National Food Monitoring 1999

Joint Report of the Federal Republic of Germany and the Federal Länder

Ministries responsible for Food Monitoring

(Addresses at the end of the brochure)

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1. Introduction: What does food monitoring mean?

Food monitoring is a system of repeated examination, measurement and evaluation of levels of undesirable substances, such as plant protection products, heavy metals and other contaminants, in and on food. It is the aim of food monitoring to obtain informative data for a representative description of the presence of undesirable substances in food in the Federal Republic of Germany on the one hand and to identify at an early stage any potential risks from these substances, on the other. In the long run, food monitoring is also employed to demonstrate chronological trends in the contamination of foods and to provide an adequate number of data as a basis for calculation of the intake of undesirable substances from food by the consumer.

Food Monitoring was developed under a large-scale research project conducted from 1988 to 1993. Based on §§ 46 c-e of the German Foods and Other Commodities Act (Lebensmittel- und Bedarfsgegenständegesetz – LMBG), it has been an independent activity performed by official food control since 1995, and thus has become an additional instrument to improve preventive health protection of consumers.

Up to the present, the Federal Ministry for Health, in cooperation with responsible representatives of the Federal Government and the Länder, has elaborated each year a detailed plan for the performance of the monitoring scheme and published this plan in the form of General Administrative Provisions. (From 2002 onwards, these activities will be conducted by the Federal Ministry of Consumer Protection, Food and Agriculture).

As a rule, the examinations cover a total amount of ca. 4700 samples per year to be collected by the 16 Federal Länder in proportion to their population figures.

Over a period of 5 years, ca. 100 food items are to be examined in order to provide representative information about the presence of undesirable substances in foods. The results obtained from this general overview are to provide data on the intake of undesirable substances from food.

Sampling and analysis of the foods are performed by the competent authorities and laboratories of official food control in the individual Federal Länder.

The tasks of organization of the monitoring, recording and maintenance of data and evaluation of monitoring results as well as reporting have been assigned to the Federal Institute for Health Protection of Consumers and Veterinary Medicine (BgVV).

The data forming the basis of this report have been summarized and published in a special brochure available from the BgVV: Lebensmittel-Monitoring, Tabellen-Band zum Bericht über das Jahr 1999 (Food Monitoring Tables: Supplement to the 1999 Report).

The reports published so far on the subject of food monitoring have been made available on the internet under the following address: *www.bgvv.de/fbs/fb1/lebensmittel/monitor.htm*

2. Summary

Under the 1999 Food Monitoring scheme, 4918 samples of domestic and foreign origin were examined which had been collected from the following foods:

- Camembert
- Turkey meat
- Turkey liver
- Salami
- Mackerel smoked
- Tuna in water canned
- Infant formula

- Wheat grain
- Whole grain rolled oats
- Linseed
- Pistachio
- Cauliflower
- Onion
- Sweet pepper
- Melon / honeydew melon
- Cultivated mushroom (*Agaricus bisporus*)
- Papaya
- Rhubarb
- Nougat cream, sweet spread
- Coffee roasted
- Mineral water

Depending on the food involved, examinations included residues of plant protection products (insecticides, fungicides, herbicides etc.), environmental contaminants (e.g. persistent organochlorine compounds including PCBs, and the heavy metals, lead, cadmium and mercury) as well as nitrate, nitrite and mycotoxins (aflatoxins and ochratoxin A). Some of the foods examined in 1999 had already been included in previous monitoring programmes covering almost the same spectra of substances so that it has been possible to draw a comparison between the contamination levels found in these foods.

In conformity with the results obtained in the preceding years, no residues of plant protection products or only traces of these were detected in the majority of samples also in 1999. On the whole, levels exceeding legally fixed maximum levels were found in 2.3 % of samples.

From the results obtained in the 1999 monitoring year combined with those of the preceding years, the following conclusions are drawn:

1. The general contamination of foods with undesirable substances was confirmed to be low by the results of monitoring in 1999 as well as by the results of the preceding years. The foods examined did not give rise to a situation which would have required specific action with regard to a preventive health protection of consumers. It should be underlined in particular that an important food for human nutrition such as wheat proved to be virtually free from residues. This had also been documented earlier by the 1997 and 1998 results. In 1999, foods for infants and young children were examined for the first time in the context of the monitoring. Being subject to particularly restrictive regulations on legally fixed maximum levels, these products as well proved to be virtually free from residues.
   In their overwhelming majority, the foods examined did not exhibit findings giving rise to concern regarding the presence of organic environmental contaminants and residues of

plant protection products. Generally, the share of samples in which maximum levels had been exceeded was low. In 2.3 % of samples only, maximum levels were found to have been exceeded (also cf. Maximum level, chapter on Terminology).

2. None of the typical nitrate-accumulating vegetable species was examined in 1999. Nitrate levels in the foods examined this time were within the low ranges typical of the species.

3. Examination of foods for levels of heavy metals in 1999 did not reveal any particular situation regarding contamination, with the exception of high cadmium levels frequently found in linseed. In contrast to wild forms, cultivated mushrooms exhibited a low contamination with heavy metals. Levels of heavy metals and other elements found in mineral water complied with legal provisions.

4. The problem of aflatoxin levels in pistachios of Iranian origin was again confirmed by high and very high levels found as a result of examinations for mycotoxins. As in the previous years, the presence of aflatoxins in pistachios of other origin has proved not to raise any problems.

Notes for consumers

Monitoring results obtained in 1999 have again demonstrated that consumers do not have to be concerned about the presence of undesirable substances with regard to the foods examined. However, the foods consumed should result in a diet that is balanced and varied. Fruit and vegetables should be washed thoroughly before consumption or preparation. Contamination of cultivated mushrooms with heavy metals is low. However, the recommendation is maintained that consumption of **wild mushrooms** should not exceed amounts of 200 to 250 g per week. There is a persisting aflatoxin problem associated with Iranian pistachios. Measures of inspection have been intensified so that adherence to legal maximum levels can be controlled anywhere.

3. Monitoring plan 1999

Every year, a detailed plan for the performance of the monitoring procedure is published within the framework of General Administrative Provisions (AVV-Monitoringplan). This plan is elaborated in cooperation with the institutions of the Federal Government and the Länder responsible for monitoring. It comprises the selection of foods and of substances to be examined as well as the requirements concerning the methodology of sampling and quality of analysis.

3.1 Selection of foods and substances

The 1999 monitoring plan covered the examination of 7 foods of animal and 13 foods of vegetal origin as well as of mineral water. Table 1 provides an overview of substances and substance groups for which foods of animal origin were examined. The respective data for foods of vegetal origin have been listed in Table 2. Foods which had also been examined under the monitoring schemes of the preceding years have been marked accordingly.

In the reporting year of 1999, foods of vegetal origin were examined for an even greater number of plant protection products compared with the preceding years. The extension of the spectra of substances covered resulted from an increased use of the potential for analysis provided by the multiple methods developed by Deutsche Forschungsgemeinschaft (DFG) (also cf. 3.2). Thus, some foods of vegetal origin were examined for more than 120 plant protection products or their metabolites. The decision to extend the spectra of substances was aimed at an even more comprehensive examination and description of the contamination levels found in foods with regard to a preventive health protection of consumers.

Table 1: Foods of animal origin and substances/substance groups examined

Foods	**Substances and substance groups**
1. Camembert cheese	Environmental contaminants: persistent organochlorine compounds, PCB, nitro musk compounds, bromocyclen, heavy metals
2. Turkey meat	Environmental contaminants: persistent organochlorine compounds, PCB, nitro musk compounds, bromocyclen, heavy metals
3. Turkey liver	Heavy metals
4. Salami	Environmental contaminants: persistent organochlorine compounds, PCB, nitro musk compounds, bromocyclen, heavy metals
5. Mackerel smoked	Environmental contaminants: persistent organochlorine compounds, PCB, musk compounds, bromocyclen, heavy metals
6. Tuna in water canned	Environmental contaminants: persistent organochlorine compounds, PCB, musk compounds, bromocyclen, heavy metals
7. Infant formula	Environmental contaminants: persistent organochlorine compounds, PCB, musk compounds, bromocyclen, heavy metals

Foods of animal origin - reasons for selection

Cheese
Camembert
The name goes back to the town of Camembert in Normandy, France, where this soft cheese is said to have been produced for the first time in 1791. As all types of cheese produced by means of rennin coagulation, Camembert is an excellent source of readily absorbed calcium thus forming an important dietary factor for maintaining a healthy bone structure. In order to clarify to what extent these positive characteristics are reduced by possible contamination with undesirable substances, this type of soft cheese was to serve as an example under the present monitoring scheme.

Meat
Turkey meat
An increasing tendency is seen in the consumption figures for this lean and white type of meat. As to the amounts consumed, it assumes the second position after chicken meat. Turkeys are almost exclusively fed under intensive farming conditions using high shares of imported feeds. Hence, an elevated risk of contamination with undesirable substances cannot be excluded.

Edible offals
Turkey liver
For turkey liver, the reasons stated for the examination of turkey meat apply correspondingly. In addition, it has to be taken into account that turkey liver, similar to liver in general, is an organ that may accumulate heavy metals.

Sausages
Salami
The name of salami goes back to the Italian word “salame” meaning something like salted or pickled meat. Salami may be produced exclusively from the meat of a single animal species. In most cases, however, mixtures of beef, pork and bacon of most varying origin are used for production. In technological terms, salami is a type of raw sausage. Preservation of this sausage type is not performed by heating as usual but mainly by water removal, e.g. by air drying. Examination of salami under the monitoring scheme was to provide information missing so far on the contamination situation regarding this special type of sausage.

Fish products
Mackerel smoked
Being a tasty food suitable for a quite versatile culinary use, this predator may contain elevated levels of environmental contaminants. This is explained by its position within the food chain as a predator.

Tuna in water canned
Being a predator as well, tuna may exhibit elevated contamination levels. Of tuna, the canned product was examined because this is the form in which tuna is commonly offered in the market.

Food for infants and young children
Infant formula
Being a highly sensitive type of food, food for infants and young children is subject to more stringent provisions than other foods. Thus, the concentration of plant protection products, pesticides and crop protection products including those no longer used and classified as environmental chemicals, must not exceed 0.01 mg/kg admitting no exception. Examinations under the monitoring scheme were intended to demonstrate whether this stringent provision had been complied with.

Table 2: Foods of vegetal origin including mineral water and substances/substance groups examined

Food	Substances and substance groups
1. Wheat grain*	Plant protection products, heavy metals, mycotoxins
2. Whole grain rolled oats	Plant protection products, heavy metals, mycotoxins
3. Linseed	Plant protection products, heavy metals
4. Pistachio **	Aflatoxins
5. Cauliflower	Plant protection products, heavy metals, nitrate
6. Onion	Plant protection products, heavy metals, nitrate
7. Sweet pepper	Plant protection products, heavy metals, nitrate
8. Melon / honeydew melon	Plant protection products, heavy metals, nitrate
9. Cultivated mushrooms	Plant protection products, heavy metals, nitrate
10. Papaya	Plant protection products, heavy metals, nitrate
11. Rhubarb	Heavy metals, nitrate
12. Nougat cream	Heavy metals, aflatoxins
13. Coffee roasted	Heavy metals
14. Mineral water	Heavy metals and other elements

* Also examined under the 1997 and 1998 monitoring schemes
** Also examined under the 1995, 1996 and 1998 monitoring schemes

Foods of vegetal origin including mineral water - reasons for selection

Cereals
Wheat grain
Wheat is the most important cereal species in food economy. This is why examination of this cereal for contaminants is of paramount importance. Under the 1999 monitoring scheme, wheat has been examined in the third consecutive year in order to confirm results gained in previous years, particularly concerning the presence of mycotoxins.

Cereal products
Whole grain rolled oats
In physiological terms, oats is more valuable than the other cereal species. Rolled oats stand out for containing biologically highly valuable protein and high levels of unsaturated fatty acids as well as of E and B vitamins and of physiologically valuable dietary fibre. Owing to these constituents, rolled oats have become an established component of foods for infants and young children, special diets for sick persons and of health-focussed diets. In view of these uses, information about the presence of undesirable substances in rolled oats is of particular importance.

Hard-shelled dry fruit, oilseeds
Pistachio
In 1999, pistachios were examined for the fourth time under the monitoring schemes. Such frequent sampling was due to the fact that aflatoxin levels found earlier had been extremely high in parts.

Linseed

Linseed has assumed increasing importance as a constituent of a healthy diet. Owing to its mildly laxative effect, linseed is consumed as a proved means to promote healthy conditions in the intestinal tract. This most favourable property is contrasted by the fact that, like many other types of oilseeds, linseed may accumulate considerable quantities of undesirable substances such as heavy metals.

Fresh vegetables

In Germany, a great variety of fresh vegetables is offered in the market. Most vegetables are available throughout the year. This is ensured by imports from all over the world, or by vegetable production with the help of cultivation under conditions of a controlled environment.

Vegetables are available in a great variety and in particular serve as an important source of dietary fibre, vitamins and minerals in the human diet. Therefore, they are an ideal constituent of a balanced diet. As a consequence of technical measures in the cultivation process or due to environmental influences, vegetables may contain substances undesirable from the viewpoint of a preventive health protection of consumers (e.g. residues of plant protection products, nitrate, heavy metals).

Stalk vegetables

Cauliflower

Cauliflower is a vegetable grown in temperate climates. It is available throughout the year, originating from growing regions in the northern parts of Europe during the summer season and from the warmer regions in the south of Europe during the winter season. Cauliflower is consumed quite frequently as it is most versatile in culinary use, whether in a raw, cooked, or steamed state or au gratin.

Onion

Onions are among the vegetables consumed most frequently. In terms of per capita consumption of vegetables, onions rank third after tomatoes and cucumbers.

Fruiting vegetables

Sweet pepper

This vegetable is grown under various conditions and is therefore available throughout the year. During the cold season, the major part of sweet peppers offered in the market originate from cultivation in controlled environments. Sweet pepper was examined under the monitoring scheme in order to update the available information on residue levels.

Melon / honeydew melon

Although meanwhile, melons are available throughout the year, originating in part also from cultivation in controlled environments, they are mainly offered during the period from July to October. Melon is a low-calorie vegetable containing high quantities of vitamin C and potassium. In the past, little information had been available about the presence of undesirable substances in melons.

Edible fungi

Cultivated mushrooms

Button mushrooms (*Agaricus bisporus*) are among the few species of edible fungi suitable for cultivation. Unlike green plants, fungi do not assimilate, i.e. they are not capable of forming organic matter from inorganic matter. Hence, mushroom cultivation has to be performed on suitable growth substrates that already contain the organic matter required for the growth of the fruiting body of the fungus (e.g. compost). It is known that mushrooms may accumulate considerable quantities of certain undesirable substances, e.g. heavy metals, from the substrate. Generally, this applies to wild mushrooms. Examinations under the food monitoring scheme were intended to clarify to what extent cultivated mushrooms may be affected by this phenomenon.

Fresh fruit
Like that of vegetables, a regular consumption of fruit has been recommended for a healthy diet. Therefore, a continued monitoring of the presence of undesirable substances in fruit is necessary. This is particularly important since most fruit species are susceptible to pests and fungal diseases. Because in general, consumers will accept flawless fruits only and disapprove of an occasional presence of worm-infested or scabby fruits, a variety of plant protection measures is required in fruit growing.

Exotic fruit and rhubarb
Papaya
In tropical regions, the use of plant protection products is determined by conditions different from those in Europe. Due to a higher risk of pest infestation, a more intense treatment with plant protection products than in temperate zones is mostly required. Therefore, the monitoring was intended to elucidate residue levels of this fruit which is imported from tropical regions.

