National Food Monitoring 1995

Joint Report Federal Republic of Germany and the Federal Länder

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1. Introduction

Food monitoring is a system of repeated observation, measuring and evaluation of levels in and on food of harmful and therefore undesirable substances such as pesticides, heavy metals and mycotoxins. Its purpose is a timely detection of possible health risks posed by individual foods or the total diet. It is based on the results of the examination of representative food samples.

It is the aim of food monitoring covering the entire territory of the Federal Republic of Germany to obtain representative data of a nation-wide relevance on the existence of undesirable substances in food. Therefore, there was a need to develop a functional system working in compliance with the federal structures and with the constitutional distribution of responsibilities between the Federal Government and the governments of the German Länder.

In the long run, food monitoring is to demonstrate chronological trends in the contamination of foods and to provide a sufficient amount of data as a basis for calculations of the dietary intake of undesirable substances by the consumer.

The efficiency of food monitoring must be ensured on the one hand by a central coordination of the project on a federal level and on the other, by decentralized sampling and analysis of the samples at the responsible institutions in the individual Länder. After such a monitoring system had been successfully developed by cooperation of the Federal Government with the Länder from 1988 to 1994, food monitoring was put on a legal basis in 1994 [*)] and for the first time carried out accordingly in 1995.

Food monitoring is an independent task within the framework of official food control. Thus, it works as an additional instrument to improve prevention in the interest of a health protection of consumers.

Every year, the Federal Ministry for Health (BMG) issues a plan for the performance of the monitoring procedure which is based on cooperative efforts of officials of the Federal Government and the Länder. This plan is published in the form of General Administrative Regulations.

As a rule, the examinations encompass a total amount of ca. 4600 samples, which are collected each year from the 16 Federal Länder proportional to their population figures. Sampling and examination of the foods is carried out by the competent authorities of the Federal Länder.

Organization of the monitoring, documentation and evaluation of the monitoring results as well as reporting have been assigned to the Federal Institute for Health Protection of Consumers and Veterinary Medicine (BgVV).

The present publication consisting of the report for the year 1995 is the first one in a series of reports to be continued on an annual basis which are intended to inform the public on monitoring activities and results.

Monitoring results - compiled by groups of foodstuffs and substance combinations - have been published in a separate brochure available at the BgVV (Title: Lebensmittel-Monitoring, Tabellen-Band zum Bericht über das Jahr 1995 (Food Monitoring Tables: Supplement to the 1995 Report)).

[*)] Zweites Gesetz zur Änderung des Lebensmittel- und Bedarfsgegenständegesetzes vom 25.11.1994 (Second Act to Modify the Foods and Other Commodities Act of 25 November 1994) Bundesgesetzblatt I, S. 3538 (1994)

2. Summary

In the year of 1995, 4363 samples were examined for monitoring purposes. This amount included 19 different types of food 5 of which were of animal and 14 of vegetal origin. The share of foodstuffs imported from abroad was 45 %.

The samples were examined for residues of pesticides (insecticides, fungicides, herbicides, etc.), for polychlorinated biphenyls (PCBs), for toxic heavy metals (lead, cadmium and mercury), for nitrate and mycotoxins (aflatoxins, patulin). In the selection of these substances food-specific aspects were taken into account.

In a vast majority of samples, no residues of pesticides could be detected. In general, the levels of contaminants were low. However, 262 out of the 4363 samples (6 %) showed levels exceeding maximum levels or guide values.

There were no considerable differences concerning the contamination by the substances listed above between German products and products from abroad.

However, if individual foods were looked at in a differentiated way, a number of findings became prominent.

In 96 samples, the levels of nitrate in vegetables exceeded the guide values. In some cases, very high levels of this substance which markedly exceeded the guide values were detected. Differences in the contamination by nitrate depending on the origin could always be attributed to seasonal factors. In winter, levels of nitrate in vegetables are distinctly higher as due to a lack of sunlight the metabolic activity is too weak for the nitrate to become sufficiently transformed into plant protein.

In a large proportion of the samples of pistachios examined, aflatoxin levels were found which in some cases exceeded the legal maximum levels by several times.

The monitoring results of 1995 have led to the following **conclusions**:

1. In a summarizing view, it can be stated that, on principle, the results of the examinations point to a satisfactory situation as far as the fundamentals of a preventive health protection of consumers are concerned, because residue and contaminant levels in foods were low. Even if the legal maximum residue levels for some pesticides were exceeded occasionally, a health risk could be excluded as a rule since the maximum levels have been fixed on very low levels and were exceeded in most cases to a minor degree only.

2. Some vegetables showed high nitrate levels. Although such levels do not pose a direct health risk they should be avoided for reasons of preventive health protection. Therefore, efforts should be made to improve the agricultural conditions of cultivation in order to reduce nitrate levels. In addition, legislative measures should be taken to update maximum levels for nitrate by including more types of vegetables in accordance with the current EU regulation setting maximum levels for certain contaminants in foodstuffs.

3. Pistachios were frequently found contaminated by aflatoxins due to colonization by moulds with concentrations in part considerably exceeding the maximum levels. Therefore, increased efforts should be made by industry and commerce to reduce aflatoxin levels by taking appropriate preventive measures prior to the import of pistachios.

Meanwhile, the problem of aflatoxins has been discussed with the competent authorities in the country of origin directly on the spot. Thus, it became clear that a number of measures to prevent moulding had already been initiated there. Nevertheless, further results are needed to decide whether these measures have brought about an improvement. Food control authorities should thus intensify their efforts to examine pistachios offered on the market on the basis of a sampling practice which is most representative and nevertheless practicable.

In order to prevent such food from being diverted by taking national import measures, efforts should be made to ensure that maximum levels for aflatoxin concentrations in pistachios are adopted on an EU level as soon as possible.

Recommendations to reduce consumer exposure:
The average exposure of consumers can be reduced noticeably if seasonal fruit and vegetables are given preference in the diet. This would not impair the supply of vital vitamins and minerals. It is recommended to reduce the consumption of products rich in nitrate, such as salad greens, radishes and celery.

Since the consumer is not in a position to identify aflatoxin-contaminated pistachios, the consumption of pistachios cannot be recommended at present for preventive reasons until results confirming a decisive reduction of aflatoxin levels have been presented.

3. Monitoring Design 1995

3.1 Selection of foods and substances

Food monitoring is aimed at compiling reliable data on possibly existing levels of substances which are undesirable in foods from the point of view of preventive consumer protection. On the one hand, these data can serve to identify possible peak exposure situations and to eliminate or reduce the risk involved for the consumer by taking appropriate counter-measures. On the other hand, they are intended to form the basis for the observation of consumer exposure to these substances in the diet. Therefore, it is necessary to include foods consumed in larger amounts as well as foods which, in spite of constituting only a minor proportion of the total food intake, can contribute considerably to the intake-related exposure of the consumer due to a higher level of contamination.

In 1995, the monitoring design covered 19 different foods, 5 thereof of animal origin and 14 of vegetal origin. They belonged to the food categories of cheese, fish, crustaceans, vegetables, fruit/ fruit products and hard-shelled dry fruit. Tables 1 and 2 provide an overview of these foods and the substance groups for which the samples were to be examined.

