk xylol is comparable with that of organochloride compounds. The data of the Central Data Documentation of the Federal Institute for Consumer Health Protection and Veterinary Medicine show a steady decline of average concentrations of musk xylol in human milk from 0.056 to 0.014 mg/kg fat for the years 1993 to 1997. Contamination with musk ketone, in contrast, stayed at a

relative constant level, similar to the one measured for musk xylol in 1997. This development seems to be due to the partial, voluntary refraining from the use of musk xylol in cleaning agents / detergents and personal hygiene products since 1994.

Synthetic musk compound contamination of mainly fish and fish products from the fresh-water area, as well as coastal waters do not explain the general contamination of human fat tissue and human milk. Therefore, apart from the oral intake also skin as well as absorption by the inhalation and trans-placental intake must be considered. Other substances sometimes found in human milk samples are ultraviolet filter agents (component of suntan lotions), polybromated diphenylether (flame retardants) and phthalic acid ester (plasticiser).

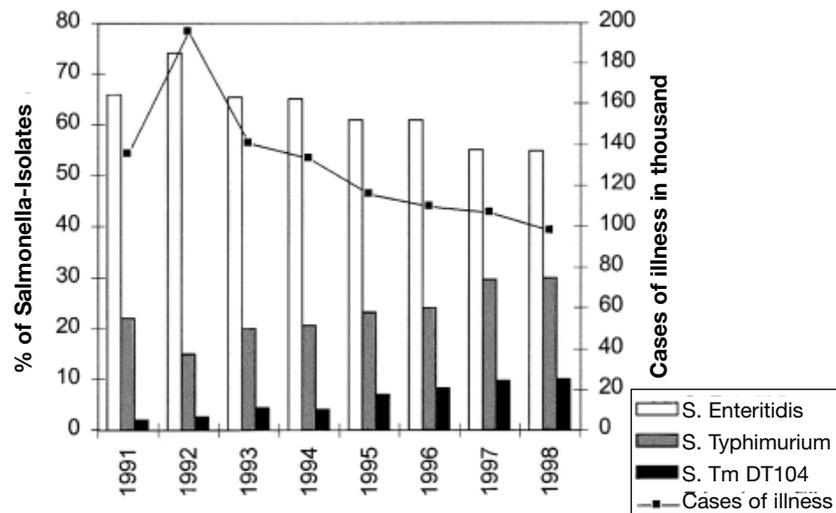
Since comprehensive studies concerning chronic toxicity including carcinogenesis, teratogenesis and mutagenicity of synthetic musk compounds are lacking, a final risk evaluation is not possible. Consumers are advised to use scented cosmetics as well as detergents and cleaning agents sparingly.

## **Chapter 7: Microbiological aspects of nutrition**

Type and frequency of *foodborne infections and intoxications* are subjected to a constant change. Therefore, official reporting (of diseases) is not always complete. According to the Federal Communicable Diseases Act, notification of the number of cases only is mandatory. Between 1995 and 1999 the following number of persons suffered (died) from salmonellosis: 515,218 (313), from "enteritis infectiosa": 501,765 (676), from shigellosis: 8,625 (1), from typhus: 565 (1), from paratyphus: 338 (0), from trichinellosis: 93 (1) and from botulism 74 (3). While the number of cases for salmonellosis decreased by 26 % during this time period, they rose by 47 % for other infectious enteritis forms, including infections with *Campylobacter*, enterohemorrhagic *Escherichia coli* (EHEC), *Listeria* and *Vibrio*. This development could be due to the improved methods of investigation. Of all voluntary reports that reached the Robert Koch Institute between 1993 and 1997, 88 % of the identified pathogens were salmonella species.

In the last years, *Salmonella (S.) enteritidis* was the most frequent salmonella species responsible for *salmonellosis*, followed by *S. typhimurium*. The salmonellosis rates, as reported between 1995 and 1998 to the Federal Institute for Consumer Health Protection and Veterinary Medicine by the federal states, illustrate that *S. enteritidis* is found especially in foods associated with eggs and poultry. *S. enteritidis* was responsible for over two-thirds of the isolated salmonella serovare in eggs and egg-containing pasta, as well as crême-filled fine pastries. *S. typhimurium* is mainly found in meats other than poultry, especially in pork. The Chicken Egg Ordinance, the Poultry Salmonella Ordinance and a voluntary control system for slaughter pigs are of central importance in the fight against salmonellosis. In the last two years, a new strain of *S. typhimurium*, the DT 104, reached a total of approximately 30 % of all *S. typhimurium* infections. This strain, that is especially present in cattle, but also increasingly in pigs, is resistant against several antibiotics.