Rhubarb
(Rhubarb is classified as “fruit” under German food legislation.)
Rhubarb is often used to prepare compote, cake, jam and wine as well. Examinations under the monitoring scheme were intended to update the available information on the presence of undesirable substances in this ”fruit”.

Spreads
Nougat cream
Main ingredients of this spread being very popular particularly among children are cocoa, nut paste and sugar. In particular, the raw materials, cocoa and nuts, may exhibit considerable levels of contamination with heavy metals and aflatoxins. It was the aim of the examinations to demonstrate whether the raw materials used for the production of nougat cream were appropriate in terms of quality.

Coffee roasted
Coffee is among the beverages consumed most frequently. This is why information on levels of heavy metals which may be present in roasted coffee is of particular importance.

Mineral water
Mineral water is required to represent “original purity”. Depending on the source, levels of heavy metals and other elements may vary considerably, and there are special regulations applicable to these. Corresponding examinations were to be performed under the monitoring scheme.

3.2 Sampling and quality of analysis

The sampling of foods was performed according to a sampling plan developed by the Federal Institute for Health Protection of Consumers and Veterinary Medicine (BgVV), which allows to make representative statements about contamination levels in foods as sold on the German market. Samples were collected in commerce or at the producers' premises.

Sampling and chemical analysis of the foods are tasks performed by the competent authorities and the laboratories of official food control in the 16 Federal Länder.

In the laboratories, the food samples were prepared for analysis (e.g. washing, cleaning, peeling) according to standardized methods in order to obtain comparable results. The analytical methods chosen had to ensure comparability of the results and compliance with the criteria for validation as stipulated in Council Directive 85/591/EEC[*)]. In order to cope with the sometimes very large spectra of organic substances in the examination of food samples, multiple methods were preferentially used, e.g. methods developed by the Deutsche Forschungsgemeinschaft (DFG), as required by the Collection of Methods under § 35 of the German Foods and Other Commodities Act (LMBG). The reliability of test results was ensured by additional laboratory-specific measures as e.g. the use of appropriate reference materials and interlaboratory comparison.

[*)] Council Directive 85/591/EEC of 20 December 1985 concerning the introduction of Community methods of sampling and analysis for the monitoring of foodstuffs intended for human consumption. (Official Journal of the European Communities No L 372/50, 31 December 1985.)

4. Numbers of samples and origin

In 1999, a total of 4918 samples was examined. Most of these samples had been collected in commerce, but in part also at the producers' or importers' premises and at slaughtering establishments. Figure 1 shows the absolute and relative shares of foods of animal and vegetal origin in the total numbers of samples. Figure 2 shows the shares of samples of domestic and foreign origin. The numbers of samples by geographical origin have been listed in Table 3 for foods of animal origin and in Table 4, for foods of vegetal origin.

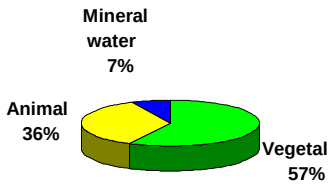

Fig. 1: Shares of samples of animal/vegetal origin

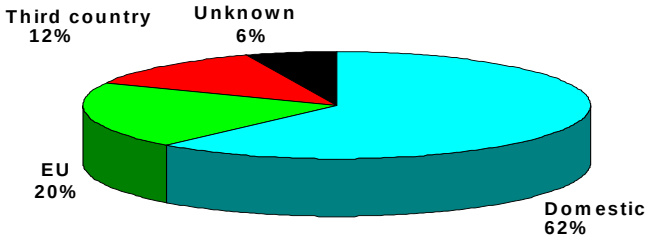

Fig. 2: Shares of samples by geographical origin

Table 3: Numbers of samples by geographical origin (foods of animal origin)

Food	Domestic		Other origin			Unknown / Others		Total
	No.	%		No.	%	No.	%	No.
Camembert			France	107	42.6			
	143	**57.0**	*Total*	**107**	**42.6**	**1**	**0.4**	**251**
Turkey meat			France	87	25.0			
			Netherlands	33	9.5			
			Italy	8	2.3			
			Great Britain	6	1.7			
	207	**59.5**	*Total*	**134**	**38.5**	**7**	**2.0**	**348**
Turkey liver			Netherlands	9	4.6			
	182	**93.8**	*Total*	**9**	**4.6**	**3**	**1.5**	**194**
Salami			France	15	5.9			
			Italy	9	3.5			
	223	**87.8**	*Total*	**24**	**9.4**	**7**	**2.8**	**254**
Mackerel smoked			Denmark	5	1.9			
	201	**77.3**	*Total*	**5**	**1.9**	**54**	**20.8**	**260**
Tuna canned			Thailand	32	12.2			
			Ivory Coast	27	10.3			
			Philippines	22	8.4			
			France	20	7.6			
			Ecuador	13	5.0			
			Papua New Guinea	12	4.6			
	43	**16.4**	*Total*	**126**	**48.1**	**93**	**35.5**	**262**
Infant formula	**191**	**100**						**191**

Table 4: Numbers of samples by geographical origin (foods of vegetal origin)

Food	Domestic		Other origin			Unknown / others		Total
	No.	%		No.	%	No.	%	No.
Wheat grain	**96**	**93.2**				**7**	**6.8**	**103**
Whole grain rolled oats	**235**	**94.4**				**14**	**5.6**	**249**
Linseed			Canada	4	1.9			
			Argentina	3	1.4			
	172	**81.1**	*Total*	**7**	**3.3**	**33**	**15.6**	**212**
Pistachio			Iran	22	50.0			
			Turkey	4	9.1			
			USA	4	9.1			
			Total	**30**	**68.2**	**14**	**31.8**	**44**
Cauliflower			France	81	32.3			
			Italy	31	12.4			
			Spain	6	2.4			
			Netherlands	3	1,2			
			Belgium	1	0.4			
	127	**50.6**	*Total*	**122**	**48.7**	**2**	**0.8**	**251**
Onion			Netherlands	23	8.8			
			New Zealand	20	7.6			
			Spain	17	6.5			
			Italy	13	5.0			
			Poland	10	3.8			
			Argentina	10	3.8			
	154	**58.8**	*Total*	**93**	**35.5**	**15**	**5.7**	**262**
Sweet pepper			Spain	110	44.7			
			Netherlands	93	37.8			
			Turkey	8	3.3			
			Hungary	8	3.3			
	17	**6.9**	*Total*	**219**	**89.1**	**10**	**4.1**	**246**
Melon			Spain	152	63.3			
			Costa Rica	31	12,9			
			Brazil	22	9.2			
			Total	**205**	**85.4**	**35**	**14.6**	**240**
Cultivated mushroom			Netherlands	84	35.7			
			Hungary	16	6.8			
	119	**50.6**	*Total*	**100**	**42.5**	**16**	**6.8**	**235**
Papaya			Brazil	140	61.4			
			Ghana	29	12.7			
			USA	14	6.1			
			Total	**183**	**80.2**	**45**	**19.7**	**228**
Rhubarb	**196**	**92.5**				**16**	**7.5**	**212**
Nougat cream	**243**	**97.2**				**7**	**2.8**	**250**
Coffee roasted			Central / South America	11	4.7			
	177	**75.3**	*Total*	**11**	**4.7**	**47**	**20.0**	**235**
Mineral water			France	19	5.7			
			Italy	12	3.6			
	301	**89.6**	*Total*	**31**	**9.3**	**4**	**1.2**	**336**

5. Contamination of foods with undesirable substances

In this chapter, the results of the examination of foods under the 1999 monitoring scheme are presented, broken down by foods of animal and vegetal origin.

5.1 Foods of animal origin

5.1.1 Cheese

Camembert

251 Camembert samples were examined for 26 mainly fat-soluble and persistent organochlorine compounds including PCB as well as bromocyclen, musk compounds, and the heavy metals, lead, cadmium and mercury. In addition to a description of the contamination levels in general, it was intended to examine whether there were differences between the contamination levels found in Camembert of German and Camembert of French origin.

Organic substances

Ca. 100 l of milk are needed to produce ca. 11 - 12 kg of Camembert. This fact suggests a presence of certain concentrations of undesirable substances in the cheese. However, findings have demonstrated Camembert to be contaminated to a generally very low degree, a result certainly attributable also to a low contamination of milk. None of the substances was detected frequently, i.e. in more than 50 % of all samples. The levels of substances measured were very low. Ca. 31 % of samples were free from detectable levels, and none of the samples was found to have exceeded a maximum level (ML) (cf. Fig. 3).

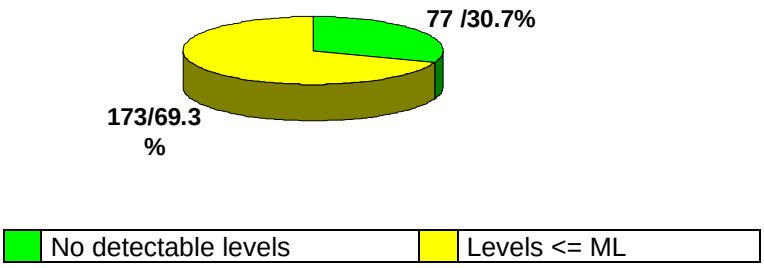

Fig. 3: Contamination of Camembert cheese with organic substances

A comparison of contamination levels in Camembert originating from France and Germany resulted in the finding that of all substances considered, only DDT levels differed significantly, but within very low level ranges (cf. Fig. 4). For an interpretation of the levels of contaminants depicted in Fig. 4, it has to be mentioned that the maximum level of DDT in Camembert has been fixed at 1.0 mg/kg (total DDT in the fat share).

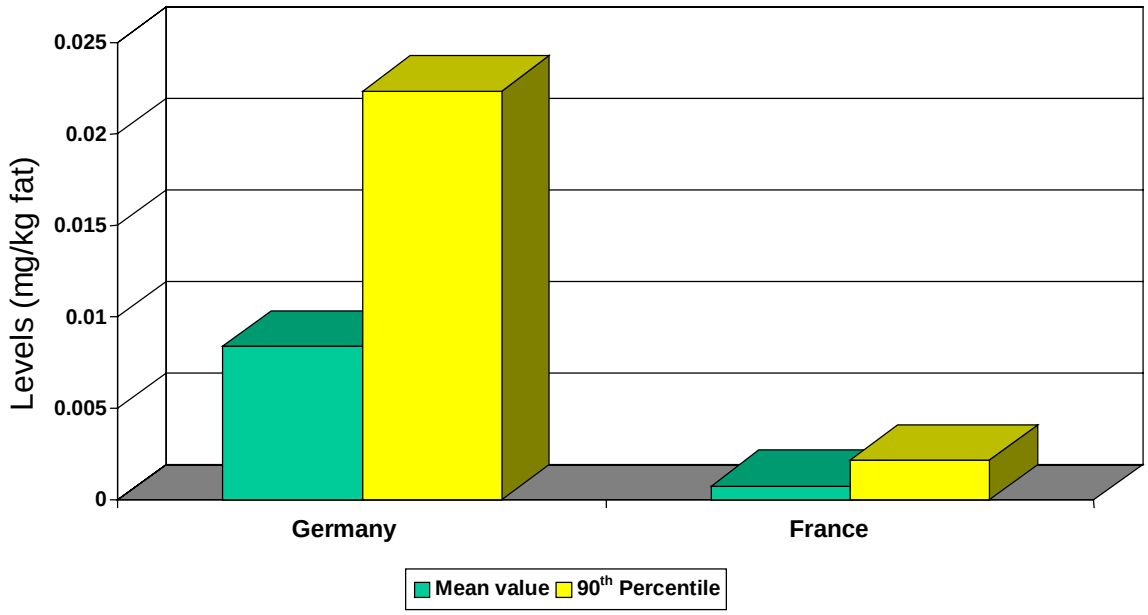

Fig. 4: Total DDT levels found in German and French Camembert

No differences could be established between German and French samples with regard to the substances, lindane, HCB and PCB 153, detected in more than 20 % of samples each.

Heavy metals
Levels of lead and cadmium found in Camembert were very low. Only in one sample each, levels were found to exceed the respective guide value. Mercury contamination levels were found to be somewhat more noticeable. The guide value was exceeded in a total of 14 samples. Although differences concerning the mercury levels found in German and French Camembert were not statistically significant, the nominal share of samples exceeding the guide value was higher for French Camembert samples (10) than for the German ones (4) (Table 5).

Table 5: Number of samples with levels exceeding guide values (GV)

	No of samples	Lead GV 0.25 mg/kg	Cadmium GV 0.05 mg/kg	Mercury GV 0.01 mg/kg
French Camembert	107			10
German Camembert	143	1	1	4

Conclusion
Contamination of Camembert was generally low. There were significantly higher DDT levels found in German Camembert when compared with French Camembert, however still ranging at low levels.

5.1.2 Meat

Turkey meat
348 samples of this poultry meat were examined for 21 persistent organochlorine compounds including PCB as well as for bromocyclen, musk compounds and heavy metals.

Organic substances
Owing to their low fat content, turkey meat and turkey meat products are very popular among consumers interested in a low-fat diet. Results of the 1999 examinations have demonstrated that contamination of this low-fat food with fat-soluble persistent organochlorine compounds was naturally very low. Generally, the levels measured were very low. None of the substances was quantified frequently, i.e. in more than 50 % of all samples. Fig. 5 illustrates

that 65.5 % of samples were free from detectable residues, and above-maximum levels were found in only a very low percentage of samples (0.9 %).

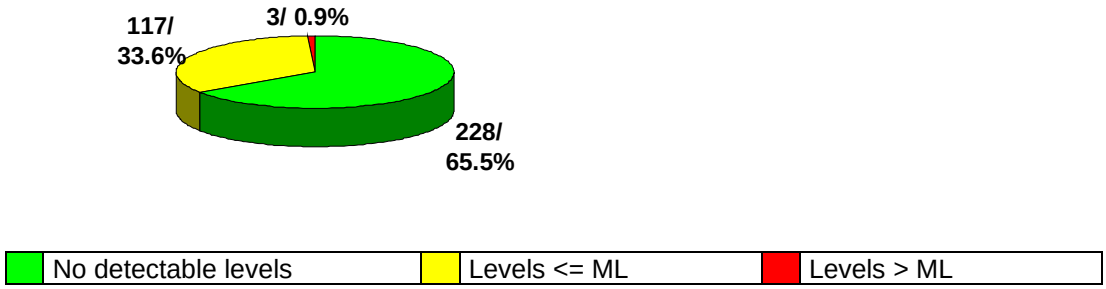

Fig. 5: Contamination of turkey meat with organic substances

Heavy metals

Lead, cadmium and mercury levels found were low and complied with the levels typical of muscle tissue whose contamination is generally low. Only for mercury, a statistically significant difference was found when a comparison was drawn between samples originating from Germany and those from other EU countries. Quantified levels in samples originating from other EU countries, although very low, were significantly higher than those in samples from Germany (Fig. 6).