Substances were selected on the basis of food-specific aspects. Thus, examinations were focused on substances of special importance from the viewpoint of preventive consumer protection because of their quantity or toxicity.
These include:

- Pesticides which are used in agricultural and industrial production and/or storage of food and therefore may be present in foods in the form of residues or degradation products,
- Environmental contaminants of ubiquitous character, e.g. heavy metals, PCBs,
- Nitrate as a preliminary stage for a possible nitrosamine formation,
- Mycotoxins.

Table 1: Foods of animal origin and substance groups

Foods of animal origin	Substances and substance groups
1. Cheese	Pesticides, polychlorinated biphenyls, musk compounds
2. Herring	Pesticides, polychlorinated biphenyls, musk compounds, heavy metals
3. Fillet of saithe (*Pollachius virens*)	Pesticides, polychlorinated biphenyls, musk compounds, heavy metals
4. Rainbow trout	Bromocyclen, musk compounds, pesticides, polychlorinated biphenyls, heavy metals
5. Crustaceans	Pesticides, polychlorinated biphenyls, musk compounds, heavy metals

Reasons for selection

Cheese:

Cheese is amongst those foods which have become increasingly popular in Germany in recent years. Important representatives of this group in terms of the quantity of consumption are the cheese types, **Emmentaler** and **Gouda.**

Fish:

Both marine fish and freshwater fish were taken into consideration.

Typical representatives of marine fish are **herring** and **saithe** (*Pollachius virens*) which are consumed frequently.

The habitats of the herring, which is counted amongst the high-fat marine fish species, include areas of the Baltic Sea and the North Sea, where environmental contamination is relatively heavy in some regions.

Saithe, which has a low fat content, lives in the north Atlantic in fishing grounds which are situated far from the coast and therefore are less affected by environmental contamination. There is a great variety of industrially processed foods made from this fish species.

From the number of freshwater fish used for consumption, the **rainbow trout** is very popular. It has a low fat content and is mainly farmed under controlled conditions.

Custaceans:

To find out about the effects of environmental conditions on contamination levels in this kind of seafood, different species were examined, viz.

brown shrimps, pink shrimps, prawns, deepwater prawns and northern shrimps.

They have extremely low fat contents and their sources of food are different from those of fish. Hence, the sampling of these species can provide further information on the aquatic food chain, as far as possible sources of contamination are concerned.

Table 2: Foods of vegetal origin, substances and substance groups

Foods of vegetal origin	Substances and substance groups
1. Lamb's lettuce	Nitrate, pesticides, heavy metals
2. Endive varieties	Nitrate, pesticides, heavy metals
3. Iceberg lettuce	Nitrate, pesticides, heavy metals
4. Lollo rosso	Nitrate, pesticides, heavy metals
5. Green beans	Pesticides, heavy metals
6. Cucumber	Pesticides, heavy metals
7. Celery	Nitrate, pesticides (dithiocarbamates), heavy metals
8. Radish	Nitrate
9. Radish, small	Nitrate
10. Apple sauce	Patulin, pesticides
11. Apple juice	Patulin, pesticides
12. Orange juice	Pesticides
13. Table grape	Pesticides
14. Pistachio	Aflatoxins

Reasons for selection

Vegetables:

In a wholesome and balanced diet, vegetables are particularly important. Vegetables are available in a large variety and serve as an important source of dietary fibre, vitamins, nutrients and minerals in the human diet.

However, as a consequence of technical measures in the production process, vegetables may contain substances undesirable from the viewpoint of preventive consumer protection.

These include:

residues of **pesticides**, **nitrate** and the **heavy metals,** lead and cadmium.

In order to examine the contamination levels in vegetables of the substances/substance groups mentioned, a number of typical representatives were selected from the following aspects:

Salad greens (lamb's lettuce, endive varieties, iceberg, lollo rosso):

These types are consumed in large quantities especially by consumers who are particularly interested in healthy foods. As they are counted amongst the vegetables rich in nitrate it was considered necessary to examine them for nitrate in addition to residues of pesticides.

Green beans, cucumber:

These vegetables were included in the spectrum of foods of vegetal origin selected for testing because they are consumed frequently and in relatively large quantities.

Celery, radishes:

For these vegetables, the reasons stated under salad greens apply correspondingly.

Fruit/ fruit products:

Residue levels in **table grapes** were to be examined as this kind of fruit is for the most part imported from countries where a relatively large spectrum of pesticides is used.

Examination of **apple juice** and **apple sauce** was focused on the presence of the mycotoxin, patulin. Patulin is a toxic and carcinogenic substance forming on spoiled apples. Both of these products should be produced from unspoiled fruit only. Excess levels of patulin detected in these foods suggest an illegal use of spoiled apples.

Testing results are also supposed to help in discussions so that a limit value for patulin can be established on the basis of well-founded data.

Orange juice is regarded as a beverage rich in vitamin C and is therefore consumed in large amounts also by population groups requiring particular protection such as children and sick persons. Therefore, a possible contamination of orange juice with residues of pesticides was of particular interest.

Pistachio:

If certain precautionary measures are not observed, in particular during harvesting and storage, this kind of hard-shelled dry fruit becomes subject to mould development and formation of toxic substances, i.e. aflatoxins.

As the necessary measures aiming at the prevention of mould were not always complied with in the past, complaints were filed repeatedly about imported pistachios.

In an effort to investigate this issue and gain representative and confirmed data on aflatoxin contamination in this kind of food, pistachios were examined for substances from this group.

3.2 Sampling and analysis

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

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) under biostatistical aspects, which allows representative statements about contamination levels in these foods as sold on the German market. Except for pistachios, samples were taken in commerce or at the producers' premises. Pistachio samples were taken in a free port **prior to** their possible import to Germany.

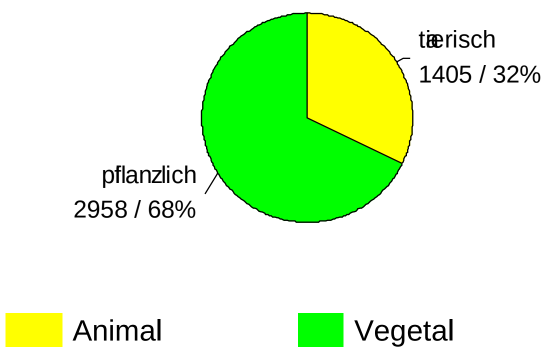
In the laboratories, the food samples were prepared for analysis according to standardized methods (e.g. washing, cleaning, peeling) in order to get comparable results. The analytical methods chosen had to ensure comparability of the results and compliance with the criteria for validation of Council Directive 85/591/EEC[*)]. In order to be able to examine the food samples for the large spectrum of organic substances (e.g. residues of pesticides), multiple residue methods recommended by the Deutsche Forschungsgemeinschaft (DFG) were used for the analysis of this substance group.