**Figure 3: Salmonellosis in humans between 1981-1998, as well as the proportion of *S. enteritidis*, *S. typhimurium* and its phage type DT 104**



*Campylobacteriosis* is the second most frequently infection with 11,495 cases reported from 10 federal states since 1998. Infections with *Campylobacter jejuni* are mainly associated with the intake of not adequately heated poultry meat and the drinking of raw milk. As this bacteria species does not reproduce outside of the host organism, poor hygiene in the preparation of meals is an important causal factor for such an infection.

In the year 1998, a total of 644 infections with EHEC were diagnosed and recorded in Germany. In 37 % of all cases, children between the ages of 1 and 4 years of age were affected. In the course of the EHEC-surveillance, 14 % of the infected persons were identified as being EHEC-excretors. Known reasons for an infection with EHEC are a broad spectrum of foods mostly of animal origin, but also of plant origin. However, due to the time delay between the infection and visible of clinical symptoms, a complete clarification of the infectious chain is usually extraordinary difficult. The most important EHEC-strain is the *E. coli* serovar O 157.

The frequency of infections with *Listeria monocytogenes* is estimated to be around 200 cases per year. Most listeria strains have a low virulence, and their contents in foods are usually low. Foods that can become a problem are those, that allow listeria to reproduce during processing, packaging and storage, e.g. soft cheese, vacuum-packed meat products and vacuum-packed smoked fish. Pregnant women, elderly people and immune-suppressed persons are especially at risk for listeriosis.

In order to avoid infections with *Vibrio cholerae*, the European Union placed a temporary import ban on fishery products from African countries that had widespread cases of cholera. There has not been any case of cholera caused by food in Germany.

*Trichinellosis* (trichinosis) is very rare due to the legal regulations of meat inspections. Raw sausage and raw meat, especially pork and horsemeat, can be infested with the thread-worm *Trichinella spiralis*. This zoonotic agent can be destroyed by thorough heating or deep-freezing.

**Table 6: *Trichinellosis* in humans (in Germany between 1974–1998)**

Year	Cases
1974	1
1975	2
1976	0
1977	71
1978	6
1979	3
1980	9
1981	11
1982	412
1983	9
1984	4
1985	4
1986	6
1987	4
1988	3
1989	6
1990	6
1991	1
1992	3
1993	2
1994	0
1995	10
1996	1
1997	9
1998	51

According to estimates, around 20 persons are infected yearly by the eggs of the *small fox tapeworm* in Southern Germany. As a preventive measure, it is recommended that low-growing wild fruits are to be consumed only after heating to at least 60 °C.

Up to October 2000, 80 persons succumbed to a new variety of the “Creutzfeldt-Jacob-Disease” in Great Britain. Outside of Great Britain, 2 cases became known in France and 1 case in Ireland. The reasons, even when not completely proven, are considered to be the consumption of beef and beef products that contained the agents of the *Bovine spongiform encephalopathy (BSE)* in the second half of the 1980s and at the beginning of the 1990s in Great Britain. In the year 1992, 37,280 cows were infected in Great Britain. Since March 1996, there has been a general export ban on cattle, beef and beef products. Since the plans for the fight against BSE have led to a decrease in cases to 2,157 in the year 1999, the export ban for beef was loosened as of August 1, 1999. For Switzerland and Portugal, an export ban has been in effect since November 1998, as the use of BSE-contaminated fodder brought about 358 and 449 cases of infected animals, respectively. In Germany, 6 cases of BSE in imported cattle from Great Britain (5) and Switzerland (1) have appeared. In cattle of German origin there has not been any reported case of BSE<sup>7</sup>. Therefore, consumers are advised to eat only beef originating from German stocks. In the future, for beef the proof of origin will be mandatory in the European Union. For the confirmation of suspected clinical diagnosis of BSE, 3 high-speed tests are presently available. A test that allows the detection of BSE in an early state of infection in the live animal still needs to be developed.