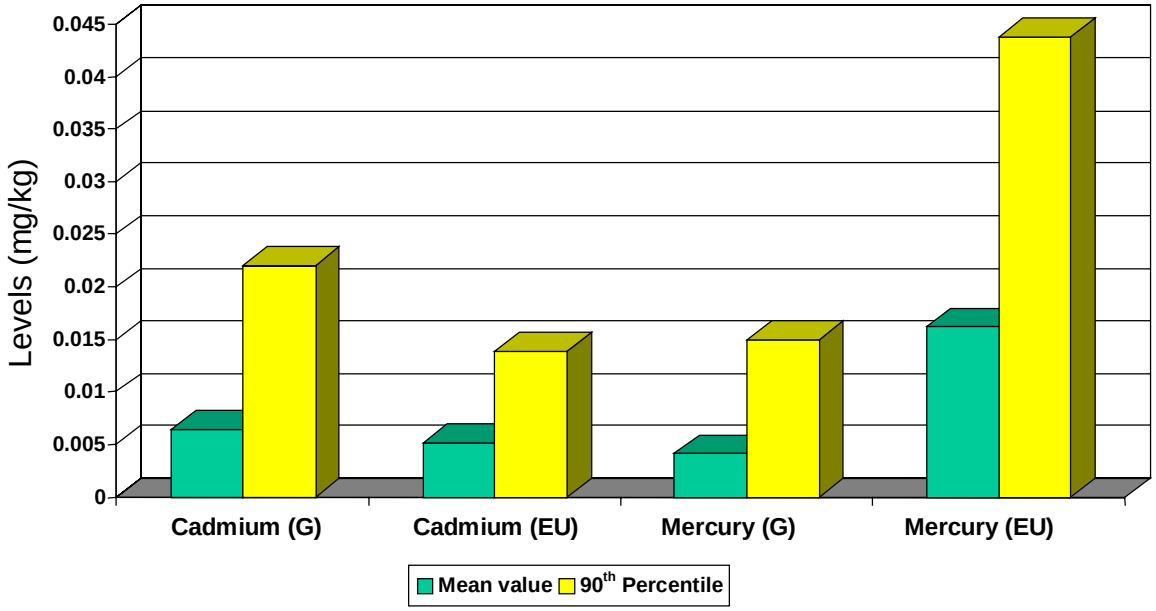

Fig. 6: Levels of cadmium and mercury in turkey meat by origin

Conclusion

Turkey is a food exhibiting low contamination levels.

Turkey liver

It has been known from the past that contamination of liver with heavy metals may be very high. This fact gave rise to intensive examinations of this food under the monitoring schemes. Thus, pork liver and lamb's liver were examined in 1996, pork liver again in 1997 and beef liver, in 1998. For further confirmation and completion of the findings made so far, 194 samples of turkey liver were examined for the heavy metals, lead, cadmium and mercury.

Heavy metals

Contamination of turkey liver with lead, cadmium and mercury can be rated as low. As depicted in Fig. 7, cadmium levels in turkey liver were generally somewhat higher when compared with the levels found in liver from other animal species examined while lead and mercury levels were lowest in turkey liver. With reference to the ubiquitous presence of heavy metals, it is worth mentioning in addition that only cadmium was quantified in almost all samples, although generally at low levels. In contrast, lead was quantified in no more than 4.6 % and mercury in 11.3 % of turkey liver samples.

Examinations of liver meanwhile performed over a period of several years have shown that liver is no longer among the foods involving a potential for high contamination with heavy metals, as has now been confirmed by the findings for turkey liver. This fact is certainly to be attributed to an improved environmental situation on the one hand and to intensified activities in the control of feeds on the other.

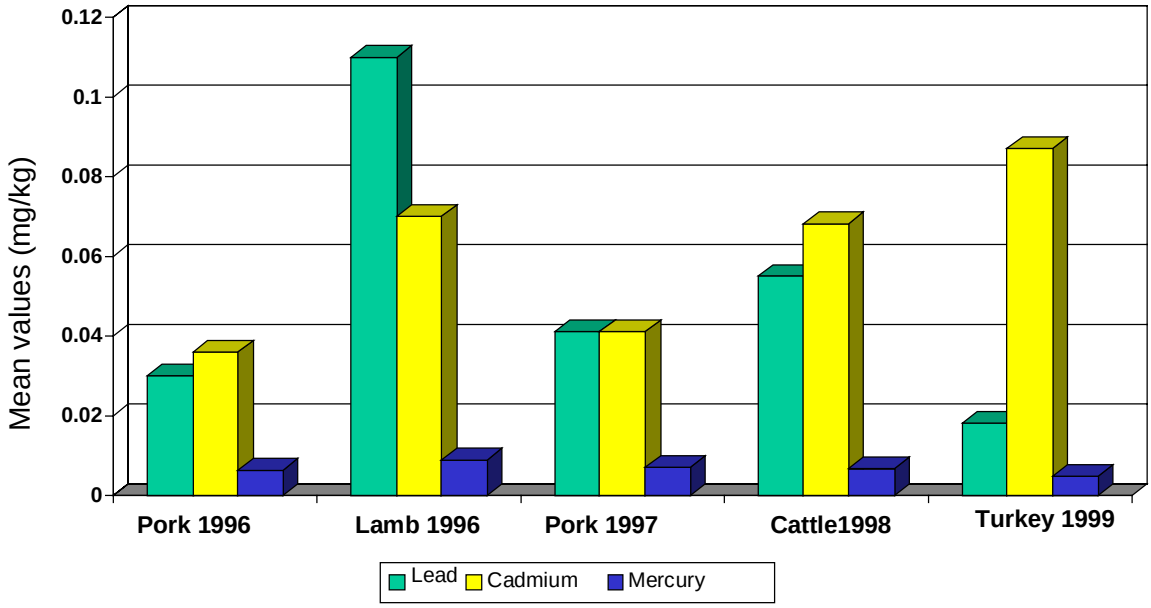

Fig. 7: Levels of heavy metals in liver from different animal species

Conclusion

Contamination of turkey liver with heavy metals was comparatively low.

Salami

Like all types of raw sausages, salami is a high-quality type of sausage. Only muscle and fat tissue may be used for the production of salami. Low-quality ingredients such as rinds, tendons or offals of any type must not be used for salami production. 249 samples of this type of sausage were examined for 22 persistent organochlorine compounds including PCB as well as for bromocyclen, musk compounds, lead, cadmium and mercury.

Organic substances

Contamination of salami with organic substances was low. None of the substances was detected frequently, i.e. in more than 50 % of all samples. Levels quantified were low. In one sample only, the content of a substance (bromocyclen) was found to exceed the maximum level. The major part of samples was free from detectable levels of organic contaminants (Fig. 8).

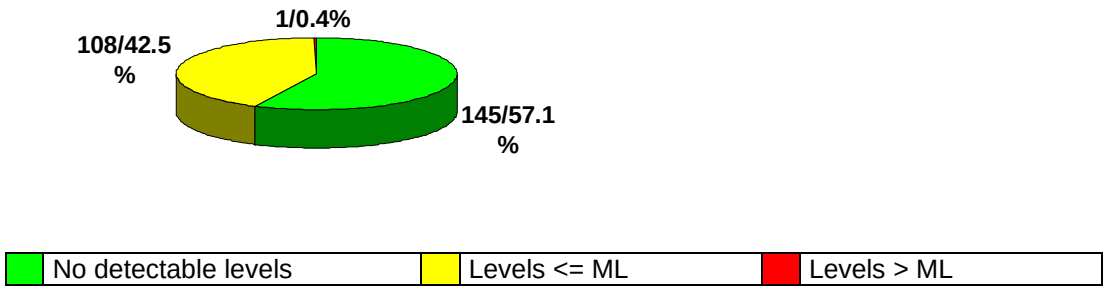

Fig. 8: Contamination of salami with organic substances

Heavy metals

The levels of heavy metals found in salami were generally low, and only a low percentage of samples was found to exceed guide values for lead and cadmium, respectively (2.4 % each, Table 6).

Table 6: Levels of heavy metals in salami (mg/kg)

	Median	90th Percentile	95th Percentile	Guide value	% > Guide value
Lead	0.030	0.050	0.075	0.250	2.4
Cadmium	0.003	0.012	0.053	0.100	2.4
Mercury	0.005	0.020	0.020	0.050	

Conclusion

Salami is a food generally exhibiting low contamination levels.

5.1.3 Fish products

Mackerel smoked

Smoked mackerel is a fish product commonly available in the market. 260 samples of this popular fish speciality were examined for 28 persistent organochlorine compounds including PCB and selected Parlar congeners, as well as for bromocyclen, musk compounds, lead, cadmium and mercury.

Organic substances

Mackerel is caught exclusively as wildlife fish. Therefore, multiple contamination of this marine fish and its products with ubiquitous substances is possible. The 11 contaminants listed below were detected frequently, i.e. in more than 50 % of samples examined, although at low levels, as a rule.

PCB 138
PCB 153
PCB 180
DDE-pp'
Dieldrin
HCB
Parlar 26
Parlar 50
Parlar 62
Alpha HCH
Alpha chlordane

Due to the frequent presence of ubiquitous substances, only a low share of samples (6.5 %) was free from detectable levels (Fig. 9). The levels measured were low, which was additionally confirmed by the fact that none of the levels found in the samples exceeded any maximum level.

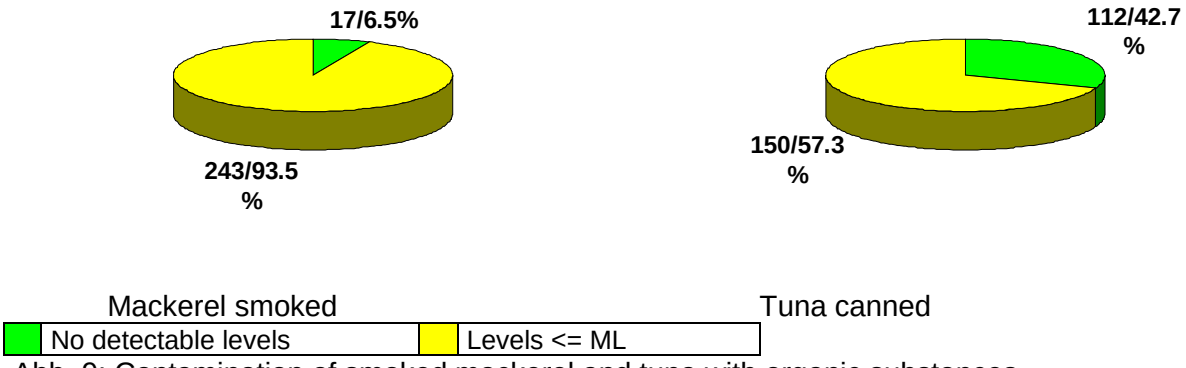

Abb. 9: Contamination of smoked mackerel and tuna with organic substances

Heavy metals

Contamination of smoked mackerel with heavy metals was low (Fig. 10). In none of the samples, levels were found to exceed the guide values for lead and cadmium, respectively. Only one sample exceeded the maximum level of 0.5 mg/kg for mercury. When compared with other fish products as shown in Fig. 10, the level of contamination of smoked mackerel more or less corresponded to a mean position.

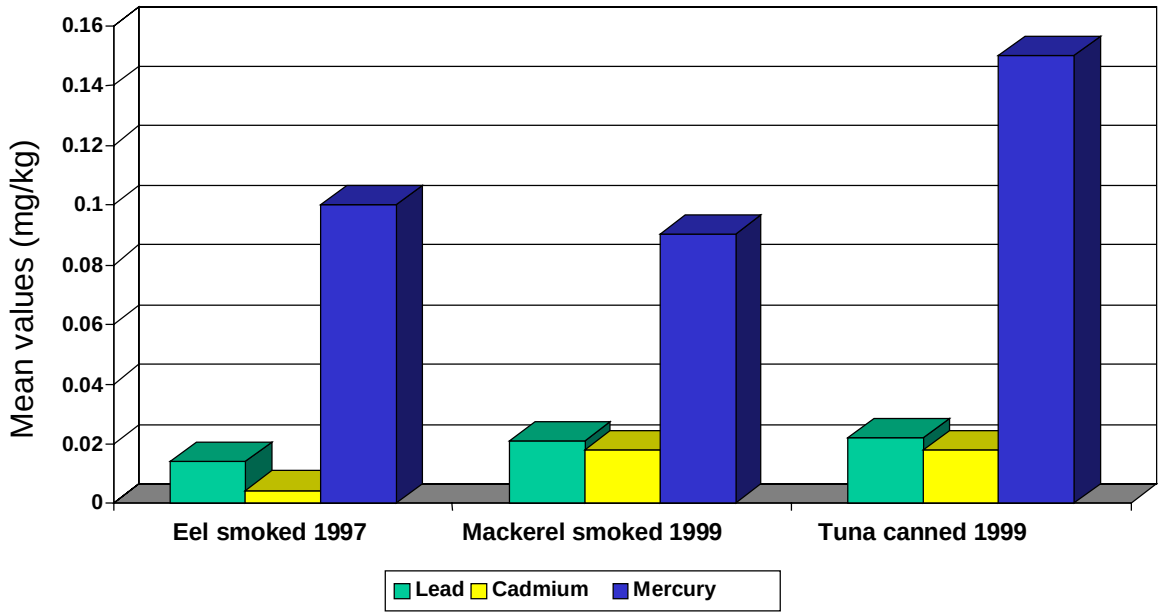

Fig. 10: Levels of heavy metals in fish products

Conclusion
Although the levels of contaminants found were low, smoked mackerel has to be classified as a moderately contaminated food due to the high number of substances detected frequently.

Tuna in water canned
Canned tuna in water is produced from fresh fish of best raw product quality. In this product, the characteristic taste of the fish is largely maintained. 262 samples of canned tuna were examined for the same spectrum of substances as was smoked mackerel.

Organic substances
Only few organic contaminants at low concentrations were detected in canned tuna. In contrast to smoked mackerel, no substance was quantified frequently in this fish product, which is also produced from wildlife fish. Ca. 43 % of samples were free from detectable levels of contaminants, and none of the samples was found to have exceeded a maximum level (ML) (Fig. 9). The considerable differences found between smoked mackerel and canned tuna regarding the contamination with ubiquitous substances are to be attributed to the different fat content of the two fish species and their special positions within the marine food chain.

Heavy metals
Contamination with lead and cadmium of canned tuna was low (Fig. 10). In 0.8 of samples only, the cadmium level exceeded the guide value (Table 7).
Mercury levels were moderate. Compared with those found in smoked eel and smoked mackerel, they were highest in this predator (Fig. 10; see also box). There was no sample found to exceed any maximum level (Table 7).

Table 7: Levels of heavy metals in canned tuna (mg/kg)

	Median	90th Percentile	95th Percentile	GV/ML	% > GV/ML
Lead	0.020	0.030	0.055	0.500	
Cadmium	0.014	0.033	0.043	0.100	0.8
Mercury	0.100	0.350	0.440	1.0(ML)*	

* ML= Maximum level

Conclusion
Tuna canned in water is a food that was generally found to exhibit low contamination. Mercury contamination was moderate.

Mackerel, tuna

The fish species of **mackerel** has a relatively small share of 2 % only in the total quantity of fish products consumed in Germany. The main fishing grounds are the north-east Atlantic Ocean and the adjacent shelf seas including the North Sea. Mackerel is commercially available mainly as a smoked or canned product. Due to its high share of polyunsaturated fatty acids, this fish species is particularly valuable in terms of nutritional physiology (special diet for the prevention of coronary heart disease). However, being a predator rich in fat, mackerel must be expected to be potentially contaminated with fat-soluble environmental chemicals.
The name of **tuna** refers to a group of subspecies in the Scombridae family (to which also the mackerels belong). In Germany, tuna is mainly available as a canned product having a share of ca. 6 % in the consumption of fish products. Fishing, processing and marketing take place all over the world. As a rule, canned tuna is produced using species and sizes contaminated to a minor degree only. This practice also helps to avoid high mercury contamination levels in canned tuna, which has occasionally become known in the past.
Additional note:
A problem existing independently of the contamination situation considered in the present publication is that of both tuna and mackerel having shown a tendency towards **histamine formation**. Being a protein degradation product, histamine may cause allergic reactions in susceptible persons. Histamine formation is a problem exclusively related to food hygiene. Histamine levels in fish products may be reduced to a minimum by suitable hygienic measures, in particular by chilling during the processing of tuna and mackerel.