[*)] 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. Number and origin of samples

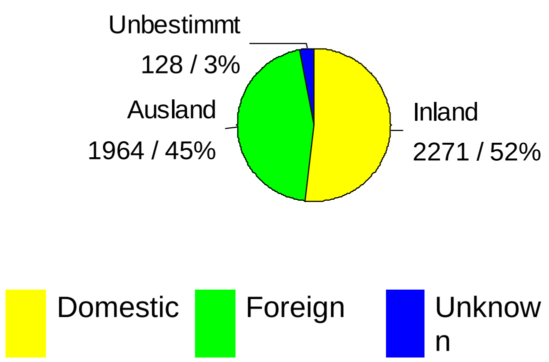
In 1995, a total of 4 363 samples were analyzed which had been taken from 19 foods of animal and vegetal origin (cf. Fig. 1):

Fig. 1: Shares of foods of animal origin and of foods of vegetal origin



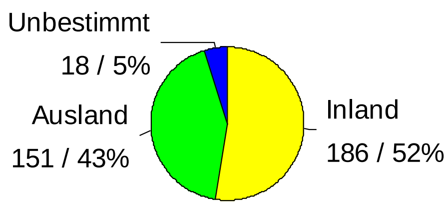
Sampling included domestic as well as foreign products. In some cases, the origin of the samples was unknown. Fig. 2 shows the numbers of samples and their shares according to origin.

Fig. 2: Shares of domestic/foreign products/ products of unknown origin

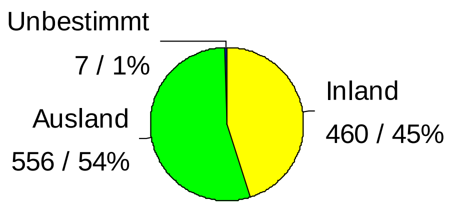


As can be seen from Fig. 3, the 19 foods involved were classified by 6 typical groups of foods and their shares broken down according to their origin (domestic/foreign). All samples of pistachios (23) were of foreign origin.

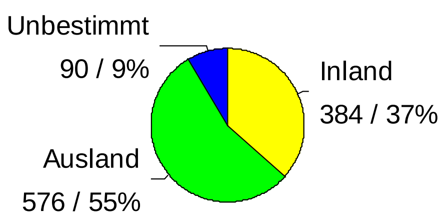
Fig. 3: Origin of samples by groups of foods



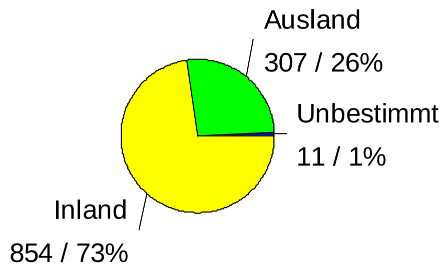
Cheese (355 samples)



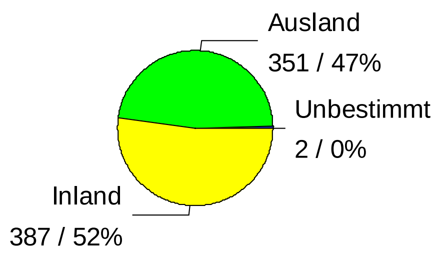
Vegetables (1 023 samples)



Fish and crustaceans (1 050 samples)



Fruit and fruit products (1 172 samples)



Salad greens (740 samples)

For further information, Table 3 shows the corresponding shares of the 19 individual foods.

Table 3: Numbers of samples by origin:

Food item	Domestic	Foreign	Unknown	Total
Herring	97	89	1	187
Cheese	186	151	18	355
Crustaceans	108	94	15	217
Rainbow trout	70	258	18	346
Fillet of saithe (*Pollachius virens*)	109	135	56	300
Apple sauce	259	35	6	300
Apple juice	294	8	2	304
Celery	33	96	2	131
Green beans	135	135	1	271
Iceberg lettuce	118	169	1	288
Endive varieties	63	43		106
Lamb's lettuce	94	87		181
Cucumber	108	216	1	325
Lollo rosso	112	52	1	165
Orange juice	299	9	1	309
Pistachio		23		23
Radish, small	87	62	1	150
Radish	97	47	2	146
Table grape	2	255	2	259
Total	**2271**	**1964**	**128**	**4363**

5. Contamination levels in foods

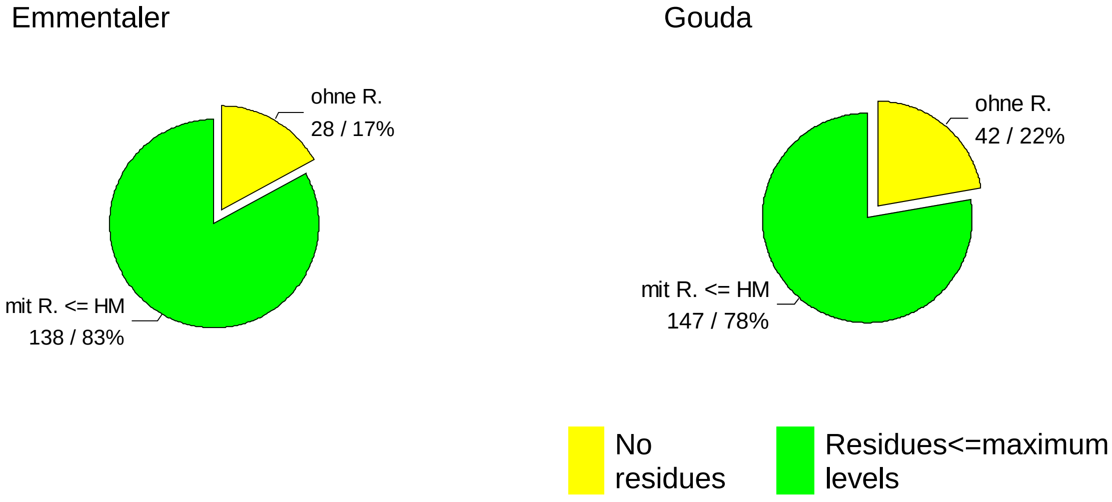
In this chapter, information is given on the foods examined under the 1995 monitoring scheme. Results are depicted for typical groups of foods.

5.1 Foods of animal origin

5.1.1 Cheese (Emmentaler, Gouda)

355 samples of cheese (189 of Gouda and 166 of Emmentaler) were examined for 27 substances, including pesticide residues, PCB and nitro musk compounds.
Fig. 4 shows the shares of residue-free samples and of samples in which levels of residues detected were below the maximum level.