Different establishments of community provisioning have reported about 44 group illnesses with 1,721 isolated cases in the years 1994 to 1997. The share of *salmonellosis* cases declined from 61 % of the isolated cases to 26 % between 1990 and 1993, apparently due to the Chicken Egg Ordinance. As in the early 1980s, *Bacillus cereus* once again dominates with 43 % of the isolated cases, followed by *Clostridium perfringens* (15 %). Especially risky dishes are puddings and semolina, as well as potato and noodle dishes that are heated and then cooled. An effective measure for eliminating microbiological risks is given by the monitoring of the known critical temperature/time relations. Since August 1998 controls by the respective companies for the identification and evaluation of risks are embodied in the Food Hygiene Ordinance. On the household level, it is to be assumed that consumer education, although carried out quite intensely, does not reach the accustomed persons to a sufficient degree.

## **Chapter 8: Technological aspects of food processing**

Raw materials of plant and animal foods usually have to undergo food processing for preservation and partly also for making foods ready for consumption. The treatment and processing of foods, by using thermal methods, may lead to considerable losses of vitamins, minerals (e.g. up to 30 % during blanching of leafy vegetables) and dietary fibre (e. g. 70 % in white-flour rolls compared to wheat grain). Moreover, loss of flavour, colour, texture and change in taste may result.

<sup>7</sup> The printing process of the Nutrition Report 2000 was too far in progress to add any comments when the information about the first case of BSE of a German horned cattle was published.

In food treatment and processing attention is focussed on measures to suppress or minimise the process of spoilage caused by micro-organisms, enzymatic and non-enzymatic chemical reactions and, more seldom, by physical processes. A large number of various methods adapted to the characteristics of the product and possible mechanisms of spoilage are applied. According to the prevailing principle of the process, a differentiation can be made of mechanical, chemical, biochemical, thermal, electro-physical or other procedures. With the exception of thermal methods, the effects of these on nutritive value or nutritionally important components of foods are negligible in most cases. The loss of nutrients, especially vitamin C and thiamine by the use of such important conventional methods as heat-sterilisation, drying and freezing, are briefly reviewed as described in the literature. Modern and novel processes are referred to as well.

The most important methods of industrial preservation of food such as milk, fruit juices, fruit preparations, vegetables, meat and fish products as well as ready-to-serve meals are the thermal processes of blanching, pasteurisation and sterilisation. Consumption of canned fruit and vegetables alone amounted to 1 430 600 tons in 1998. The data obtained from the literature concerning nutrient losses by heat sterilisation vary considerably due to many process modifications and other influences. As an example, the figures for vitamin C range between 10 and 55 % for peas and 10 and 65 % for tomato juice, or between 10 and 40 % for thiamine in vegetables and 20 to 70 % in meat and fish products. Of nutritional relevance are also the losses of pantothenic acid in vegetables (50 to 75 %), fruit and fruit juices (50 %) and of  $\beta$ -carotene in yellow vegetables (35 %). Whether the nutritional value of food proteins is affected by heat denaturing cannot be clearly assessed on the basis of the present literature data.

For the preservation of food by partial extraction of water, numerous different types of dryers and drying methods (temperature range: - 20 to 80° C) are employed. Food dried on the industrial scale the industrial level, dried foods are sugar (sales 1997/98: 2 829 500 tons), fruit and fruit juices (consumption 1997/98: 113 000 tons), vegetables and vegetable products, meat, fish and dairy products, egg powder, breakfast cereals, coffee, cornflour, flour, soy protein, tea and pasta. The drying process may lead to a loss of sensory and nutritional quality. When the drying process carried out properly, a greater loss of nutrients (0 to 10 %) is not to be expected. Exceptions are vitamin C (up to 70 %) and  $\beta$ -carotene (up to 25 %). For dried dairy products, a general evaluation of the nutritional quality is not possible because of the heterogeneity of the products. Quality losses in egg powder products appear due to improper storage (e.g. thiamine and vitamin A losses). By gentle drying of meat, the possibility of the meat becoming rancid by oxidative processes (also during storage) plays a greater role, and not the loss of vitamins or the denaturation of protein.