5.1.4 Food for infants and young children

Infant formula

Infant formula is classified under foods for special dietary uses under the German Foods Act. Under the above Act, foods for special dietary uses are subject to special and strict requirements (see also box). These requirements are mostly restrictive. Thus, levels of organic contaminants must not exceed 0.01 mg/kg, on principle. 171 samples of infant formula (powder) were examined for 21 persistent organochlorine compounds including PCB as well as bromocyclen, musk compounds, and the heavy metals, lead, cadmium and mercury. In addition, 91 samples were examined for aflatoxin M1.

Organic substances
In accordance with the stringent criteria applying to foods for special dietary uses, contamination of infant formula with ubiquitous organic substances was very low. This fact also appears to prove manufacturers to have properly complied with their obligation to carefully select the raw materials. Accordingly, no contaminants were detectable in the majority of samples (66.5%), as depicted in Fig. 11. Only one sample was found to exceed the general maximum level of 0.01 mg/kg.

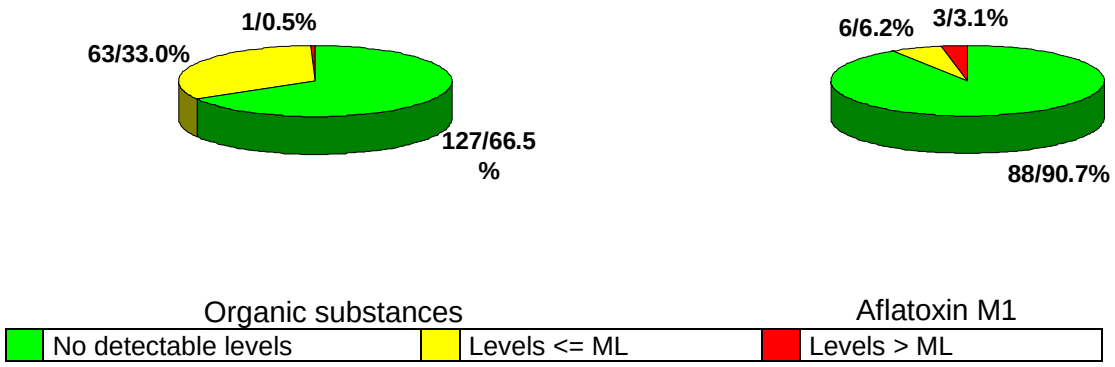

Fig. 11: Contamination of infant formula with organic substances

Heavy metals

As can be seen from Table 8, levels of heavy metals were consistently very low. Only a minor share of samples exhibited levels exceeding the guide values for milk.

Table 8: Levels of heavy metals in infant formula (as referred to the food ready for consumption, in mg/kg).

	Mean	90th Percentile	95th Percentile	Guide value*	% > GV
Lead	0.0063	0.0112	0.0239	0.030	1.6
Cadmium	0.0011	0.0026	0.0030	0.005	2.6
Mercury	0.008	0.0010	0.0029	0.010	-

* For evaluation purposes, guide values (GV) for milk have been used in the absence of GV for infant formula.

Aflatoxin M1

Aflatoxin M1, a mycotoxin mainly present in milk, was detected at low levels in less than 10 % of samples (Fig. 11). The maximum level fixed for aflatoxin M1 in the Regulations on Foods for Special Dietary Uses is as low as 0.01 µg/kg in the product ready for consumption. A still tolerable share of 3.1% of samples exceeded this maximum level to a minor degree (Fig. 11).

Conclusion

Infant formula is contaminated to a very low degree only. The stringent legal requirements applying to foods for special dietary uses have largely been complied with.

Foods for special dietary uses

In view of their special purpose, foods for special dietary uses must comply with specific requirements. Consumption of these foods is intended to increase or decrease the intake of certain nutrients or other substances considered as active in terms of nutritional physiology. Foods for special dietary uses must distinguish themselves from other comparable foods with respect to their composition and/or characteristics to a decisive degree. They are used to meet special dietary requirements as e.g. in cases of deficiency signs, functional anomalies or hypersensitivity to individual foods or their components. Foods for special dietary uses are by no means medicinal products. The properties required for these foods which include particularly strict maximum levels for environmental contaminants and other undesirable substances have been laid down in the German Regulations on Foods for Special Dietary Uses (Diätverordnung). For example, foods for infants and young children, which are also counted among foods for special dietary uses, must not contain more than 0.01 mg/kg of plant protection products, pesticides and crop protection products. The single or total levels of aflatoxins B1, B2, G1 and G2 in these foods must not exceed 0.05 µg/kg, and the level of aflatoxin M1 must not exceed 0.01 µg/kg. Furthermore, limits have been fixed for nitrate levels (max. 250 mg/kg) and contamination with several microbiological agents.

5.2. Foods of vegetal origin

5.2.1 Cereals

Wheat grain

Wheat is an important food in human nutrition. Accordingly, wheat was intensively examined under several monitoring schemes, i.e. in 1997, 1998 and 1999. These examinations performed over a period of several years permit a comparative presentation of contamination levels. Over the years, the spectrum of substances for which wheat was examined under the monitoring schemes has undergone some variation and has been reduced to relevant substances in order to cut down on analytical expenditure. This appeared to be justified because many substances had never been found in previous years. Thus, in 1999, 103 wheat samples were examined for the residues of 46 plant protection products, the heavy metals, lead, cadmium and mercury as well as ochratoxin A.

Plant protection products

As illustrated by Fig. 12, contamination of wheat with residues of plant protection products resulted in approximately identical pictures for three consecutive years. They suggest that wheat can be considered as virtually free from residues, as no detectable residues were found over several years in the majority of samples. Also in 1999, none of the samples was found to exceed any maximum levels.

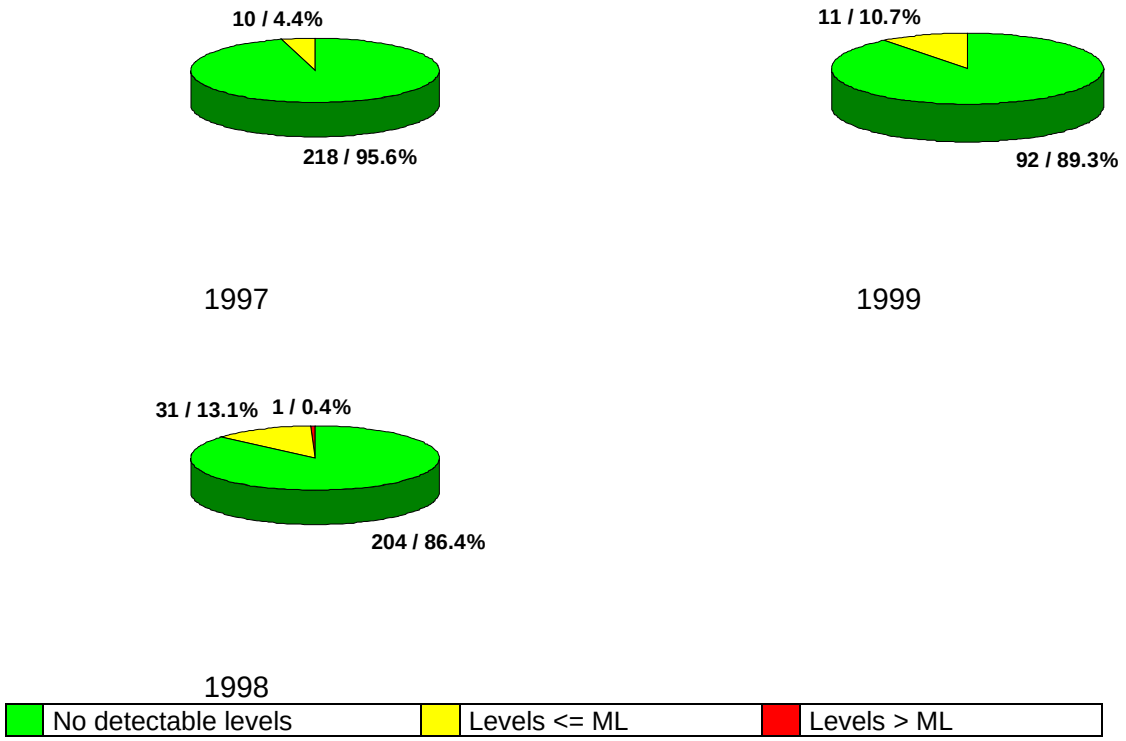

Fig. 12: Contamination of wheat grain with plant protection products

Heavy metals

Levels of lead and cadmium found in wheat gave no rise to concern and did not vary essentially over the past 3 years (Fig. 13 and 14).

The share of samples exceeding guide values was low and did not vary within the examination period, apart from minor variations (Table 9).

Table 9: Shares of wheat samples showing levels above guide values (GV)

	GV mg/kg	1997 % > GV	1998 % > GV	1999 % > GV
Lead	0.30	1.3	0.4	1.0
Cadmium	0.10	3.1	1.3	4.9

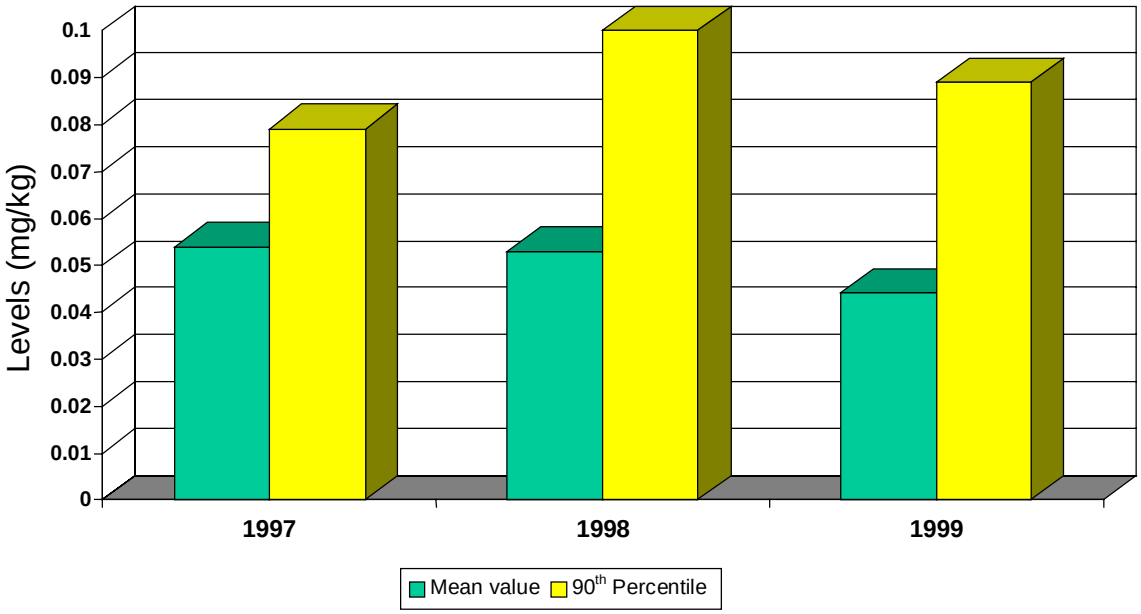

Fig. 13: Lead levels in wheat

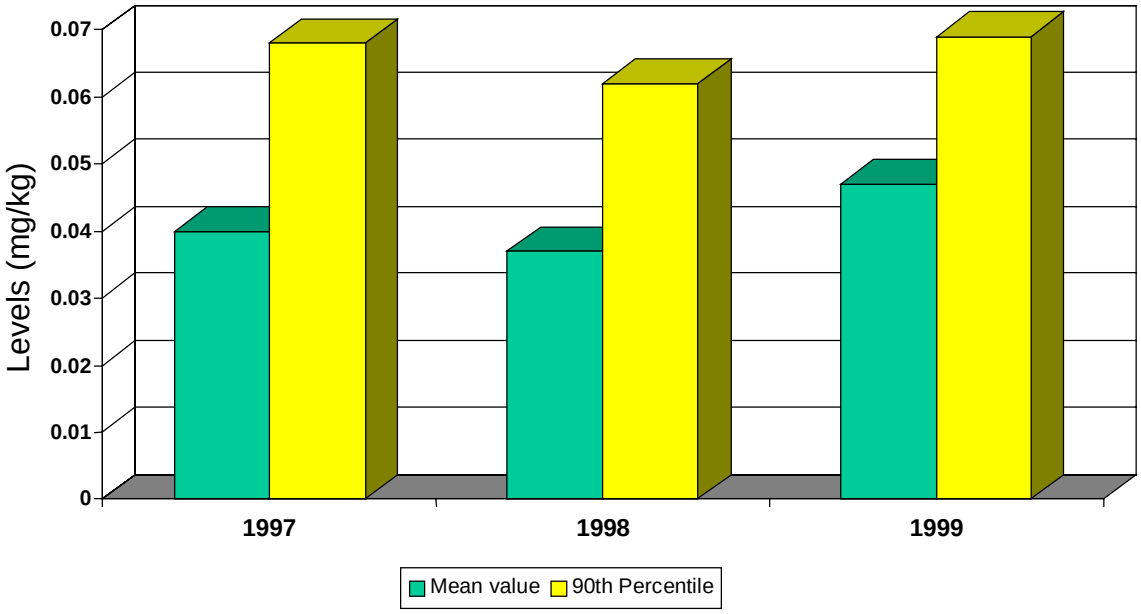

Fig. 14: Cadmium levels in wheat

Mycotoxins

For the mycotoxin, ochratoxin A, there are no fixed reference values such as maximum levels or guide values at present which could serve as yardsticks for evaluation of the levels found. The substance was examined under the monitoring scheme in order to observe its presence and to derive maximum levels from the data obtained or use them as a basis for other measures if necessary for purposes of a preventive consumer health protection. Wheat has been examined for ochratoxin A since 1997 already. From the data listed in Table 10 for three consecutive years, it can be seen that the shares of wheat samples with quantifiable levels of ochratoxin A have shown a decreasing tendency. This may be due to a number of causes. Thus, weather conditions (humidity) in the year of harvest have an essential influence. In relatively dry years, fungal infestation is less extensive, which may result in lower shares of samples exhibiting ochratoxin A levels.

Table 10: Shares of quantified ochratoxin A levels in wheat

Year	1997	1998	1999
Total no of samples	225	234	101
Per cent share	20.9	16.2	9.9

However, the ochratroxin A levels found did not appear to depend on the level of infestation. As illustrated in Fig. 15, the mean levels found have remained almost unchanged over the years considered.