Fig. 4: Contamination levels in cheese



Residues of the following compounds were quantified relatively frequently:

- HCB
- Lindane
- DDT (including metabolites)
- PCB congeners

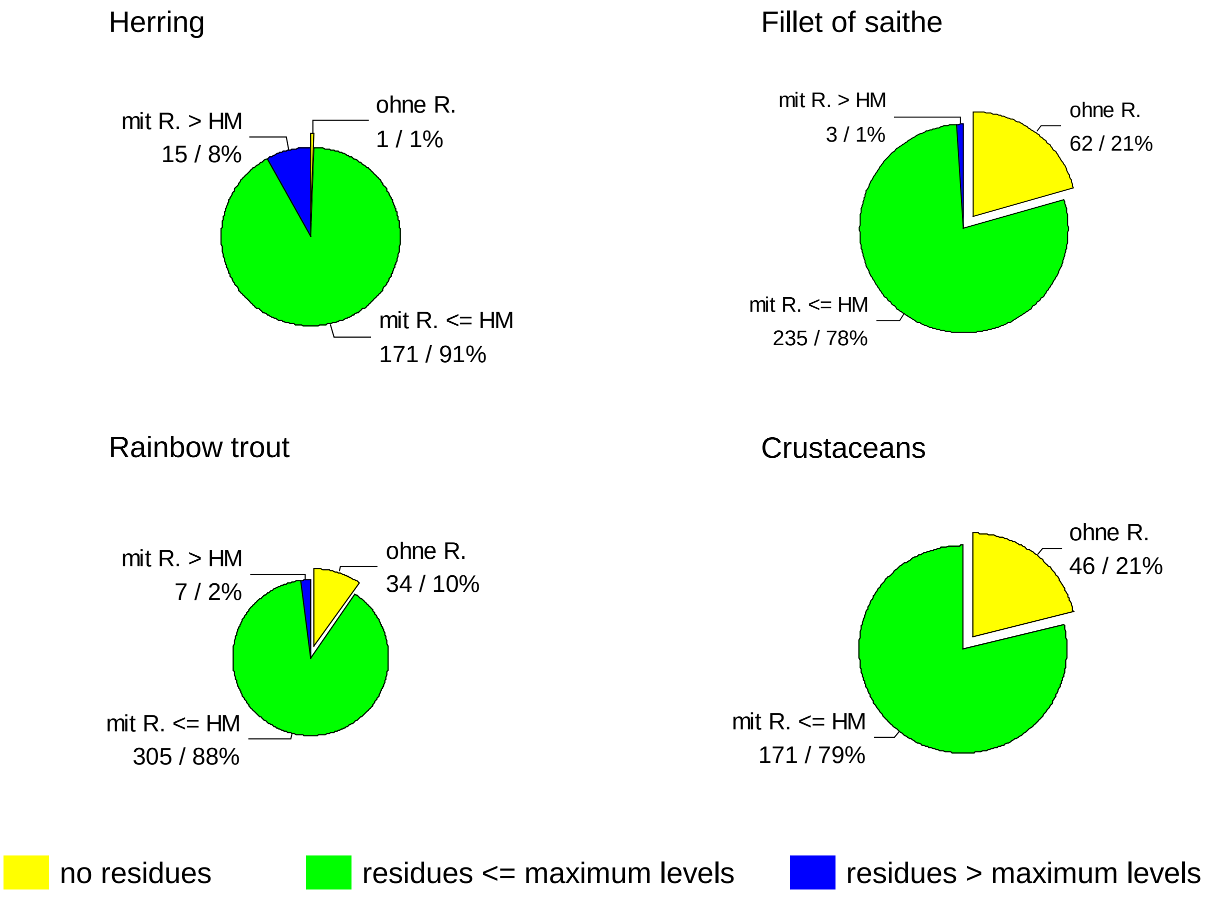
All residue levels detected were far below the maximum levels fixed for these substances. No differences could be established for the residue levels as related to the countries of origin.

5.1.2 Fish (herring, fillet of saithe, rainbow trout) and crustaceans

187 samples of herring,
300 samples of fillet of saithe,
346 samples of rainbow trout,
217 samples of crustaceans
were examined for organic substances (residues of pesticides, PCB, bromocyclen and nitro musk compounds) and toxic heavy metals (lead, cadmium and mercury).

Organic substances:
The following figure gives an overview of the shares of samples containing no residues, samples containing residues below the maximum level or the guide value and samples containing residues which exceeded the maximum level or the guide value.

Fig. 5: Contamination levels in fish and crustaceans



The foremost part of the samples contained measurable residues. With a share of ca. 20 % of residue-free samples, saithe and crustaceans showed the lowest contamination.
Table 4 gives an overview of the substances quantified most frequently in fish and crustaceans.

Table 4: Frequency of the presence of selected substances in fish and crustaceans

Substance	Herring No of samples / %	Saithe No of samples / %	Rainbow trout No of samples / %	Crustaceans No of samples / %
Chlordane	99 / 55.6 %	121 / 40.3%	163 / 47.4%	26 / 12.3%
DDT (including metabolites)	184 / 98.3%	205 / 68.3%	295 / 85.7%	132 / 61.3%
Dieldrin	163 / 96.6%	125 / 42.8%	189 / 56.7%	43 / 22.6%
HCB	171 / 91.4%	176 / 58.6%	236 / 68.4%	86 / 40.9%
Lindane	161 / 86.0%	174 / 58.0%	247 / 71.3%	120 / 55.2%
PCB 138	171 / 91.9	179 / 59.6%	269 / 77.7%	110 / 50.9%
PCB 153	179 / 96.2%	192 / 64.2%	283 / 81.7%	118 / 54.6%
PCB 180	140 / 78.6%	138 / 46.0%	238 / 68.9%	77 / 36.6%
Xylene musk	47 / 26.4%	89 / 31.3%	188 / 57.4%	56 / 29.7%
Bromocyclen			123 / 37.2	

The substances of which residues were detected frequently were identical in the 3 types of fish and crustaceans. The frequency of their occurrence differed, however, it was highest in herring.
As far as **herring** is concerned, the assumption of Baltic herring being contaminated to a higher degree than herring from the North Sea due to a higher environmental pollution was not confirmed by the present data.

Levels above maximum levels
Conspicuously, maximum levels in **herring** were exceeded for the substance chlordane only, although a great variety of substances was quantified. However, more than 8 % of the samples were affected.

In **fillet of saithe**, maximum levels were exceeded in 1 % of all samples only, i.e. relatively seldom.

The levels of bromocyclen, which were determined in **trout** only, were found to exceed the guide value in a small number of cases. The same applies to xylene musk.

In samples of **crustaceans**, maximum levels were not found to be surpassed.

In principle, fish and crustaceans examined under the 1995 monitoring scheme are to be regarded as contaminated to a relatively low degree because the residue levels found were low, although maximum levels were exceeded in some cases and residues occurred frequently.

As compared to the other types of fish considered in this study, herring was slightly more contaminated with persistent organohalogenides due to its higher fat content and its origin (Baltic and North Sea).

Heavy metals
In the types of fish examined, the heavy metals, lead, cadmium and mercury were quantified in low concentrations. In one case only, the guide value for lead was exceeded.

The levels of heavy metals measured in crustaceans tended to be slightly higher than those in fish.

Lead levels exceeded the guide value in 2 samples.
There were, however, differences between fish and crustaceans concerning the cases of an exceeded guide value for cadmium. Thus, it was found that in 14 samples (6.6 %) of crustaceans, guide values had been exceeded by 0.10 mg/kg. Nevertheless, the frequency of exceeded guide values alone does not allow the conclusion that crustaceans were particularly strongly contaminated with cadmium. The median level of contamination by the 3 heavy metals was ca. 0.015 mg/kg.
A comparison between the different crustaceans has shown that there was a significantly higher mercury contamination in brown shrimps (originating from the North Sea) than in the other species.