Cooling and freezing of food are those methods which preserve the nutritional and sensory characteristics of a product. The spectrum of frozen foods comprises ready-to-serve meals (consumption 1998: 660 300 tons), ice cream (503.7 million litre), potato products (334 600 tons), poultry (331 000 tons), vegetables (254 800 tons), pastries, meat and game, fish and fish products, fruit and fruit juices as well as dairy products. During pre-processing and storage, greater losses of valuable substances may occur. During blanching of

vegetables, there is a loss of water-soluble vitamins (e.g. vitamin C: 20 to 50 %), minerals and heat-sensitive substances. There are, furthermore, losses due to frozen storage, for example for vitamin C in the range of 10 % after 9 to 12 months at – 18 °C. Leafy vegetables and small products are more affected than large products. For  $\beta$ -carotene, thiamine and folic acid the losses in deep-frozen, blanched vegetables are around 20 to 30, 10 to 20 and 40 %, respectively. At lower temperatures (– 30 °C) the loss of water-soluble vitamins is smaller. Oxidative changes in the lipid fraction also occur at temperatures below – 30 °C. In fruit frozen-stored for 12 months at temperatures over – 18 °C a vitamin C degradation of 10 to 30 % has to be expected. For meat stored at – 18 °C for 3 months, losses due to reactions with atmospheric oxygen have been found, especially for vitamin E (up to 70 % in beef) and the B-vitamins thiamine (up to 25 % in pork) and riboflavin (up to 35 % in pork). For fatty fish, oxidative changes in the lipid fraction are the main reason for losses in quality.

In terms of preserving important nutritional components, the modern and novel methods of food treatment and processing are of interest. Modern processes, the principles of which have been well-known for quite some time, are increasingly employed in food processing due to adapted and improved technologies and new insights. They include thermal processes like microwave, high frequency heating, Ohmic and inductive heating and sous-vide methods, as well as the non-thermal methods of ionising radiation treatment, osmotic treatment and high pressure carbon-dioxide treatment. Treatment with ionising radiation is forbidden in Germany according to § 13 of the Food Law. Because of the internal market in Europe, § 47a was introduced which allows specific products as irradiated spices in particular. An EC Directive (“Positivliste”) which came into force on March 20, 1999 demands that irradiated food and food ingredients be labelled; the Directive has still to be implemented in domestic law.

Novel methods such as high-voltage, magnet and light-pulse methods, high-pressure, ultrasound and gas plasma treatment are all based on principles so far not used in food-processing. All these methods fall under the Novel Food Regulation. Study results presently available have shown that these in some cases very selective methods – the functioning and fields of application of which are described in more detail – barely lead to a decrease of the nutritional characteristics of the raw material under practically relevant conditions.

Developments in industrial food treatment and processing aim at producing food of maximum nutritional and microbiological-hygienic quality; in doing so, emphasis is laid on environment-friendly production processes and on a minimum of waste.

It can be stated that, as far as the supply with nutritionally high-quality food is concerned, losses occurring at the present state of food technology, in view of the great many different foods commercially available, play a marginal role in some areas only (e.g. folate and dietary fibre), especially when the intake of fresh food is low.

## Chapter 9: Influence of nutrition on the intestinal flora

The intestinal flora has various metabolic, immunological and protective functions, and acts as a natural barrier against pathogens. Among the health-promoting microbes of the complex intestinal flora, accounting for about 400 different species, there are lactic acid-forming bacteria such as lactobacilli and bifidobacteria. Studies in the past years in humans have shown, that the intake of probiotics and prebiotics can influence the gut flora numerically and metabolically. Most strains that are employed for a “probiotic” effect are of the kind of lactobacilli and bifidobacteria.

In the stomach, more than 99 % of all micro-organisms ingested are destroyed due to the pH-level of 2.5 to 3.0. The microbe population increases – from  $10^2$  to  $10^3$ /g in the stomach to  $10^8$ /g in the terminal small intestine (ileum). Apart from enterococci and several gram-negative groups, mainly lactobacilli (e. g. the acidophilic lactobacilli “group”) are present. The main groups of microbes in the large intestine are after the anaerobic kinds of eubacteria and bacteroides the bifidobacteria and clostridia.