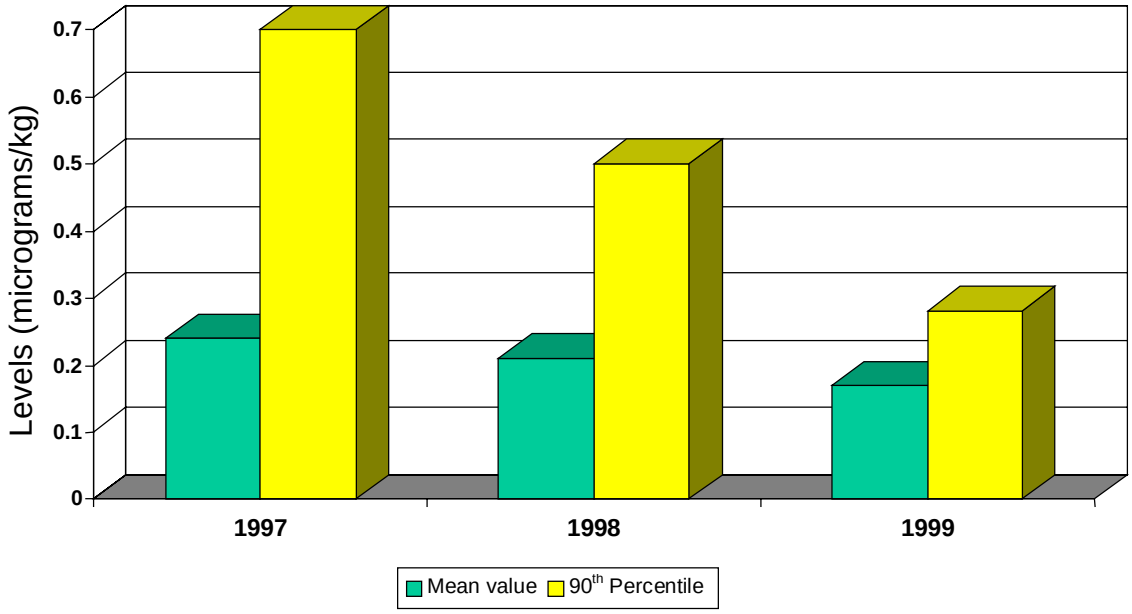

Fig. 15: Ochratoxin A levels in wheat

Conclusion

Wheat was virtually free from residues of plant protection products. Contamination with heavy metals gave no rise to concern. Contamination with ochratoxin A will be subject to further monitoring.

5.2.2 Cereal products

Whole grain rolled oats

Apart from being used in bakery products and foods for infants and young children, rolled oats are mainly consumed as a raw product in the form of muesli. 249 samples of this food, which is of high value in terms of nutritional physiology, were examined for residues of 78 plant protection products and for lead, cadmium and ochratoxin A.

Plant protection products

Contamination of rolled oats with residues of plant protection products was very low. 90 % of samples did not contain any detectable residues (Fig. 16). Except for the fact that above-maximum levels were found in 1.2 % of samples, rolled oats can be considered as virtually free from residues of plant protection products.

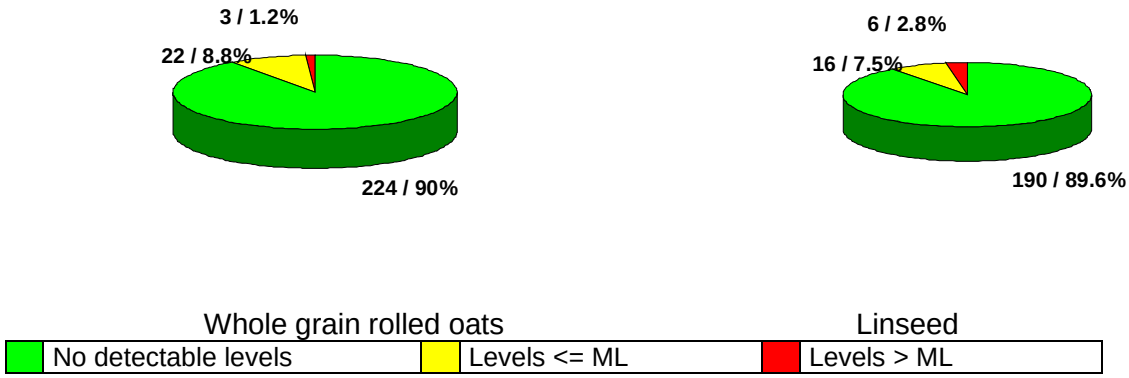

Fig. 16: Contamination of whole grain rolled oats and linseed with plant protection products

Heavy metals

Levels of lead and cadmium found in whole grain rolled oats were low (Figs. 17 and 18).

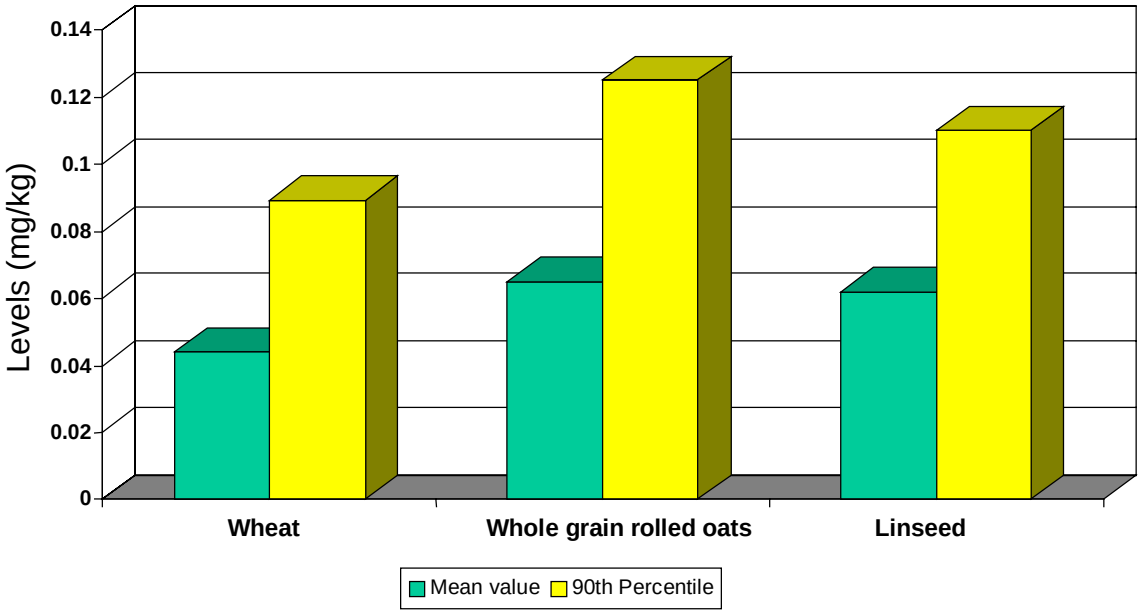

Fig. 17: Lead levels in wheat, whole grain rolled oats and linseed

Ochratoxin A

Ochratoxin A levels were measured in a share of 9.2 % of samples. This is a finding corresponding approximately to the share found in wheat in 1999.

Conclusion
Contamination of rolled oats is low.

5.2.3 Hard-shelled dry fruit, oilseed

Linseed

Consumption of linseed is intended to increase the intake of dietary fibre. At the same time, it helps to maintain a healthy intestinal tract (see also box). 212 linseed samples were examined for an extended spectrum of 116 residues of plant protection products and for lead and cadmium.

Plant protection products

Although the spectrum of substances covered was very broad comprising 116 residues of plant protection products, linseed was found to be contaminated to a minor degree only. Fig. 16 shows 89.6 % of samples to have been free from residues. Apart from the fact that above-maximum levels were found in 2.8 % of samples, linseed can be considered as virtually free from residues.

Linseed

Linseed has been used mainly as a mild laxative being free from undesirable side effects and helping to maintain gastrointestinal health. Its effects are mainly based on its content of mucilage and dietary fibre. Its swelling capacity causes a volume increase and consequently, a stretching stimulus for the intestinal peristalsis activating and promoting the passage of bowel contents. This most favourable property is contrasted by the fact that linseed may contain undesirably high cadmium levels.
Linseed is commercially available in bruised form, as whole seeds or “slightly cracked”. In the latter type of processing, only the outer layer of the seed is slightly cracked to enable a quick release of the swelling substances situated underneath.
Absorption of constituents of linseed including cadmium by the human body depends on the degree to which the seed has been comminuted. It is highest after consumption of bruised linseed and lowest after that of whole seeds. In order to minimize cadmium intake, only consumption of whole or slightly cracked linseed is therefore recommended, in particular if linseed is consumed regularly and over long periods of time.

Heavy metals

The lead levels detected in linseed were low (Table 11 and Fig. 17). In contrast, the known problem of high cadmium levels in linseed has been confirmed to persist by the findings obtained. In Fig. 18, cadmium levels in linseed have been depicted together with those in cereals for comparison and as a reference. In almost 50 % of samples, cadmium levels exceeded the guide value (Table 11). This may be attributed, among other reasons, to the fact that the guide value had been deliberately fixed at a low level (0.3 mg/kg). Since this food is consumed for health considerations, this approach was taken to ensure that only batches which were contaminated to a minor degree would become commercially available (see also box). As demonstrated by the findings made, manufacturers obviously do not always comply with this requirement.

Table 11: Levels of heavy metals in linseed (mg/kg)

	Median	90th Percentile	95th Percentile	Guide value	% > GV
Lead	0.030	0.110	0.200	-	
Cadmium	0.290	0.400	0.450	0.300	44.3

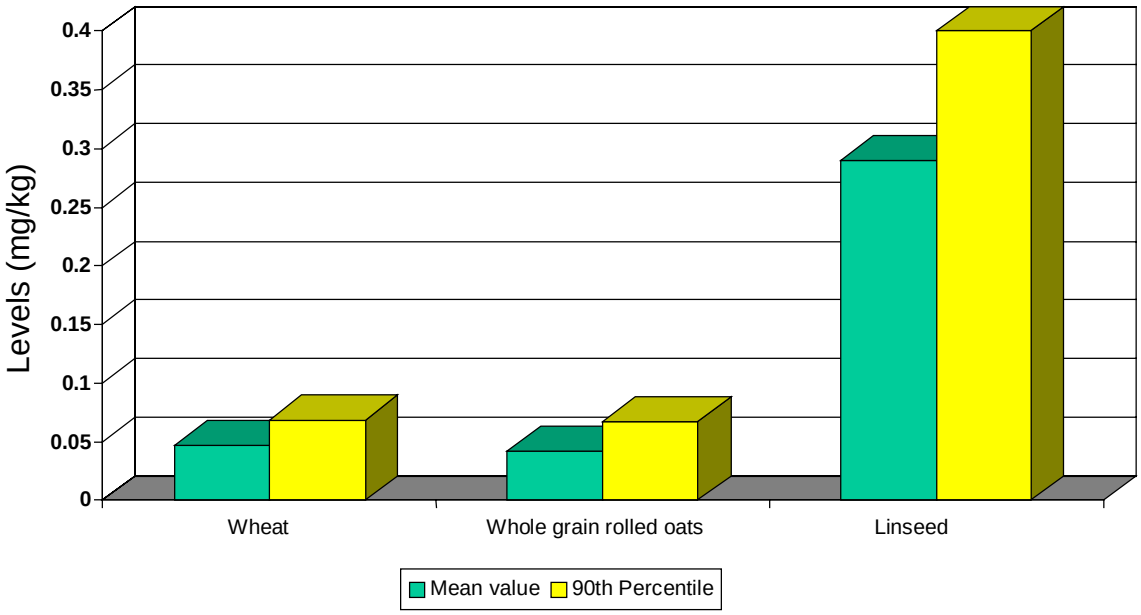

Fig. 18: Cadmium levels in wheat, whole grain rolled oats and linseed

Conclusion

There was virtually no contamination with residues of plant protection products in linseed. Cadmium contamination was high.

Pistachio

Pistachios are among the foods having a potential for high aflatoxin contamination. Therefore they had been examined for aflatoxins earlier, i.e. under the 1995, 1996 and 1998 monitoring schemes. Also in 1999, 44 pistachio samples were examined for aflatoxins.

Aflatoxins

Results obtained in 1999 have again confirmed that levels above the maximum ones may be found in high shares of samples. In these shares, high and extremely high aflatoxin levels of up to 141.1 µg/kg (total) were found. These levels were ca. 35 times higher than the admissible maximum level. As in the past, the problem described above, i.e. the presence of extremely high levels and high shares of samples exceeding maximum levels has been limited almost exclusively to pistachios of Iranian origin (Fig. 19). As a consequence, control measures and import controls have been intensified. These measures are intended to ensure that, as far as possible, batches exceeding maximum levels are identified at the site of importation already and thus cannot become commercially available.

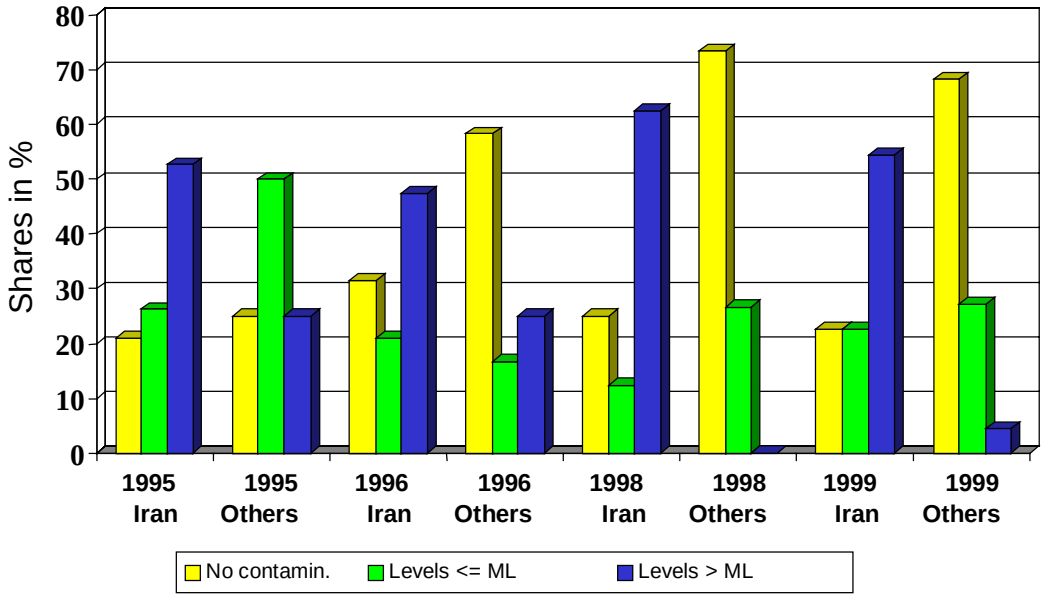

Fig. 19: Contamination of pistachios with aflatoxins

Conclusion

Pistachios may be heavily contaminated with aflatoxins. This is mainly the case with pistachios of Iranian origin. The presence of aflatoxins in pistachios of other origin was of minor importance. Adherence to legal maximum levels is closely controlled by means of intensified inspection measures.

5.2.4 Stalk vegetables

Cauliflower

251 samples of cauliflower were examined for residues of 108 plant protection products as well as for lead, cadmium and nitrate.

Plant protection products

Cauliflower was examined for a great variety of substances. It proved to be virtually free from detectable plant protection products, apart from the fact that 1.2 % of samples exceeded maximum levels (Fig. 20).

Dithiocarbamates, i.e. sulphur-containing compounds which were detected in ca. 60 % of samples have not been included in this evaluation. The reason was that analysis of dithiocarbamates is massively interfered with by the sulphur-containing constituents of cabbage varieties which can often lead to false-positive results. The share of samples exceeding maximum levels was as low as 1.2 %.

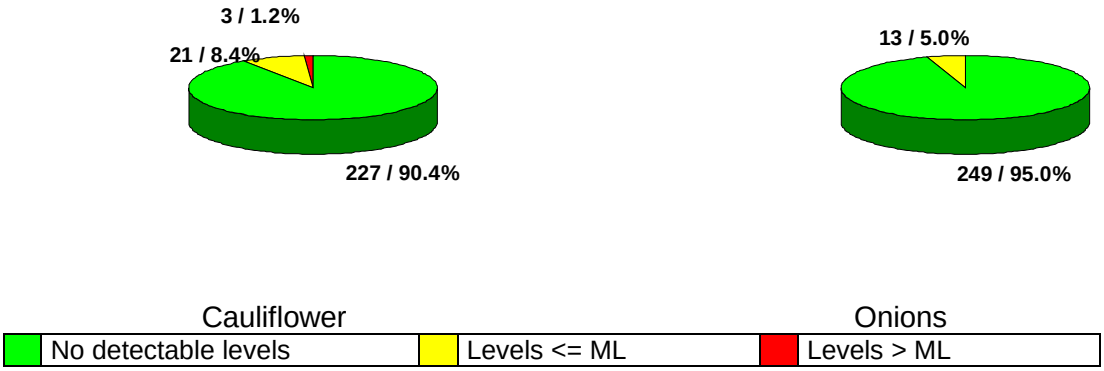

Fig. 20: Contamination of cauliflower and onions with plant protection products (dithiocarbamates excluded)

Heavy metals

Levels of heavy metals were low. In no more than one sample, the lead level detected exceeded the guide value.