5.2 Foods of vegetal origin

5.2.1 Salad greens (lamb's lettuce, endive varieties, iceberg lettuce, lollo rosso)

These four types were examined for 38 pesticides, 2 heavy metals and nitrate.

<u>Pesticides</u>
Fig. 6 shows the shares of residue-free samples, samples containing residues below maximum levels and samples in which maximum residue levels were exceeded for the individual types of salad greens.

Fig. 6: Contamination levels in salad greens

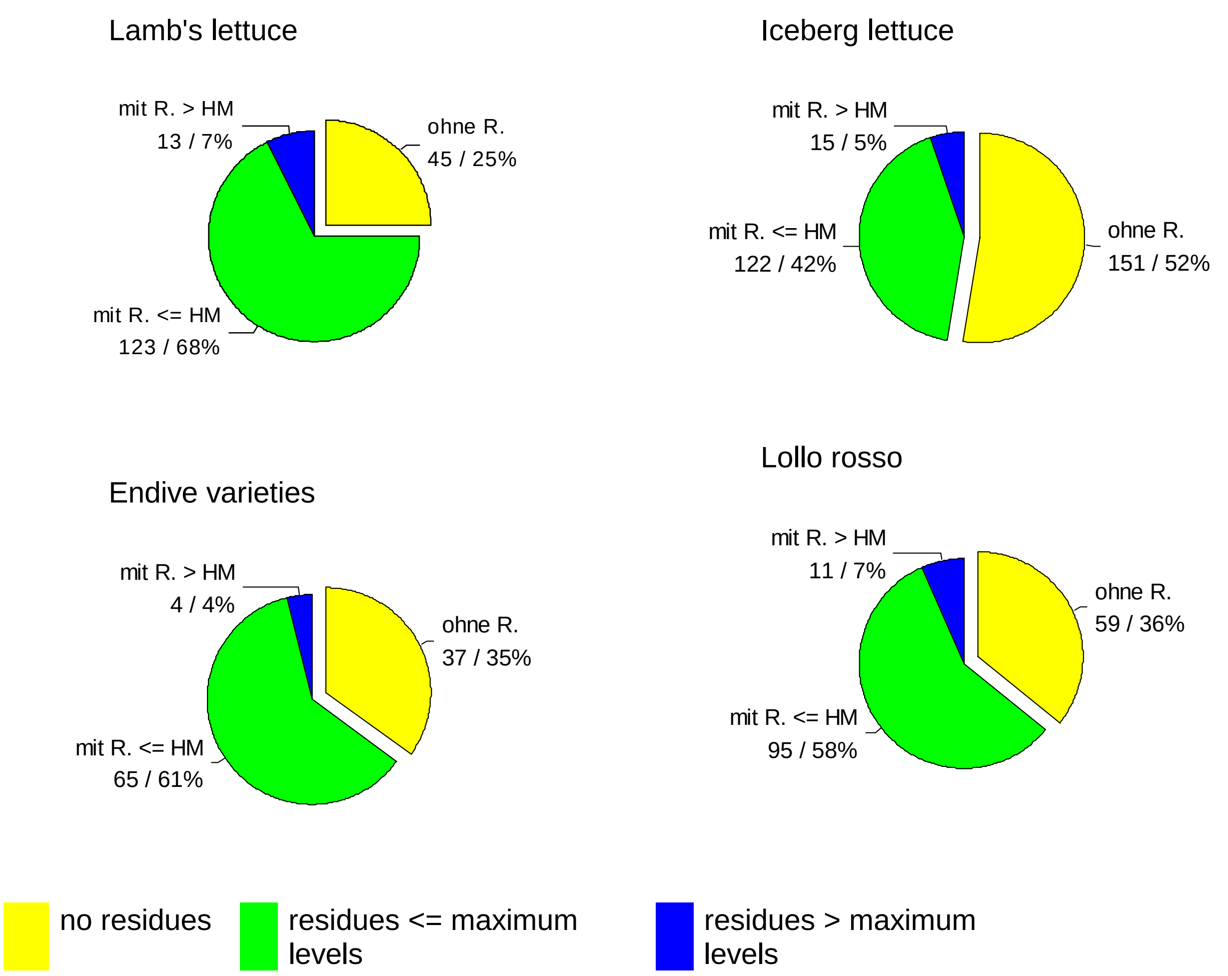


Table 5 lists the substances found to be most conspicuous in all 4 types due to the frequency of occurrence of quantifiable residues.
Absolute numbers of samples in which the substances were detected are stated along with their relative share among the number of samples examined for this substance. Except for bromide, these substances were fungicides.

Table 5: Frequency of the presence of certain substances in salad greens

Substance	Lamb's lettuce No of samples / %	Endive var. No of samples / %	Iceberg lettuce No of samples / %	Lollo rosso No of samples / %
Bromide	72 / 69.9%	30 / 48.3%	48 / 35.8%	31 / 48.4%
Dithiocarbamates	48 / 29.4%	17 / 18.0%	30 / 12.3%	31 / 21.9%
Iprodione	55 / 31.9%	18 / 17.4%	16 / 5.7%	36 / 23.5%
Procymidone	5 / 2.7%	7 / 6.6%	28 / 10.0%	21 / 13.3%
Vinclozolin	22 / 13.0%	12 / 12.6 %	17 / 6.6%	16 / 10.6%

<u>Levels above maximum residue levels</u>

For each type of salad greens, the share of samples in which maximum levels were exceeded is shown in Fig. 6. The percentage shares of these samples were between 4 and 7 %. Maximum levels were exceeded for 15 substances. Table 6 provides information on absolute numbers and shares of samples in which maximum levels were exceeded.

Table 6: Substances whose maximum levels were exceeded in salad greens

Substance	Lamb's lettuce No of samples / %	Endive var. No of samples / %	Iceberg lettuce No of samples / %	Lollo rosso No of samples / %
Dithiocarbamates	4 /2.5%	1 / 1.0%		
Chlorthalonil	3 / 1.7%	3 / 2.8%	1 / 0.4%	1 / 0.6%
Chlorpyrifos	2 / 1.1%			
Iprodione	2 / 1.2%		1 / 0.4%	1 / 0.6%
Isofenphos	1 / 0.6%			
Vinclozolin	1 / 0.6%			
Acephat			8 / 3.5%	1 / 0.7%
Methamidophos			4 / 1.6%	1 / 0.7%
Bromide			1 / 0.8%	
Captan / folpet				3 / 2.0%
Fenvalerate				3 / 2.0%
Metalaxyl				3 / 2.0%
Demethon-S-methyl				1 / 0.7%
Pirimicarb				1 / 0.7%
Propyzamide				1 / 0.7%

Only in a very low percentage of samples, maximum levels of the individual substances were exceeded.

Heavy metals

The four types of salad greens were examined for the toxic heavy metals, lead and cadmium. The results revealed that neither of these posed a special contamination problem. The median contamination levels were between 0.004 and 0.05 mg/kg.
Of the total number of 740 samples of salad greens, guide values were exceeded in 11 cases (1.5 % of samples). In most of these cases, guide values were exceeded to a minor extent only.