The “prebiotic” concept is based on the fact that 30 to 45 g of carbohydrate polymers, e.g. oligosaccharides, must be fermented to short-chain fatty acids such as acetate, propionate and butyrate in the colon to compensate for biomass losses, accounting for about 15 g per day via the faeces. In conjunction with this concept, only the promotion of bifidobacteria and, in a very few studies, lactobacilli, as well as a decrease of bacteroides through carbohydrate polymers has been shown. Resistant starch, in contrast to saccharose, can lead to a 10- to 100-fold increase in lactobacilli and bifidobacteria populations.

The metabolism of carbohydrates, protein and bile acids by bacterial fermentation in the intestine is described in summary. The formation of short-chain fatty acids (especially from carbohydrates) is estimated to be 300 mmol per day. These short-chain fatty acids are absorbed to about 90 % and are oxidised in the intestinal cells (especially butyrate) or are delivered to the portal vein (especially acetate and propionate).

In contrast to the non-digestible polysaccharides such as resistant starch and non-starch polysaccharides which non-specifically stimulate the increase and metabolic activity of the intestinal flora as a whole, only certain non-digestible oligosaccharides (OS) such as fructo-OS, galacto-OS, soybean-OS and raffinose, that are naturally found in many plants, in milk and in yoghurt as well as lactosucrose and lactulose, that are synthetically produced, stimulate the growth of lactic acid forming bacteria in the colon and fulfill the criteria of a prebiotic. The short-chain fatty acids, that originate from the fermentation in the distal colon, create an acidic milieu; bacterial mass and faeces volume increase whereby fructo-OS and galacto-OS demonstrably promote especially the proliferation of bifidobacteria.

Whereas lactobacilli and streptococci possess enzymes for the formation of anti-microbial substances (hydrogen peroxide, bacteriocines), the bacterial enzymes  $\beta$ -glucuronidase,  $\beta$ -glucosidase, azoreductase, nitroreductase and 7- $\alpha$ -dehydrogenase are responsible for the formation of carcinogenic and mutagenic substances in the colon and are seen in

connection with the development of colonic cancer. In comparison to other anaerobic bacteria, lactobacilli and bifidobacteria exhibit lower activities of these enzymes.

Tumours of the colon are the second most frequent kind of cancer in Europe. Of all colonic tumours, 25 % are related to various risk groups, 75 % constitute age-related sporadic cases of illness. Colonic tumours probably develop due to colonic lumen exposition with genotoxic, toxic and growth-promoting substances. These substances can either be formed in the colon, reach the colon directly with the chyme, or get in the colon indirectly via the enterohepatic circulation.

Probiotics and prebiotics, as well, can minimise carcinogen-induced colonic tumours in animal studies. An even stronger reduction can be achieved with a combined administration of probiotics and prebiotics. In humans, consumption of probiotics and prebiotics led to a modulation of those enzymes responsible for activation of carcinogens. Only very few, contradictory data are available concerning lactic acid forming bacteria as the true potential cancer prevention agents. For prebiotics the data are not precise. In contrast to probiotics, however, they have the additional potential for the promotion of further microorganisms that do not necessarily form lactate, but form butyrate. This potential can, among others, lead to the promotion of apoptosis (cell death) in tumour cells, to the repair of damaged epithelial cells and to the synthesis of mucine. Altogether it is assumed that probiotics and prebiotics are very promising candidates for possible primary prevention of tumours in the colon.

The intestinal-associated immune system, that is comprised of a large amount of immune cells (lymph follicles, Peyers' plaques, immune cells of the Lamina propria, intraepithelial lymphocytes), is the largest immune organ of the human body. It recognizes the immunogenic structures of the intestinal microflora and the vast amount of foreign substances which reach the inner parts of the body via foods. It prevents an overreaction against harmless, with the food ingested, foreign substances (so-called immunologic oral tolerance) and can prevent illnesses caused by pathogenic bacteria and viruses that have reached the intestine.