Nitrate

The median nitrate level found was 94.5 mg/kg, and the detected maximum level, 1 012 mg/kg. Considering the nitrate levels commonly present in vegetables, cauliflower belongs to those species which are contaminated to a moderate degree. Certain differences in nitrate contamination were found between cauliflower originating from Germany and that originating from other EU countries. Nitrate levels found in cauliflower from Germany were significantly higher than those in cauliflower from other EU countries (Fig. 21).

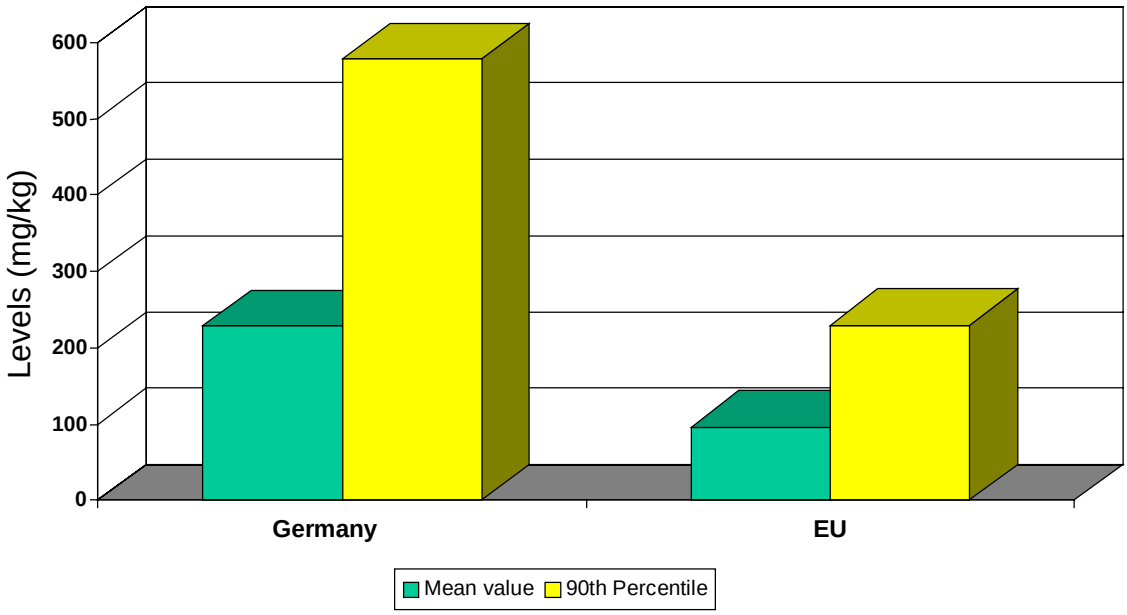

Fig. 21: Nitrate contamination of cauliflower by origin

Conclusion
Cauliflower is virtually free from residues of plant protection products. Contamination with heavy metals is low. This vegetable belongs to the vegetable species exhibiting a moderate nitrate contamination.

Onions
Onions are among the vegetables consumed most frequently. 262 samples of this versatile vegetable were examined for residues of 18 plant protection products, the heavy metals, lead and cadmium, and for nitrate. In contrast to other vegetable species, onions were examined for a relatively narrow spectrum of plant protection products only. This can be explained by the fact that only a few active substances are necessary for plant protection purposes in onion cultivation.

Plant protection products
As illustrated in Fig. 20, onions are virtually free from residues of plant protection products. Dithiocarbamates were detected in 20 % of samples, however, they were not considered in evaluation due to the “interfering effect” described above for cauliflower.

Heavy metals
Levels of heavy metals were very low. In one sample only, the cadmium level exceeded the guide value of 0.1 mg/kg.

Nitrate
Onions are among the vegetables contaminated with nitrate to a minor degree. The median nitrate level found was 18.0 mg/kg, and the detected maximum, 284.2 mg/kg.

Conclusions
Onions are a food exhibiting very low contamination levels.

5.2.5 Fruiting vegetables

Sweet pepper

In 1999, sweet pepper, particularly that originating from Spain, was in the headlines for high residual levels of plant protection products. 246 samples of this vegetable were examined for residues of 106 plant protection products as well as for lead, cadmium and nitrate.

Plant protection products

As illustrated in Fig. 22, almost one half (44.3 %) of the samples of sweet pepper examined did not contain any detectable residues. Levels measured in the samples, if any, were low. This is also underlined by the fact that in only 9 samples (3.7 %), a maximum level was exceeded. Evaluation by origin resulted in the finding that residues were found in almost 90 % of samples of Spanish sweet pepper while in those of other origin, this was the case in no more than 30 % (Fig. 23).

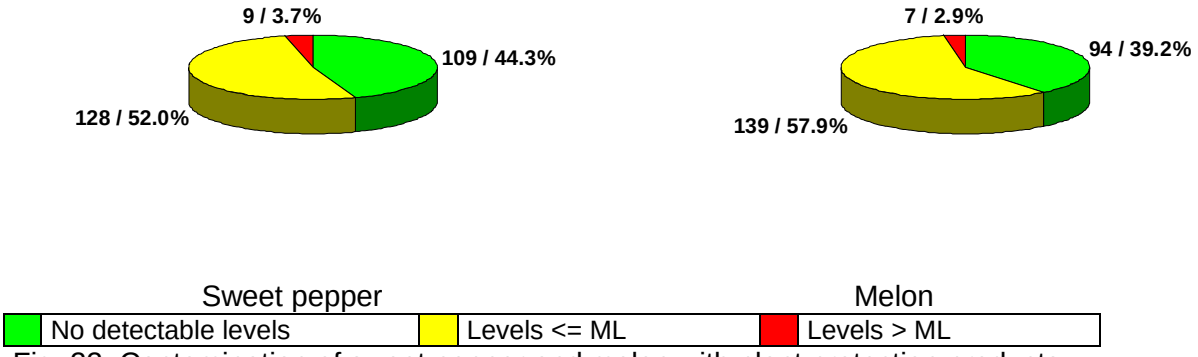

Fig. 22: Contamination of sweet pepper and melon with plant protection products

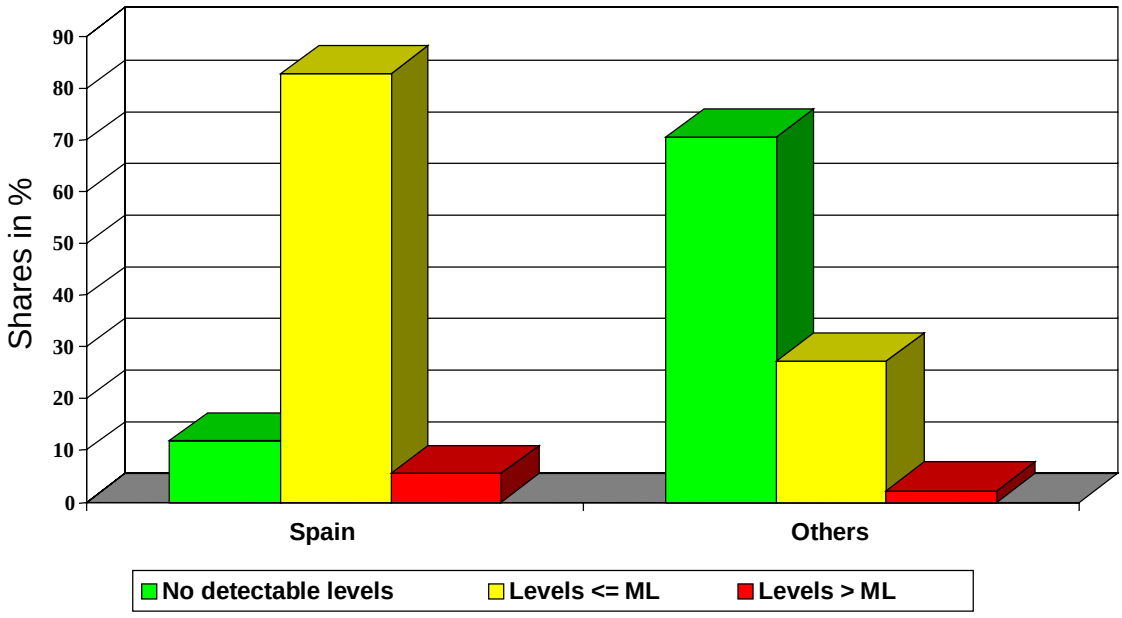

Fig. 23: Contamination of sweet pepper with plant protection products, by origin

Heavy metals

Levels of heavy metals, as measured by a median of 0.010 mg/kg for lead and 0.003 mg/kg for cadmium, were low, which has been typical of fruiting vegetables in general. Only in 2 samples the guide value of 0.25 mg/kg for lead and in one sample that for cadmium of 0.10 mg/kg were exceeded.

Nitrate
Contamination of fruiting vegetables with nitrate was generally low. Thus, the median nitrate level found in sweet pepper was 36 mg/kg, and the detected maximum level, 447.0 mg/kg.

Conclusions
Contamination of sweet pepper was low in general. However, there were striking differences concerning the levels of residues of plant protection products associated with the origin of the vegetable.

Melon / honeydew melon
240 samples of melon were examined for residues of 103 plant protection products as well as for lead, cadmium and nitrate.

Plant protection products
Residue levels below maximum levels were found in 57.9 % of melon samples (Fig. 22). Residues of endosulfan accounted for the major share (ca. 50 % of samples). Maximum levels were found to have been exceeded in 2.9 % of samples. Contamination may still be regarded as low. However, this assessment is a formal one. Taking into account that often, residues of plant protection products stick to the fruit surface, i.e. they are located on the rind, which is not consumed on principle, consumer exposure to plant protection products by way of melon consumption is negligible.

Heavy metals
The median contamination with heavy metals was low. It amounted to 0.010 mg/kg for lead and to 0.003 mg/kg for cadmium. One sample exceeded the guide value of 0.25 mg/kg for lead.

Nitrate
Contamination of fruiting vegetables with nitrate is generally considered to be low. However, within this vegetable category, nitrate contamination of melons must be regarded as moderate. Thus, the median nitrate level found was 90.0 mg/kg, and the detected maximum, 861.1 mg/kg.

Conclusion
Contamination of melons with heavy metals was low. Contamination with plant protection products is of minor relevance since the most residues stick to the inedible rind. Nitrate contamination was moderate for this fruiting vegetable.

5.2.6 Mushrooms

Cultivated mushrooms

Agaricus bisporus mushrooms are among the few fungal species forming a fruiting body which are suitable for cultivation (see also box). 235 samples of this edible mushroom commercially available throughout the year were examined for residues of 107 plant protection products, for lead, cadmium and nitrate.

Plant protection products

Contamination of cultivated mushrooms with residues of plant protection products was very low (Fig. 24). In 66.4 % of samples, no residues were detected. Residues found were mainly those of carbendazim (in 28.8 % of samples). On the whole, levels above the fixed maximum levels were found in no more than 3 samples.

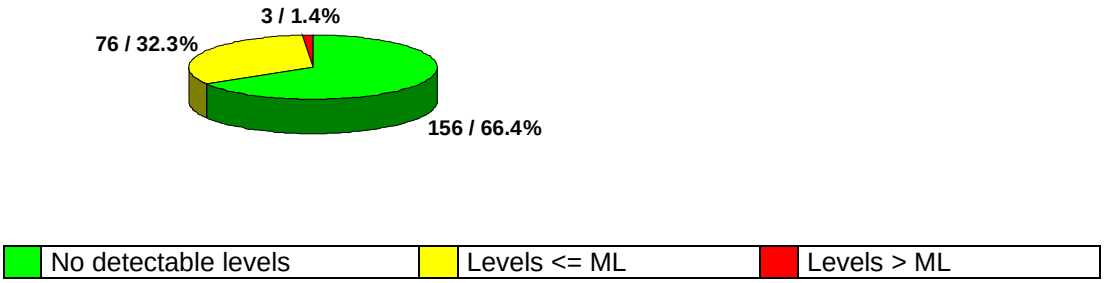

Fig. 24: Contamination of cultivated mushrooms with plant protection products

Heavy metals

Mushrooms are able to accumulate considerable quantities of heavy metals. In wild *Agaricus* mushroom varieties, for example, cadmium levels of up to 7 mg/kg were found. Therefore, the former Federal Health Office had published recommendations concerning the consumption of wild mushrooms which are still being maintained (see also box). In contrast, cultivated mushrooms were contaminated with heavy metals to a very low degree. Thus, the median lead level found was 0.01 mg/kg, and the detected maximum level, 0.07 mg/kg. Such low levels of heavy metals are due to a suitable selection of the substrate, among other causes (see also box).

Nitrate

The median nitrate level found was 46 mg/kg, and the detected maximum, 430 mg/kg. This means that nitrate contamination of cultivated mushrooms was low.

Mushroom cultivation

In the middle of the 17th century or so, *Agaricus* mushrooms were cultivated for the first time in France. Today, also oyster mushrooms and shiitake mushrooms are cultivated and are available to consumers in a fresh state throughout the year. Mushrooms are very selective concerning the substrate they grow on, and there are only few species in addition to those mentioned which would be suitable for regular cultivation. Cultivation and breeding of mushrooms is performed by specialized establishments in specially constructed cultivation rooms using specially prepared compost. Under optimal conditions, i.e. at temperatures around 22°C and a relative humidity of 95 %, a yield of ca. 100 kg of mushrooms may be harvested per cubic metre of compost.

Since mushrooms tend to accumulate heavy metals, the growth substrate must not contain any sewage sludge or other components containing heavy metals. Contamination of cultivated mushrooms with plant protection products is very low. If residues are detected they may have originated from products used in cereal cultivation that enter the compost via the straw used, or from a special product used to control the mushroom fly.

Conclusion
Contamination of cultivated *Agaricus* mushrooms is low in general.

5.2.7 Fresh fruit

Exotic fruit and rhubarb

Papaya

228 samples of papaya were examined for residues of 108 plant protection products as well as for lead, cadmium and nitrate.

Plant protection products

The findings made concerning the contamination of papaya with residues of plant protection products gave a contradictory picture. On the one hand, the share of samples free from detectable residues was relatively high (68.9%), on the other, this was also the case for samples exceeding maximum levels (18.4 %, Fig. 25). Nevertheless, the consumer's exposure to residues via papaya consumption hardly involves any problem since residues often stick to the peel, which is not consumed.

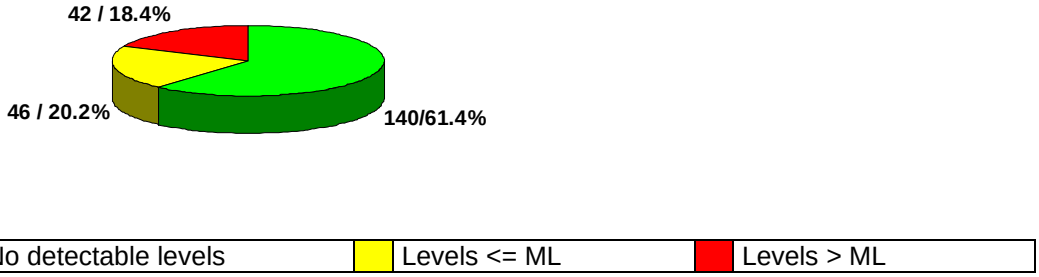

Fig. 25: Contamination of papaya with plant protection products

Heavy metals

Levels of heavy metals in papaya were very low, with median levels of 0.01 mg/kg for lead and of 0.002 mg/kg for cadmium. No level was found to exceed a guide value.