Nitrate

The salad greens considered in this study are amongst the vegetables rich in nitrate. The level of nitrate can be influenced by the time of harvesting, by climatic and weather conditions, by fertilization and other factors.
To limit nitrate levels for reasons of preventive consumer protection, maximum levels or guide values have been fixed for a number of vegetables particularly rich in nitrate. Of the salad greens considered in this study, lamb's lettuce is the only one at the moment for which a guide value exists which is 2 500 mg/kg.
In 81 samples of lamb's lettuce, nitrate levels exceeded this guide value.

The following table shows the median and maximum contamination with nitrate of the four types of salad greens.

Table 7: Nitrate contamination of salad greens

Type	No of samples	Level of nitrate (mg/kg)			Samples with levels >2 500 mg/kg	
		Median*	90th perc.**	Max.***	absolute	%
Lamb's lettuce	176	2379	3710	4906	81	46,0
Endive	102	836	2016	2880	2	2,0
Iceberg lettuce	274	764	1296	5400	2	0,7
Lollo rosso	155	1580	2894	4677	21	13,5

***Median** - level which half of the values measured fall below (often stated in biostatistics instead of the arithmetic mean)
****90th perc.** - 90th percentile - 90 % of the levels measured were below this value
*****Max.** - the highest level detected

The highest median contamination level for nitrate was found in lamb's lettuce, followed by that in lollo rosso. This ranking also applied to the 90th percentile.
For endive varieties and iceberg lettuce, the 90th percentile was markedly below the 2 500 mg/kg guide value fixed for lamb's lettuce.

Differences in the nitrate level between the countries of origin could always be attributed to seasonal factors (time of harvesting). Thus, nitrate contamination was higher in the winter months, which provide less daylight, regardless of the country of origin.
Measures taken for reasons of preventive health protection of consumers aim at avoiding nitrate levels clearly above 3 000 mg/kg. These high levels do not involve a direct health risk for the consumer as nitrate in itself has no toxic effect. However, in the human body reduction of nitrate to nitrite and chemical reaction with amines may result in the formation of nitrosamines which have produced carcinogenic effects in animal experiments.

Within the framework of the food monitoring, more examinations for nitrate will be conducted in the next few years as a critical follow-up of contamination levels. Legislation should consider whether maximum levels should be fixed for more vegetables rich in nitrate in order to bring about a reduction of nitrate contamination.

Recommendations for consumers

- Salad greens should always be washed thoroughly.
- During the winter months, salad greens may be consumed, but not in excess quantities.
- Preference should be given to seasonal food.

5.2.2 Vegetables (celery, green beans, cucumber, radishes)

The vegetables of this group were examined for the following substances / substance groups:

Vegetables	Substances and substance groups
Green beans	Pesticides, heavy metals
Cucumber	Pesticides, heavy metals
Celery	Nitrate, dithiocarbamates, heavy metals
Radish	Nitrate
Radish, small	Nitrate

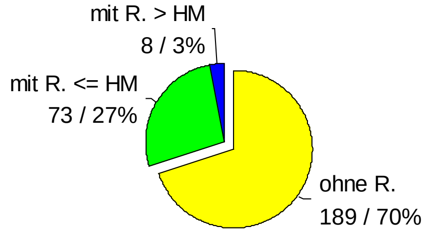
Pesticides

Green beans and cucumbers were examined for 28 pesticides each, and celery was examined for residues of dithiocarbamates.

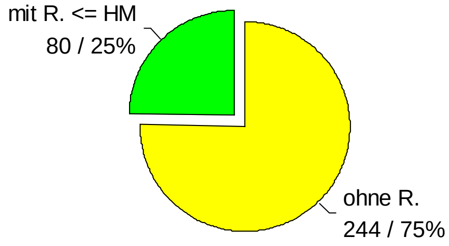
Fig. 7 shows the shares of residue-free samples, of samples containing residues below maximum levels and of samples in which maximum levels had been exceeded.

Fig. 7: Contamination levels in vegetables

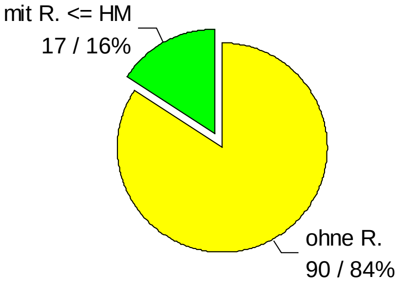
Green beans



Cucumber



Celery



Contamination of the vegetable samples was low for the substances examined. Thus, more than 70 % of samples were residue-free. Maximum levels were exceeded in very few cases only: in green beans, 3 % of the samples exceeded maximum levels for the substances iprodion, methamidophos and/or dithiocarbamate.

Heavy metals
259 samples of green beans, 299 samples of cucumbers and 91 samples of celery were examined for the heavy metals, lead and cadmium. There were hardly any conspicuous findings. Only in three out of the total number of 649 samples tested, guide values were exceeded to a minor extent.

Nitrate
The vegetables examined for nitrate, i.e. celery and radishes are considered as vegetables rich in nitrate.
For radishes, the guide value is 3 000 mg/kg, for celery, no guide value has been established.
Particularly in celery, extremely high levels were detected in single cases. A maximum value of more than 6 000 mg/kg was detected in a sample of foreign origin in the 2nd quarter of 1995.
Table 8 provides an overview of the median and maximum contamination levels and of the share of samples in which nitrate levels exceeded 3 000 mg/kg.

Table 8: Nitrate contamination of the vegetables examined

Vegetables	**No of samples**	**Level of nitrate (mg/kg)**			**Samples with levels >3 000 mg/kg**	
		Median*	**90th perc.****	**Max.*****	**absolute**	**%**
Celery	128	1534	3313	6128	15	11,7
Radish	145	1385	2760	3864	13	9,0
Radish, small	149	1404	2406	3170	2	1,3