Various studies have proven that the intestinal microflora plays an important role in the development of the intestinal immune system in infants and in the maintenance of an intact immune system in adults. Furthermore, the intestinal microflora can protect against an invasion of pathogens in setting up a barrier at the surface of the intestinal mucosa, that hinders the appearance of these bacteria (colonisation resistance).

The influence of probiotics and prebiotics on the human immune system has only been insufficiently investigated up to now. This is among other things primarily due to the fact that the assessment of an alimentary-related influence of the microflora composition has only been methodologically accessible in the past few years. There are no studies with adults that demonstrate modulating effects of a defined nutrition and, with that, a change of the composition of the intestinal microflora of the intestinal-associated immune system. Indications from experimental studies with animals, as well as first clinical studies with orally given live lactic acid forming bacteria, lead to the assumption that probiotics and prebiotics have an influence on the intestinal-associated immune system as well as the

systemic immune system like the increase of cytokine formation and phagocyte activity of leucocytes. On the other hand, a placebo-controlled study, that took a large spectrum of immunological parameters into account, could not demonstrate the influence of *Lactobacillus casei* Shirota on the human immune system. In contrast it is proven that the consumption of fermented dairy products can contribute to the prevention or to the weakening of symptoms of intestinal infections caused by pathogens. This effect may possibly be due to lie in the interaction between the lactic acid forming bacteria with the intestinal-associated immune system. However, probiotics may have undesired effects in persons with a weakened or disturbed immune system, as for example in inflammatory immune reactions in the intestinal mucosa. Moreover, reactions against the body's own tissues may be stimulated in persons with auto-immune disease.

No human studies are presently available that have investigated the possible (indirect) immunostimulatory effects of prebiotics. Further studies dealing with the development of colon cancer are needed for a final evaluation of the biological relevance of probiotics and prebiotics. Also, relevant biomarkers that finally allow to state the biological relevance of immunological effects of probiotics and prebiotics need to be identified.

## **Chapter 10: Prophylaxis of diseases with wholesome nutrition**

Nutrition is one of the environmental aspects that can cause illnesses. The aim of this chapter is to present and to evaluate epidemiological studies and meta-analyses on the relationship between nutrition and diseases.

The statements made in this chapter are based on extensive reviews of the literature. For evaluation, only case-controlled studies, cohort studies and randomised experimental, placebo-controlled intervention studies were included. The correlations found in these studies between a disease and a particular nutrient, food or kind of nutrition were evaluated according to the certainty of the statements made. A ranking of these statements was made as follows: convincing, probable, possible and insufficient.

Many epidemiological studies have shown that overweight, disorders of lipid metabolism, high blood pressure, diabetes mellitus and hyperhomocysteinaemia are risk factors for premature arteriosclerosis.

*Overweight* can be convincingly lowered, eliminated or avoided by decreasing energy intake and / or increasing energy consumption through physical activity. Consequent low-fat nutrition high in dietary fibre probably prevents the development of overweight.

The risk of *disorders of lipid metabolism* probably decreases through weight reduction in case of overweight and a nutrition with little saturated fatty acids, low in trans-fatty acids and with a high proportion of dietary fibre. This speaks in favour of a nutrition based on the consumption of plenty of vegetables and fruits, lots of whole-grain products, little animal or hardened fats, and the preference of plant-derived oils.

*High blood pressure* in case of overweight can be lowered convincingly by weight reduction. It is probable that table salt restriction may lower high blood pressure. A low-fat nutrition rich in skimmed milk (1,5 % fat), skimmed milk products, fish, vegetables and fruits may possibly lower blood pressure. Alcohol consumption increases blood pressure convincingly.

Weight reduction in case of overweight is the most important measure for the prevention of *diabetes mellitus*. Moreover, nutrition high in dietary fibre and low in fat probably improves a disturbed glucose tolerance. Frequent consumption of salad and vegetables lowers the risk for *diabetes mellitus*.

A *hyperhomocysteinaemia* can be decreased by raising the intake of folic acid and vitamin B<sub>6</sub>. It is probable that one may profit from an increased intake of wholesome foods that lead to similar effects observed when administering supplements of these vitamins.