Nitrate

Nitrate contamination was also very low, with a median level of 10 mg/kg and a detected maximum of 147.9 mg/kg.

Conclusion

Contamination of papaya with nitrate and heavy metals was very low. The share of samples exceeding maximum levels for residues of plant protection products was high. This applied mainly to the inedible peel.

Rhubarb

Rhubarb, which is very popular also among children in the form of compote or cake, may exhibit high nitrate levels. Therefore, 212 rhubarb samples were primarily examined for nitrate and in addition, for heavy metals.

Heavy metals

Levels of heavy metals were low. Thus, for lead and cadmium, the median levels found were 0.01 and 0.007 mg/kg, respectively, and the detected maximum levels, 0,18 and 0.093 mg/kg, respectively. Two samples exceeded the guide value of 0.05 mg/kg for cadmium.

Nitrate
Contrary to the assumption of possibly present high nitrate levels, results revealed the nitrate contamination of rhubarb to be only moderate. The median amounted to 660 mg/kg and the detected maximum, to 2 872 mg/kg. Remarkably, levels exceeding 2000 mg/kg were measured in no more than ca. 5 % of all samples.

Conclusion
Rhubarb contamination with heavy metals can be rated as low, that with nitrate as moderate.

5.2.8 Spreads

Nougat cream
Nougat cream, a spread extremely popular among children, was examined for aflatoxins and heavy metals in 250 samples.

Heavy metals
Levels of heavy metals were low, with median values of 0.04 mg/kg for lead and of 0.012 mg/kg for cadmium.

Aflatoxins
Aflatoxins are a potential problem in all products containing nuts or oilseeds, such as nougat cream. Nevertheless, examinations performed have shown that the actual presence of aflatoxin in nougat cream gave no rise to concern. Thus, aflatoxin was detected in no more than 15 % of samples. With a median of 0.042 µg/kg of the total of aflatoxins measured and a detected maximum level of 1.5 µg/kg, the contamination level is to be rated as moderate. Another proof of the status of “giving no rise to concern” is the fact that the maximum level for aflatoxins (total) of 4 µg/kg was not exceeded in any sample.

Conclusion
Contamination of nougat cream with heavy metals was low, that with aflatoxins moderate.

5.2.9 Coffee

Roasted coffee
Coffee is among the beverages consumed most frequently. Since during the brewing procedure, in particular heavy metals may be released from ground coffee and pass into the beverage, roasted coffee was examined for lead and cadmium in 235 samples. Examination of roasted coffee for residues of plant protection products was omitted because these are destroyed to a large extent during the roasting process.

Heavy metals
Levels of heavy metals in roasted coffee were very low. Thus, the median lead level found was 0.03 mg/kg, and the median cadmium level, 0.006 mg/kg. Given these low levels and a common 1:18 ratio between coffee powder and brewing water, levels of heavy metals in the actual beverage are negligible.

Conclusion
Contamination of roasted coffee with heavy metals was low.

5.3 Drinking water, mineral water, table water

5.3.1 *Mineral water*

Years ago, some mineral waters had been subject to negative evaluation in the media due to alleged elevated levels of arsenic. Since as a rule, mineral waters spring from deeper layers of the earth, they contain, among others, heavy metals and other elements found in the corresponding geological stratum. Some of these substances are desirable in terms of

nutritional physiology and some are undesirable (see also box). For a limitation of the presence of undesirable substances, maximum levels have been fixed. 334 samples of mineral water were examined for the presence of these undesirable substances in order to check compliance with these fixed maximum levels.

Natural mineral water – "original purity"

Natural mineral water is the only food which may be placed on the market only after official approval, i.e. after having passed an extensive examination and evaluation procedure.

Natural mineral water originates from an underground water table which is protected from contamination. Over a long period of time, this water has percolated into the earth's crust accumulating minerals and carbonic acid. Levels of minerals contained in a mineral water and its composition depend on the types of rock layers, on the depth of the water table and on the presence of carbonic acid. Natural mineral water must comply with defined requirements including those made by the Regulations on Mineral and Table Waters (Mineral- und Tafelwasserverordnung).

- It must be originally pure, i. e. free from substances that are of a non-natural origin, and, if appropriate, have effects in terms of nutritional physiology owing to its contents of minerals, trace elements or other components.
- Its composition and other essential properties should remain constant within the range of natural variation.
- Levels of undesirable substances must not exceed certain limit values.

Concerning the presence of undesirable substances, the term of "original purity" is of importance. "Original purity" means that all substances contained should be of natural origin and must not have entered the mineral water e.g. as a consequence of environmental pollution. Nevertheless, there are natural mineral waters naturally containing certain harmful substances. This is why in the Regulations on Mineral and Table Waters, limit values have been fixed for ten substances of this type, such as cadmium, lead, mercury and also arsenic, which are of geogenic origin and naturally present in the soil. As a consequence, a mineral water containing for example arsenic at levels not exceeding this limit value will still be regarded as originally pure, it will be officially approved and may be placed on the market. Gratifyingly, these substances are of no relevance in the majority of mineral waters.

Elements and heavy metals

In general, levels of heavy metals and other elements in mineral water did not give rise to concern. With a few insignificant exceptions (cf. Table 12, nickel, mercury), the fixed maximum levels were complied with. In particular, it is pointed out that arsenic levels were low with no exception and did not exceed the maximum level in any of the samples examined.

Table 12: Levels of elements and heavy metals in mineral water (in mg/L)

	Mean value	Median	90^{th} Percentile	Max. level found	Maximum level fixed	% > ML
Arsenic	0.0025	0.001	0.007	0.030	0.050	
Lead	0.0012	0.001	0.002	0.003	0.050	
Cadmium	0.0003	0.0001	0.0005	0.0006	0.005	
Chromium	0.0052	0.005	0.010	0.035	0.050	
Manganese	0.0510	0.005	0.150	1.400		
Nickel	0.0070	0.005	0.015	0.062	0.050	0.6
Mercury	0,0001	0,0001	0,0001	0,0012	0,001	0,6
Selenium	0.0021	0.002	0.005	0.005	0.010	

Conclusion
Contamination of mineral waters with heavy metals and other elements was low.

Short review of the monitoring results obtained in 1995-1998

Foods	Year	Substances examined	Results
Cheese			
Gouda, Emmenthal	1995	Organochlorine comp.; PCB, musk comp.	No contaminants were found in one fifth of the samples examined. If contaminants were found, levels were low, i.e. far below the maximum levels valid for these substances.
Sheep cheese (Feta)	1997	Organochlorine comp., PCB, musk comp., Pb, Cd, Hg	Contaminated to a minor degree. Slightly elevated DDT levels in Bulgarian sheep cheese only.
Butter	1996	Organochlorine comp.; PCB, musk comp., bromocyclen	Contamination of butter with the substances under examination was low. There were no findings giving rise to concern.
	1997	As in 1996	As in 1996
Meat			
Parts of meat cuts			
Wild boar	1997	Pb, Cd, Hg	Contaminated with cadmium and mercury to a minor degree. The same applied to lead on principle, if the parts of tissue surrounding bullet entry sites and therefore contaminated by bullet particles had been generously removed.
	1998	As in 1997	As in 1997
Edible offals			
Pork liver	1996	Organochlorine comp., PCB, musk comp., bromocyclen, Pb, Cd, Hg	Contamination with organic substances and particularly with heavy metals was low. Only in single cases, samples exceeded maximum PCB levels.
	1997	Pb, Cd, Hg	As in the previous year, low contamination with heavy metals.
Lamb's liver	1996	Organochlorine comp., PCB, musk comp., bromocyclen, Pb, Cd, Hg	As for pork liver.
Beef liver	1998	Pb, Cd, Hg	Contamination with heavy metals was low.
Fatty tissue			
Fat from pig's belly	1996	Organochlorine comp., PCB, musk comp., bromocyclen	Contamination of fat from pig's belly, if any, was low. Findings gave no rise to particular concern.
	1997	As in 1996	As in 1996

Foods	Year	Substances examined	Results
Kidney fat (suet) of lamb	1996	Organochlorine comp., PCB, musk comp., bromocyclen	As for fat from pig's belly
Bovine kidney fat	1998	Organochlorine comp., PCB, musk comp., bromocyclen	Contamination was very low.
Wild boar fatty tissue	1997	Organochlorine comp., PCB, musk comp., bromocyclen	Frequently contaminated with organochlorine compounds.
	1998	As in 1997	As in 1997
Fish			
Marine fish			
Herring Fillet of saithe	1995	Organochlorine comp., PCB, musk comp., bromocyclen, Pb, Cd, Hg	Findings made gave no rise to particular concern. Contamination of saithe was low. Herring was contaminated with organic substances more frequently.
	1996	As in 1995	As in 1995
Halibut, Black halibut	1998	Organochlorine comp., PCB, musk comp., bromocyclen, Pb, Cd, Hg	Black halibut was more often contaminated with organochlorine compounds and halibut, with mercury.
Freshwater fish			
Trout	1995	Organochlorine comp., PCB, musk comp., bromocyclen, Pb, Cd, Hg	Contamination of trout was generally low.
	1996	As in 1995	As in 1995
Carp	1997	Organochlorine comp., PCB, musk comp., bromocyclen, Pb, Cd, Hg	The substances listed were detected relatively frequently, however, at low levels. No level detected was found to exceed the corresponding maximum level.
	1998	As in 1997	As in 1997, however, with a minor share of samples exceeding maximum levels.
Fish products			
Smoked eel	1997	Organochlorine comp., PCB, musk comp., bromocyclen, Pb, Cd, Hg	Contamination with the substances listed of smoked eel was considerable. Only contamination with heavy metals was low.

Foods	Year	Substances examined	Results
Crustaceans / molluscs			
Crustaceans Brown shrimps, Pink shrimps, prawns, Deepwater prawns, Northern shrimps	1995	Organochlorine comp., PCB, musk comp., Pb, Cd, Hg	Contamination of crustaceans was low in general. Only cadmium levels were slightly elevated but not alarming.
Molluscs Blue mussel (*Mytilus edulis*)	1998	Organochlorine comp., PCB, musk, bromocyclen, Pb, Cd, Hg	Low levels of organic substances. Contamination with lead and cadmium was moderate, that with mercury low.
Cereals			
Rye grain, wheat grain	1997	Plant protection products, Pb, Cd, ochratoxin A	Cereals were virtually free from plant protection products. There was a higher contamination with cadmium being specific to wheat and with lead being specific to rye. Levels detected gave no rise to concern. Ochratoxin A was detected relatively frequently, although at low levels, in ca. 20 % of samples.
	1998	As in 1997	As in 1997
Potato	1998	Plant protection products, Pb, Cd, nitrate	Contamination was consistently low.
Fresh vegetables			
Leafy vegetables			
Iceberg lettuce Endive var. Lamb's lettuce Lollo rosso Celery	1995	Plant protection products, nitrate, Pb, Cd	Only few cases of contamination with plant protection products, except for fungicides and bromide, were detected. Nitrate levels were within the (high) ranges typical of these vegetables. Contamination with heavy metals was low.
Iceberg lettuce Endive var.	1996	Plant protection products, nitrate, Pb, Cd	Moderately contaminated with residues of plant protection products. Nitrate levels were within the ranges commonly found. Levels of heavy metals were low.
Batavia lettuce Iceberg lettuce Oak leaf lettuce Lamb's lettuce Head lettuce	1997	Plant protection products, nitrate, Pb, Cd	Results obtained in 1995-1997 did not show any changes as to contamination levels.

Foods	Year	Substances examined	Results
Lollo rosso			
Kale	1997	Plant protection products, nitrate, Pb, Cd, Tl	Contamination of kale with the substances under examination was low. No differences attributable to the growing site were observed in the contamination with heavy metals, particularly with thallium.
Stalk vegetables			
Kohlrabi	1996	Plant protection products, nitrate, Pb, Cd	Kohlrabi was contaminated with plant protection products and heavy metals to a very low degree. Nitrate levels were in the medium to high range.
Broccoli	1997	Plant protection products, nitrate, Pb, Cd	Contaminated with plant protection products to a considerable degree. Nitrate contamination was in the medium range, contamination with heavy metals was low.
Asparagus	1998	Plant protection products, nitrate, Pb, Cd	Contamination was consistently very low.
Fruiting vegetables	1995	Plant protection products, Pb, Cd,	Contamination with heavy metals was low.
Green bean	1996	Plant protection products, Pb, Cd,	As in 1995
Cucumber	1995	Plant protection products, Pb, Cd,	Contamination with heavy metals was low.
Pickling cucumber	1996	Plant protection products, Pb, Cd,	As cucumber in 1995
Courgette (zucchini)	1997	Plant protection products	Contamination with plant protection products was low in general. The only extraordinary finding was a high share (ca. 11 %) of samples exceeding maximum levels for aldrin and/or dieldrin.
Roots	1995	Nitrate	Vegetables showing very high nitrate levels.
Radish, radish, small var.	1996	Nitrate	As in 1995

Foods	Year	Substances examined	Results
Carrot	1998	Plant protection products, nitrate, Pb, Cd	Of the foods of vegetal origin, carrots proved to be one contaminated to a minor degree in general.
Celeriac	1998	Plant protection products, nitrate, Pb, Cd	Contamination with plant protection products and lead was low, that with cadmium and nitrate moderate.
Vegetable products			
Spinach, deep-frozen	1998	Plant protection products, nitrate, nitrite, Pb, Cd	Contamination with plant protection products was very low. Levels of heavy metals found gave no rise to concern. No sample exceeded maximum levels for nitrate. Nitrite levels found were so low as not to suggest any shortcomings of processing.
Fresh fruit			
Berries			
Table grape	1995	Plant protection products	Contaminated with plant protection products to a considerable degree.
	1997	Plant protection products	As in 1995
Strawberry	1996	Plant protection products	Contamination with plant protection products of strawberries from pick-your-own farms (sampling was performed exclusively in such farms) was low.
	1998	Plant protection products, Pb, Cd,	Contamination with plant protection products varied depending on origin. In Spanish strawberries, there were markedly higher shares of samples exceeding maximum levels than in those originating from Germany or Italy. Levels of heavy metals were low.
Currant	1996	Plant protection products	Contamination with plant protection products was low.
Malaceous fruit			
Apple	1998	Plant protection products, Pb, Cd,	Contamination was consistently low. There were some insignificant differences depending on the origin, and between freshly harvested and stored apples.
Pear	1998	Plant protection products, Pb, Cd,	As apple. (However, no special examination was performed regarding the influence of storage.)
Stone fruit			

Foods	Year	Substances examined	Results
Peach Apricot Plum Nectarine Sweet cherry	1998	Plant protection products, Pb, Cd,	The share of samples exceeding maximum levels for residues of plant protection products was relatively high. As common for fruit, contamination with heavy metals was low.
Citrus fruit			
Orange Lemon	1996	Plant protection products	High share of samples containing residues of plant protection products.
Lemon	1997	Plant protection products, surface preservatives	As in 1996, however, with a lower share of samples exceeding maximum levels. Surface preservatives were found in ca. one fourth of samples labelled as 'not treated'.
Orange Lemon Clementine Grapefruit	1998	Plant protection products	High share of samples containing residues of plant protection products. Contamination is insignificant as residues are removed with the peel.
Exotic fruit			
Banana	1997	Plant protection products	Contaminated to a minor degree.
Kiwi	1997	Plant protection products	Contaminated to a minor degree.
Fruit products			
Apple sauce	1995	Plant protection products, patulin	Virtually no contamination with plant protection products. Patulin was detected in ca. 5 % of samples.
Fruit juices			
Apple juice	1995	Plant protection products, patulin	Virtually free from residues of plant protection products. Patulin was detected in a small share of samples.
	1996		As in 1995
Orange juice	1996	As in 1995	Virtually free from plant protection products.
		Plant protection products	
Hard-shelled dry fruit Oilseeds			
Pistachio	1995	Aflatoxins	Pistachios (originating from Iran) were found to be heavily contaminated with aflatoxins. Aflatoxin maximum levels were exceeded in a major part of the samples.
	1996	As in 1995	As in 1995
	1998	Plant protection products, aflatoxins	Virtually free from residues of plant protection products. There is a persisting aflatoxin problem associated with Iranian pistachios. The presence of aflatoxins in

Foods	Year	Substances examined	Results
			pistachios of other origins was of minor importance.
Peanut	1997	Plant protection products, Pb, Cd, aflatoxins	Low contamination with plant protection products. In general, low aflatoxin contamination, however, with a few samples exceeding maximum levels. Cadmium levels strikingly high.
Spices			
Paprika (powder)	1997	Plant protection products, Pb, Cu, aflatoxins	Paprika was mainly contaminated with bromide, lead and aflatoxins. High aflatoxin levels were detected in samples originating from Turkey.