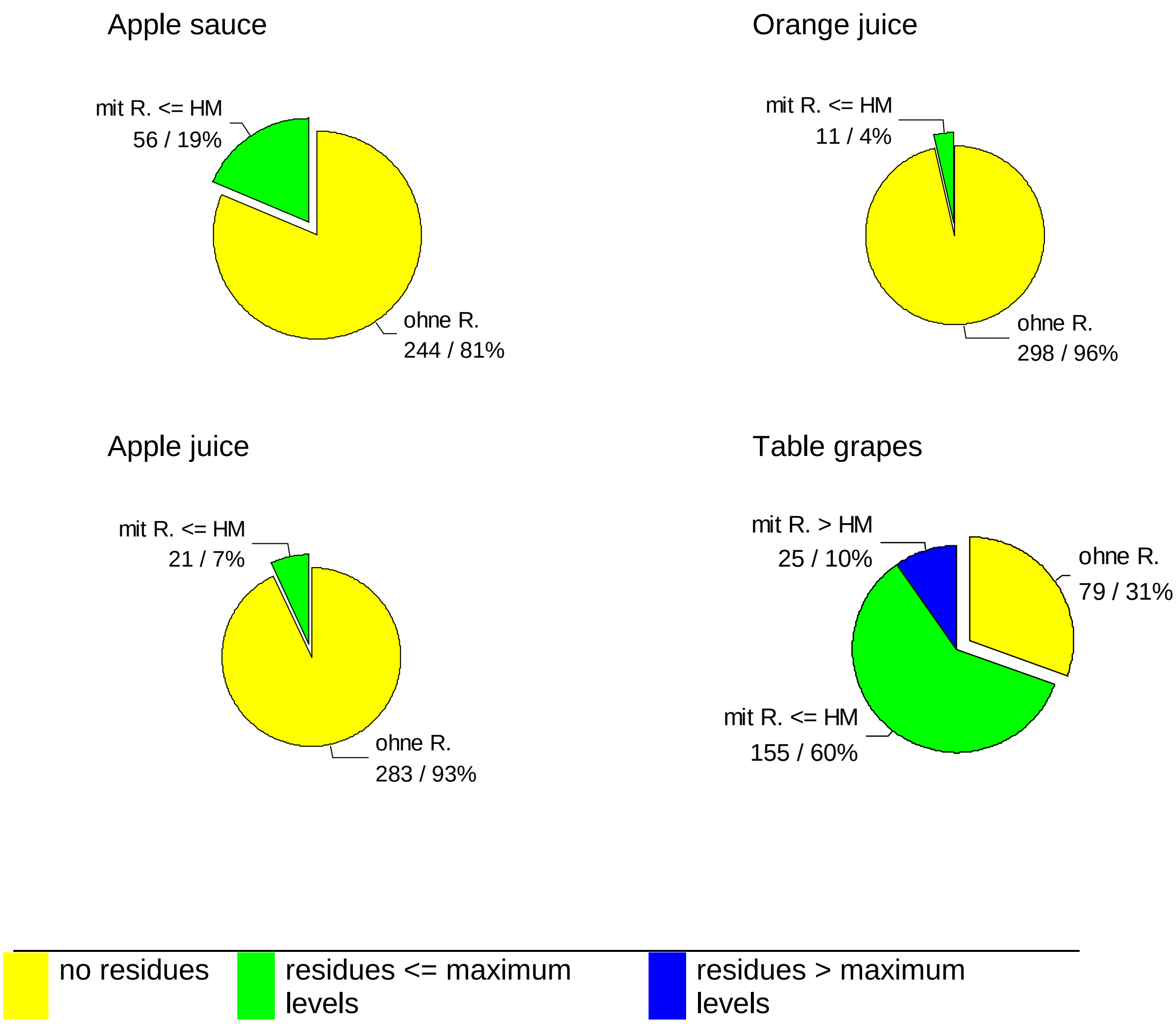
-
***Median** - value which half of the levels measured fall below (often stated in biostatistics instead of the arithmetic mean)
90th perc.** - 90th percentile - 90 % of the levels measured were below this value
*****Max.** - the highest level detected

Recommendations for consumers
Vegetables should be cleaned thoroughly prior to consumption.
As a rule, the level of pesticide residues and of lead adhering to surfaces can be reduced by the common culinary treatment and processing, as e.g. cleaning, washing, peeling, removing of soiled outer leaves. Nitrate levels may be lowered by removing those parts of the plants in which these are particularly high (outer leaves and stems).

5.2.3 Fruit and fruit products (table grape, apple sauce, apple juice, orange juice)

These foods were examined for residues of pesticides; apple sauce and apple juice were also examined for the mycotoxin, patulin.
Pesticides
Apple sauce, apple juice and orange juice proved to be almost free from residues (cf. Fig. 8). In table grapes, residues of insecticides and fungicides were detected relatively frequently. The substances concerned were: iprodione, chlorpyrifos, endosulfan, dithiocarbamates, procymidone and vinclozolin.
Maximum residue levels were exceeded in almost every 10th sample of grapes.

Fig. 8: Contamination levels in fruit and fruit products



In table grapes, the maximum residue levels for 6 substances were found to have been exceeded (cf. Table 9).

Table 9: Above-MRL residue levels in table grapes

Substance	No of samples total	No of residues > MRL	
		absolute	%
Acephate	238	13	5,5
Methamidophos	238	10	4,2
Dithiocarbamates	223	5	2,2
Decamethrin, deltamethrin	239	2	0,8
Chlorpyrifos	259	1	0,4
Procymidone	259	1	0,4

Among the foods of vegetal origin examined in 1995, table grapes were the one in which maximum levels were exceeded most frequently.

Patulin
276 samples of apple sauce and 289 samples of apple juice were tested for this substance. In both foods, patulin was detected in ca. 5% of the samples; in **one** sample of apple juice, its level exceeded 0.05mg/kg.
Patulin levels exceeding 0.05mg/kg indicate that good manufacturing practices have been ignored and partly, deteriorated fruit has been used.
In the competent EU bodies, a patulin limit value of 0.05mg/kg is being discussed at the moment.

Recommendation for consumers
Grapes should be washed thoroughly prior to consumption in order to largely remove pesticide residues adhering to the surface.

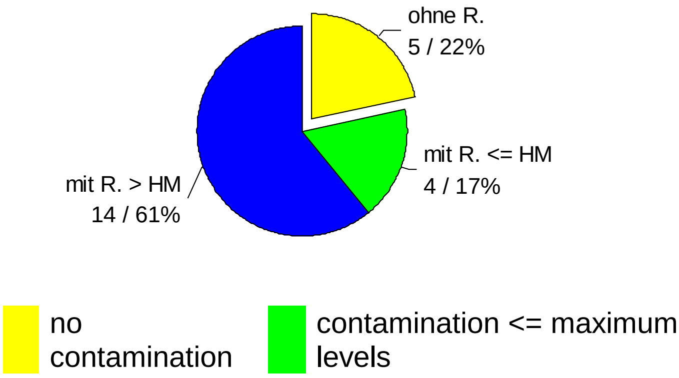
5.2.4 Pistachio

In order to examine the contamination with mycotoxins (aflatoxins B1, B2 and G1) of pistachios originating from Iran, **23** samples of raw pistachios were tested (each sample consisting of 30 kg of pistachios with shells).
The samples were taken prior to German customs clearance. At that time, it was not yet clear from the lots examined whether they were meant to be placed on the market in the Federal Republic of Germany or in another European country.

Aflatoxin levels were quantified in 19 samples. In 14 samples, levels exceeded the maximum level. In an extreme case, the aflatoxin B1 maximum level of 2 µg/kg was exceeded by a factor of 70.

The following figure gives an overview of the shares of samples free from aflatoxin, of the samples containing levels below the maximum level and of the samples in which levels exceeded the maximum level.