Nutrition is an important exogenous factor and an important protective factor of premature *arteriosclerosis*. Clinical manifestations of arteriosclerosis include coronary heart disease (e.g. myocardial infarction or coronary stenosis), stroke and peripheral arterial circulation disorder.

Information to the primary prevention of a myocardial infarction from 12 intervention studies and secondary prevention of a myocardial infarction from 33 studies are available allowing to state that nutrition probably lowers the risk of a heart attack when based on the following recommendations: moderate amounts of fat (about 30 % of the nutrient energy), with more plant-derived oils than animal-derived fats (saturated fatty acids : unsaturated fatty acids 1 : 2 und linoleic acid [n-6] :  $\alpha$ -linolenic acid [n-3] 5 : 1), as well as at least 50 % of the energy intake deriving from whole-grain products, vegetables and fruits. Moderate alcohol consumption probably lowers the risk of a myocardial infarction in 40- to 60-year-olds. A special preventative effect can be derived from a diet high in dietary fibre and high in n-3 fatty acids. The effect of vitamin E and  $\beta$ -carotene as isolated supplements has not been proven. The effects of addition of selenium to food are insufficiently clarified.

Moderate alcohol consumption may possibly elevate the risk of a haemorrhagic stroke and may possibly lower the risk of an ischaemic stroke. The data situation concerning further influential nutritional factors is insufficient.

The development of peripheral arteriosclerosis under the influence of nutrition and single nutritional factors is insufficiently clarified.

Almost one-third of all cancer diseases are nutrition-related. Of course, further factors leading to cancer diseases play a role, from environmental factors over inheritance to infection.

The available studies show that an increased alcohol consumption and overweight probably increase the risk of *breast cancer*, whereas high consumption of vegetables convincingly, and, of fruits probably, reduces the risk of breast cancer. The consumption of red meat increases and vitamin C, carotenoids and dietary fibre lower possibly the risk

for breast cancer. The data situation for the influence of nutritional fat and vitamin E as well as phytoestrogens is still insufficient.

The risk of *prostate cancer* is possibly elevated with the increased consumption of nutritional fat, red meat and alcohol, and probably decreased with a higher consumption of vegetables.

The most important risk factor for *lung cancer* is smoking. Furthermore, higher fat and alcohol consumption possibly increase the risk of lung cancer, whereas higher consumption of vegetables and fruits convincingly decrease this risk. Supplementation of  $\beta$ -carotene (and possibly vitamin A) in pharmacological doses probably increases the risk for lung cancer among smokers, especially with somewhat higher consumption of alcohol at the same time.

Promoting factors for the development of *stomach cancer* are probably foods preserved with salt and certain aggressive methods of food preparation such as the grilling of meat and fish. A convincing relationship between the decrease of stomach cancer and either the higher consumption of vegetables and fruits or the consumption of reliably cool-stored foods can be observed. Vitamin C in foods probably lowers the risk of stomach cancer and possibly carotenoids in foods, whole-grain cereals and green tea. It is insufficiently clarified whether or not vitamin E and  $\beta$ -carotene as supplements increase the risk of stomach cancer for smokers.

According to the available studies, the risk of *colon cancer* through the consumption of alcohol and red meat is probable, through grilling and frying of meat as well as through eggs, nutritional fat and sugar is possibly increased. A risk decrease is convincingly achievable by consumption of high amounts of vegetables and regular physical activity. Dietary fibre and carotenoids in the nutrition likewise possibly decrease the risk of colon cancer.

Meanwhile scientific research not only has been able to clearly identify cancer-causing substances (carcinogens) such as benzpyrene in smoke and in black-smoked products, or aflatoxins in mouldy foods, but also cancer-promoting factors (promoters) such as alcohol and cancer-protecting factors (anti-promoters), e.g. vegetables and fruits. The research into the mechanisms are just at the beginning. The cancer-protecting effects cannot be explained by certain single nutritional factors, but by the type of nutrition in general, also the amount and selection as well as the processing of foods.

In the framework of wholesome nutrition, vegetables and fruits do play an important role when it comes to cancer disease protection. A presently carried-out campaign called "5-a-day", that is also supported by the German Nutrition Society, emphasises a main demand for daily nutrition. A high consumption of vegetables and fruits offers widespread preventative effects against many different kinds of cancer. Further studies need to elucidate the optimal intakes. The given epidemiological findings up to now, and the biological plausibility, as well as the missing of arguments against a higher consumption of vegetables and fruits, already allow a practical implementation for the benefit of the population.