Legend:

Cd	Cadmium
Cu	Copper
Hg	Mercury
Musk comp.	Nitro musk compounds
Organochlorine comp.	Persistent organochlorine compounds
Pb	Lead
Tl	Thallium

Terminology

Aflatoxins
Metabolic products of moulds. Formation of aflatoxins is promoted by a warm and humid environment. Aflatoxins are a group of chemically related compounds, which include, among others, the aflatoxins B1, B2, G1, G2 and M1. Aflatoxins, particularly aflatoxin B1, are the mycotoxins having shown the strongest carcinogenic effect in animal experiments. At present, no clear and final statement can be made as to whether this aflatoxin has a carcinogenic potential for humans, too. Therefore, maximum levels were fixed in Germany (for aflatoxin B1, at 2 µg/kg, for the total amount of aflatoxins, at 4 µg/kg, and for M1 in milk, at 0.05 µg/kg) in order to avoid health hazards posed by foods contaminated with aflatoxins. These German maximum levels are the lowest in the world.

Acaricides
Substances intended to exterminate mites.

Aldrin
A persistent organochlorine compound having a considerable toxicity for mammals. Aldrin is completely transformed to dieldrin in the warm-blooded organism. In the EU, aldrin has been banned from use for many years.

Bromides
Substances that occur naturally and are therefore present in all samples, at least in traces. If higher levels are found, these may be caused by fumigating agents containing bromine which have been used for soil treatment or for crop and product storage purposes.

Bromocyclen
Was specifically used as an acaricide or insecticide on warm-blooded farm animals. There is a specific contamination of surface waters from effluents of single sewage treatment plants, the causes of which have not yet been completely elucidated. Obviously, bromocyclen is able to pass the various stages of sewage treatment in these plants. Due to its highly persistent and lipophilic character it may accumulate in the aquatic food chain. Therefore, it is found in wildlife fish from inland waters as well as in fish from fish farms that use watercourses contaminated by human settlements. At the initial stages of the German National Food Monitoring scheme bromocyclen was detected for the first time in rainbow trout originating from a number of Danish fish farms.

Camphechlor / toxaphene
Persistent insecticide which, in the past, was widely used in the cultivation of fruit, vegetables and cotton. Meanwhile, its use has been banned. Camphechlor is the name of a mixture consisting of more than 200 components (chlorinated compounds). Due to its high persistence and widespread use it is found in almost any environment. Particularly high concentrations may be found in high-fat fish.
In the framework of the monitoring scheme, some selected components of camphechlor have been examined. These are the compounds, Parlar 26, Parlar 50 and Parlar 62.

Chlordane
An organochlorine compound consisting of a mixture of isomers which used to be applied as an insecticide. In EU countries, its use as a plant protection product has been banned for many years. In chlordane analysis, it is the isomers, alpha-, gamma- and oxychlordane, that are evaluated.

DDD (dichlorodiphenyldichloroethane) see DDT

DDE (dichlorodiphenyldichloroethylene) see DDT

DDT (Dichlorodiphenyltrichloroethane)
Insecticide (used e.g. to destroy mosquitoes for malaria control, formerly also used for plant protection purposes). As a residue, mainly in food of animal origin rich in fat, it can enter the human body where it decomposes very slowly. In the EU countries, the use of DDT as a plant protection product has been banned for many years. This is why, in the natural environment, DDT occurs virtually no longer in any form other than that of its metabolites, DDD and DDE.
In analysis, DDT is detected and recorded together with its metabolites, DDD and DDE, and the level detected expressed as DDT level (total DDT) of the sample.

Dieldrin
A persistent organochlorine compound used as an insecticide (see also under Aldrin). In the EU, dieldrin has been banned from use for many years.

Dithiocarbamates
Representatives of this chemical substance group are among the fungicides used most frequently. Detection of dithiocarbamates is performed by determination of the carbon disulphide liberated from these compounds. Since certain plants (mainly cabbage varieties) have natural components containing sulphur which also liberate carbon disulphide under the analytical conditions used, sample blank values (false positive results) are obtained in these cases. These blank values have to be considered and subtracted in evaluation.

Fungicides
Substances inhibiting or preventing the growth of microscopic fungi (e.g. moulds).

Levels of contaminants
The levels of contaminants are stated in mg/kg (milligrams per kilogram) or µg/kg (micrograms per kilogram). For beverages, the unit used is mg/L.

1 mg/kg means that one milligram (the thousandth part of one gram) of a residue is present in one kilogram (or litre) of the respective food. Accordingly, 1 µg/kg means the millionth part of one gram of a residue in one kilogram of a food.

The following examples may illustrate the respective amounts:

mg/kg: If e.g. one lump of sugar is dissolved in the amount of liquid filling a tanker lorry of intermediate size (2 700 L), the sugar content is 1 mg/kg.
µg/kg: If e.g. one lump of sugar is dissolved in the amount of liquid filling a tanker ship of intermediate size (2.7 million L), the sugar content is 1 µg/kg.

HCB (hexachlorobenzene)
A persistent organochlorine compound having fungicidal and insecticidal effects. In EU countries, its use as a plant protection product (e.g. for seed dressing) has been banned for many years. Contamination of the environment may also be due to industrial processes.

HCH (hexachlorocyclohexane)
A technical mixture of the components alpha, beta, gamma, delta and epsilon HCH. Only gamma HCH, trade name: lindane (cf. 'Lindane'), has an insecticidal effect. All HCH components are highly fat-soluble. The components, alpha and beta HCH, are particularly persistent. This is why they can accumulate via the food chain especially in high-fat foods of animal origin.

Herbicides
Weed killers.

Maximum level (ML)
Maximum levels are maximum admissible levels of a substance in/on foods which are laid down by law and must not be exceeded when foods are commercially placed on the market. They are set at the lowest possible level, based on stringent internationally recognized scientific standards. In doing so, safety factors are taken into account which means that if these levels are exceeded occasionally, no health hazard for consumers will be involved. Responsibility for compliance with fixed maximum levels lies with the manufacturer or, in the case of foods of foreign origin, with the importer. The control of compliance with fixed maximum levels in foods sold in the market is exercised by official food control authorities on the basis of random sampling.

Note: The fact that in this report, shares of samples exceeding maximum levels have been mentioned does not necessarily mean that maximum levels in these samples were exceeded in a legal sense and that therefore, objections had to be filed in respect of these samples. In the present report only a nominal comparison of the levels detected with the existing maximum levels has been made. In order to identify levels exceeding the maximum levels in a legal sense it would be necessary also to take into account the individual variations of the analytical measuring inaccuracy in each case. Findings of above-maximum levels which are analytically confirmed in a legal sense, will as a rule result in the administrative procedures applicable to such cases.

Insecticides
Substances used for insect control.

Isomers
Compounds consisting of the same number of identical atoms but differing in their structural arrangement.

Contaminant
Any substance that has not been added intentionally to the food or that is present in the food as a residue resulting from production processes (including methods of treatment in arable farming, animal husbandry and veterinary medicine), transformation, preparation, processing, packaging, transport and storage and due to environmental factors. The term does not include parts of insects, hair from rodents and other foreign matter.

Contamination
The presence in food of undesirable substances (contaminants) as described above.

Lindane (gamma-hexachlorocyclohexane)
Insecticide. Restricted use for plant protection and wood preservation purposes, administration as a medicinal product for human and veterinary use. Lindane is less persistent than other organochlorine compounds and it accumulates to a minor degree only.

Matrix
The sample material examined is referred to as matrix.

Median
The median is the numerical value that divides into two halves a set of measurements arranged according to their magnitude. This means that one half of the measurements is below the median and the other one above it.
The median is preferably used to characterize asymmetrical distributions including, as a rule, concentrations of substances in foods. If all samples (inclusive of those with no levels

quantified) are included in the evaluation, statement of the median only makes sense if levels are quantified in at least 50 % of samples, otherwise, the median is 0 per definition.
Therefore, the present report often refers to the median. If this was impossible, the mean value has been stated.

Mean
The mean (value) is a statistical parameter used for characterization of data. In the present report, the arithmetic mean has been used exclusively. It is calculated as the sum of all measurements divided by their number.

Metabolites
Degradation products of chemical compounds whose formation is triggered by chemical processes or metabolic processes.

Musk compounds
The synthetic musk fragrances (i.e. substitute substances for natural musk) mostly used are nitro musk compounds and polycyclic musk compounds. The substances included in the present monitoring scheme, i.e. xylene musk and ketone musk, belong to the group of nitro musk compounds. Meanwile, they have become ubiquitous contaminants of the aquatic and marine environments. Due to their highly persistent and lipophilic character they can also accumulate in the aquatic food chain. These properties together with their high dermal permeability may also result in their accumulation in human fat and in breast milk. Similar to bromocyclen, the presence of musk compounds was detected for the first time in food samples collected under the German National Food Monitoring scheme.

Mycotoxins
Metabolic products of moulds. Aflatoxins and patulin are well-known representatives. These substances are harmful to health.

Nitrate, nitrite, nitrosamines
Nitrate is a substance naturally occurring in the soil. As plants need it for their growth, soils are supplied with nitrate mostly by fertilization. If nitrate has been supplied in excessive amounts, e.g. by over-fertilization, its level in the plant may become very high. Nitrate levels may, however, also be influenced by species-specific factors, by the time of harvesting as well as by weather and climatic conditions. Light is a factor playing a decisive role in these processes. Thus, as a rule, nitrate levels will be higher in the months providing less daylight.
In the human body, nitrosamines can form from nitrate by its reduction to nitrite and reaction with amines. Nitrosamines have been carcinogenic in the animal experiment.

Preservatives for surface treatment
Surface preservatives are applied to citrus fruit to prevent spoilage. For this type of preservation, the substances, biphenyl (E230), orthophenyl phenol or sodium orthophenyl phenol (E231 or E232) have been approved. As a rule, the preservatives are applied to citrus fruit by means of waxes. As these substances are known to affect taste in any case, the peel of treated fruit is not suitable for consumption. The surface treatment of citrus fruit must be shown in the labelling on the package.

Ochratoxin A
A metabolic product of moulds harmful to the liver and the kidneys. Formation of ochratoxin is promoted by a warm and humid environment. It is found mainly in cereals, coffee beans and oily seeds. It is detectable in foods of animal origin, e.g. in milk, if the animals have been given feeds containing ochratoxin.

Organochlorine compounds (persistent chlorinated hydrocarbons)
Persistent substances which are poorly degradable. Due to their persistence they may be found as contaminants in foods. Examples are HCB and DDT but also PCB.

Parlar
See Camphechlor / toxaphene.

Patulin
Metabolic product of moulds in fruit. It is found particularly in fruit products if spoiled fruits were used for production. In animal experiments, patulin has caused weight loss and damage to the gastric and intestinal mucosae if ingested in large amounts over extended periods. In addition, there are indications of genotoxic effects.

PCB (polychlorinated biphenyls)
Used to be applied frequently for industrial purposes (e.g. technical oils, heat transmitters, plasticizers). PCB is a mixture consisting of a number of single compounds with different degrees of chlorination. PCBs are poorly degradable, and they enter the human food chain via soil, water and feeds. Components frequently found in foods of animal origin are PCB 138, PCB 153 and PCB 180.

Percentile
Percentiles are values dividing a series of measurements arranged according to size, as the median does. Thus, the 90^{th} percentile represents the value below which 90 % of the measurements are found while it is exceeded by 10 % of them.

Plant protection products
Plant protection products are used in agricultural production in order to protect plants from harmful organisms and diseases. Thus, they help protect crops from spoilage and ensure high yields. Consumers are effectively protected by existing regulations on the authorization of plant protection products and residue control. Authorization procedures ensure that plant protection products used properly do not involve health risks for humans and animals. Excess residue levels are mainly found as a consequence of improper use. Depending on the target pests or diseases, a distinction is made between insecticides, fungicides, herbicides, acaricides and others.

Quantified levels
If the concentration of a substance is high enough to be reliably determined by the analytical method chosen, this concentration found (measured value) is referred to as a quantified level.

Reference material
In reference material, the substances to be analyzed in the monitoring samples are contained in defined concentrations. It serves to determine the reliability of the analytical method applied. Whenever possible, its matrix and composition should be identical with those of the samples collected for monitoring.

Resistance
Insensitivity to active substances.

Guide value (GV)
An orienting value indicating the level of a substance which is undesirable in foods for reasons of preventive consumer protection. If a guide value has been exceeded, all persons responsible for food quality on the producer's side as well as within the food control authorities should trace the causes of contamination and try to eliminate them. Guide values will no longer be used in the future since maximum level regulations for heavy metals have already been passed by the EU.

Heavy metals
Well-known representatives are lead, cadmium and mercury. Being naturally occurring substances, they are present in all parts of the environment and thus also in foods. Due to its mode of spreading and chemical properties, lead occurs mainly on the surface of foods of vegetal origin. Cadmium is absorbed by plants from the soil and passes into their juice. Mercury levels, if any, are found on the surfaces of fruits and vegetables. Detectable or elevated levels may be expected to occur in foods of animal origin only (mainly in fish).
Relatively high levels of heavy metals found are generally to be attributed to emissions, industrial wastewater and waste disposal.

Toxicity / toxic
Poisonousness / poisonous. The capacity of a substance to cause injury to a living organism.

Ubiquitous
Having the ability to be everywhere, omnipresent.

Addresses of ministries responsible for Food Monitoring

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Federal Länder:
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Foods examined under the 1999 monitoring scheme

Cheese
- **Camembert cheese**

Meat
- **Turkey meat**
- **Turkey liver**

Sausages
- **Salami**

Fish products
- **Mackerel smoked**
- **Tuna canned**

Food for infants and young children
- **Infant formula**

Cereals / cereal products
- **Whole grain rolled oats**
- **Wheat grain**

Hard-shelled dry fruit, oilseeds
- **Linseed**
- **Pistachio**

Fresh vegetables
- **Cauliflower**
- **Sweet pepper**
- **Melon / honeydew melon**
- **Onion**

Mushrooms
- **Cultivated mushroom**

Fresh fruit
- **Papaya**
- **Rhubarb**

Spreads
- **Nougat cream**

Coffee
- **Coffee roasted**

Mineral water