Fig. 9: Contamination levels in pistachios



<u>Comment on aflatoxin contamination of pistachios</u>
Pistachio batches containing aflatoxin are not uniformly contaminated. The contamination of a lot is determined by single pistachios being contaminated, some of them to an extremely high degree of up to 1 mg aflatoxin B1 per pistachio. It is estimated that there is one contaminated pistachio in 5 kg or in 5 000 non-contaminated pistachios. Due to this food-specific feature, each sample to be examined had to consist of 30 kg pistachios in order to ensure the representative character of the single samples.
The monitoring studies were carried out independently of the compulsory inspection of (raw) pistachios from Iran practised in 1995, which required pistachio lots to be presented to a superior Land authority for food control prior to their marketing in the Federal Republic of Germany.
The large share (>60 %) of samples with aflatoxin levels exceeding the maximum level prompted further examinations which confirmed this trend.
In order to eliminate this contamination, German authorities have contacted the competent bodies in the country of origin. The problem of high levels of aflatoxin contamination will be the subject of follow-up investigations under the monitoring scheme.

Recommendation for consumers
Since consumers are not in the position to identify aflatoxin-contaminated pistachios it is recommended, for the time being, to exercise restraint in the consumption of pistachios for reasons of preventive health protection.

Terminology:

<u>Aflatoxins</u>
Metabolic products of moulds. Formation of aflatoxins is promoted by a warm and humid environment. Aflatoxins are a group of compounds chemically related to each other, which include the aflatoxins B1, B2, G1 and G2. Aflatoxins - particularly aflatoxin B1 - are the mycotoxins having shown the strongest carcinogenic effect in animal experiments. Up to now, no clear and final statement can be made concerning the question whether this aflatoxin has a carcinogenic potential for humans, too. Therefore, maximum levels were fixed (for aflatoxin B1, at 2 µg/kg and for the total amount of aflatoxins, at 4 µg/kg) in order to avoid health hazards caused by food contaminated with aflatoxins. These maximum levels are the lowest in the world.

<u>Acaricides</u>
Substances intended to exterminate mites.

<u>Bromide</u>
A substance that occurs naturally and is therefore present in all samples, at least in traces. If higher levels are found, these may be caused by fumigating agents containing bromine and used for soil treatment.
Residues in food plants are formed if crops are grown on treated soils without keeping to the corresponding withdrawal periods. Increased levels of bromide occur exclusively in vegetables and salad greens from greenhouse cultivation offered during the winter season.

<u>Bromocyclen</u> (Trade names: Alugan and Bromodan)
has been specifically used as an acaricide or insecticide on warm-blooded farm animals. In addition, there is a specific contamination of surface waters from effluents of single wastewater treatment plants. The causes of this contamination have not yet been completely elucidated. Obviously, bromocyclen is able to pass the wastewater treatment stages of these plants. Due to its highly persistent and lipophilic character it can accumulate in the food chain. Therefore, it is found in wild fish from contaminated inland waters as well as in hatchery fish from fish farms that use water from flowing waters contaminated by civilization.
Bromocyclen was detected for the first time in food (trout) in earlier stages of the National Food Monitoring scheme.

<u>Chlordane</u>
An organochlorine compound belonging to the group of insecticides. Its use as a pesticide has been banned for many years in EU countries.

<u>Contamination</u>
Presence of undesirable substances in foods resulting e.g. from environmental influences.

<u>DDT</u> (Dichlorodiphenyltrichloroethane)
Insecticide (used e.g. to destroy mosquitoes for malaria control, formerly also 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. The use of DDT as a pesticide has been banned for many years in EU countries.

<u>Dithiocarbamates</u>
The compounds of this group are used as fungicides.

<u>Fungicides</u>
Substances able to destroy microscopic fungi (e.g. moulds).

Guide value
An orienting value indicating the levels of a substance which are 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.

HCB (hexachlorobenzene)
A persistent organochlorine compound belonging to the group of fungicides. Its use as a pesticide (e.g. as seed dressings) has been banned for many years in EU countries. Environmental contamination is also due to industrial processes.

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 spread and chemical properties, lead occurs mainly on the surface of foods of vegetal origin. Cadmium is taken up by plants into their juice via the soil. Mercury levels, if any, occur on the surface of fruit and vegetables. If at all, detectable or increased levels may be expected to occur in foods of animal origin only (e.g. fish entrails).
High levels may result e.g. from emissions, industrial wastewaters and from waste disposal.

Herbicides
Weed killers.

Insecticides
Substances used for insect control.

Lindane (gamma-hexachlorocyclohexane)
Insecticide. Restricted use for plant protection and wood preservation purposes, use as a medicinal product for human and veterinary use. Lindane is less persistent than other organochlorine compounds and it does not accumulate.

Maximum level
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 placed on the market. They are fixed on the lowest possible level, based on strict and scientific standards, which are internationally recognized and taking into account high safety factors. This means that if these levels are exceeded occasionally, no risk for the health of consumers will be involved. Compliance with the maximum levels is checked by official food control.

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

Musk compounds (xylene musk, ketone musk and others)
Due to their intense and typical odour they are used as a cheap synthetic substitute for the expensive natural musk, particularly in cosmetics and detergents. Therefore, their presence in the human body can be attributed not only to the food intake but also to absorption through the skin. They enter the environment via the receiving waters for municipal waste water. In the meantime, they rank among the 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.
Similar to bromocyclen, musk compounds were detected first in samples taken under the National Food Monitoring scheme.
Since 1993, many manufacturers of detergents and cosmetics have restricted their use of xylene musk on a voluntary basis.

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

Nitrate, nitrite, nitrosamines
Nitrate is a substance naturally occurring in the soil. As the plants need it for their growth, soils are supplied with nitrate mostly by fertilization. If nitrate is supplied in higher amounts, which is the case e.g. when soils are over-fertilized, its level in the plant can be very high. Nitrate levels can, however, also be influenced by the plant species, the time of harvesting, the weather and climatic conditions.
In the human body, nitrosamines can form from nitrate by reduction to nitrite and chemical reaction with amines. Nitrosamines have been carcinogenic in animal experiments.

Patulin
Metabolic product of moulds in fruit. It is found particularly in fruit products if spoiled fruit has been used for their manufacture. In animal experiments, patulin causes weight loss and damage to the gastric and intestinal mucosae if ingested in large amounts over an extended period. In addition, there are indications of genotoxic effects.

PCB (polychlorinated biphenyls)
They 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 (congeners) with different degrees of chlorination.
PCBs are slowly degradable, and they enter the human food chain via soil, water and feeding stuffs. Congeners frequently occurring in foods of animal origin are PCB 138, PCB 153 and PCB 180.

Persistent organochlorine compounds (persistent chlorinated hydrocarbons)
Persistent substances which are slowly degradable. Due to their persistence they can occur as residues in foods. Examples are HCB, DDT as well as PCB.

Pesticides
They are used in agricultural production to protect plants from pests and diseases. They help protect crops from spoilage and ensure high yields. Consumers are effectively protected by existing regulations on the authorization of products and residue control. The authorization procedures ensure that pesticides used properly do not involve health risks for humans and animals. Excess residue levels occur mainly if pesticides are improperly used. Depending on the target pests or diseases, a distinction is made between insecticides, fungicides, herbicides, acaricides and others.

Toxicity / toxic
Poisonousness / poisonous

Ubiquitous
having the ability to be everywhere, omnipresent