During the processing of foods, cool storage for avoidance of moulds, a gentle preservation through frozen-storage and a gentle preparation of meat and fish are to be observed.

The *neural tube defect*, a grave deformity of the neonate seen in relation to the mothers' insufficient intake of folic acid and, also, with other vitamins and trace elements. The experimental findings suggest that supplementation with folic acid convincingly decreases the risk for neural tube defects. It is insufficiently clarified which time period is most optimal for the beginning of supplementation.

According to the available results, the risk of *osteoporosis* is possibly decreased by higher calcium intakes and by higher doses of vitamin D and K as well as fluoride. These observations, that were made after administration of supplements, may also possibly profit by implementation of wholesome nutrition. The consumption of coffee may possibly increase the risk of osteoporosis. Convincingly, physical activity decreases the development of osteoporosis.

*Inflammatory rheumatoid diseases* are probably positively influenced by nutrition that is poor in arachidonic acid (e.g. vegetarian diet) and rich in n-3 fatty acids. A hypoallergenic diet can support this influence. Osteoarthritis may respond to higher intakes of vitamin C with nutrition and vitamin E as a supplement. The effect of selenium has not been sufficiently clarified.

Concerning the influence of nutrition on *multiple sclerosis*, the data available are still very unsatisfactory. Theoretical arguments for the effect of n-3 fatty acids still need to be substantiated by further intervention studies.

The influence of nutrition and life-style on *life expectancy* and *life quality* is presently secured. The citation "a person is what he/she eats" can be supplemented by the saying "a person experiences how he/she has lived".

A very effective protection against degenerative diseases can already be achieved by avoiding or decreasing the classical risk factors for arteriosclerosis (overweight, high blood pressure, diabetes mellitus, disorders of lipid metabolism, smoking) and for cancer diseases (overweight, alcohol, smoking).

A summarising evaluation of the foods and nutrients discussed in this chapter shows, that deleterious effects can be expected from a higher consumption of energy, fat, saturated fatty acids, trans-fatty acids, table salt and alcohol. The strongest preventative effects come from a higher consumption of whole-grain products, vegetables, fruit and n-3 fatty acids.

Prevention through nutrition with the aim of a *longer life with life quality* can therefore be attained with wholesome nutrition, according to the latest scientific findings, and as recommended by the German Nutrition Society (Deutsche Gesellschaft für Ernährung, DGE):

- Variety, but not too much, in order to avoid overweight.
- Lower the fat intake to 30 % of the total energy intake, preferably using favourable plant-derived oils, with the aim of a n-6 : n-3 fatty acid intake ratio of 5 : 1. The saturated/unsaturated fatty acid ratio should be 1 : 2.
- Increase of food consumption of plant origin, especially whole-grain products with complex carbohydrates and dietary fibres.
- The consumption of vegetables and fruits 5 times a day, as well as more skimmed milk (1,5 %) and skimmed milk products for an adequate supply with vitamins, minerals, trace elements, dietary fibre and secondary plant metabolites.
- Avoid alcohol or consume only small quantities.
- Decrease the intake of table salt and smoked foods.

According to the WCRF/AICR-Report, a reduction in the consumption of red meat is recommended and grilled meat and fish should only be consumed once in a while. Foods should be hygienically stored in order to avoid the reproduction of bacteria and fungi.

Nutrition based on these recommendations does not need a supplementation of nutrients, except for iodine and folic acid (for certain groups of persons).

Although there is increasing information concerning the preventative effects of vitamins, minerals and secondary plant metabolites, actual figures that reflect desirable intakes with preventative effects are not yet available.

A life-style with regular physical activity protects against overweight, strengthens the metabolic and hormonal processes and trains the heart and the circulation. Individuals with a sedentary occupation should be physically active for at least one hour daily and practise leisure sport activities for one hour weekly.

Smoking is a dangerous risk factor, especially for the development of cancer and heart attack, and should therefore be avoided.



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