National Food Monitoring 1997

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

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1. Introduction: What does food monitoring mean?

Food monitoring is a system of repeated measurements and evaluation of levels of undesirable substances, such as pesticides, 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 occurrence of undesirable substances in food in Germany on the one hand and to recognize at an early stage any potential risks from these substances, on the other. In the long run, food monitoring is to demonstrate chronological trends in the contamination of foods and to provide an adequate number of data as a basis for calculations of the intake of undesirable substances from food by the consumer.

Food monitoring is an independent activity within the framework of official food control and thus an additional instrument to improve preventive health protection of consumers.

Annually, the Federal Ministry for Health issues a detailed plan for the performance of the monitoring scheme which is jointly elaborated by representatives of the Federal Government and the Länder. This plan is published in the form of General Administrative Regulations.

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

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

Sampling and analyses 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 1997 (Food Monitoring Tables: Supplement to the 1997 Report).

2. Summary

Under the 1997 Food Monitoring scheme, 4447 samples of domestic and foreign origin were examined. Sampling covered the following food items:

- Sheep cheese
- Butter sold under brand names
- Pork liver
- Fat from pig's belly
- Wild boar meat
- Wild boar fatty tissue
- Carp
- Smoked eel

- Wheat grain
- Rye grain
- Peanuts roasted/salted
- Salad greens (head lettuce, lamb's lettuce, iceberg lettuce, oak leaf lettuce, Batavia lettuce and Lollo rosso)
- Kale
- Broccoli
- Zucchini
- Table grape white
- Lemon
- Banana
- Kiwi
- Paprika (powder)

Depending on the food involved, examinations included residues of pesticides (insecticides, fungicides, herbicides etc.), environmental contaminants (e.g. persistent organochlorine compounds including PCBs and the heavy metals, lead, cadmium, mercury and thallium) as well as nitrate and mycotoxins (aflatoxins and ochratoxin A). Some of the foods in question had been investigated already under the monitoring programmes of 1995 and 1996, respectively, covering almost the same substances so that it was possible to make a comparison between the respective contamination levels. In an annex to the Report, the results of all examinations of foods under the monitoring scheme have been listed in condensed form.

In conformity with the results obtained in the preceding years, no pesticide residues or only traces of these were detected in the majority of samples also in 1997.

On the whole, the maximum levels or guide values were exceeded in 6.0 % of samples in 1995, in 2.7 % of samples in 1996 and in 8.0 % of samples in 1997.
Based on the results of monitoring for 1997 combined with those for 1995 and 1996, the following **conclusions** are drawn.

1. As in the preceding years, the results of monitoring in 1997 confirmed the low general contamination of foods with undesirable substances. With regard to a preventive health protection of consumers, the foods examined did not give rise to a situation which would have required specific action. Particular attention should be given to the facts that foods important for human nutrition such as rye and wheat were practically free from residues and that residue levels above the fixed maximum ones were not found in any of the samples of these food items.

However, since 1997, there has been a regrettable general increase in the number of samples exhibiting residue levels above maximum levels or guide values. Nevertheless, it is not possible to infer a tendency from this fact. This rise may be due to two causes, i.e. an extension of the range of substances included in the examination and the presence of an above-average contamination level of some product groups among the foods studied. The latter include wild boar and smoked eel among the foods of animal origin and lettuce varieties, table grapes, peanuts and paprika (powder) among foods of vegetal origin.

2. Among the vegetables examined, lettuce varieties exhibited species-specific high nitrate contents. Maximum levels were not surpassed.

3. Examination of the foods for heavy metals which included the presence of thallium in kale did not reveal any particular aspects of contamination. There was only one exception, i.e. the presence of lead in wild boar meat. In some of these samples, exceptionally high lead levels were found. Lead-containing bullet particles were found to be the cause. Such excessive lead levels were found only at bullet entry sites. Meat from other parts of the wild boar carcases exhibited very low lead levels. Nevertheless, a special problem of consumer protection becomes evident in cases where meat cuts from the area of the bullet entry site are used.

4. Ochratoxin A was found to be present in ca. 20 % of wheat and rye samples. Traces of this mycotoxin can be detected in blood in almost the entire population. This fact deserves continued attention from the angle of consumer health protection. In the cereal samples examined, the average level was of the minimal order of 0.2 µg/kg.

5. A problem regarding peanuts which would be comparable to the one that has become known for aflatoxins in pistachio nuts is not seen at the moment. However, aflatoxins were detected in ca. 20 % of the peanut samples examined; only a few of these exhibited levels beyond the maximal permissible ones.

Recommendation to consumers

On the basis of the present results, the foods listed here can be consumed without being concerned about the presence of undesirable substances. However, consumption of such foods should be balanced and varied.

In any case, fruit and vegetables should be thoroughly washed before consumption or preparation. Specific studies have shown that this can largely remove contaminants which adhere to the foods.

3. Monitoring Design 1997

Each year, the Federal Ministry for Health issues a detailed plan for the performance of the monitoring scheme. This plan is elaborated in cooperation with the representatives 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 1997 monitoring design covered the examination of 8 foods of animal and 17 foods of vegetal origin. In Table 1, an overview is given of the substances and substance groups for which foods of animal origin were examined. The respective data for the foods of vegetal origin have been listed in Table 2. In both tables, foods which had also been examined under the monitoring schemes for 1995 and/or 1996 have been marked.

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

Food item	Substances and substance groups
1. Sheep cheese	Environmental contaminants: persistent organochlorine compounds, PCB, musk compounds, bromocyclen, heavy metals
2. Butter sold under brand names**	Environmental contaminants: persistent organochlorine compounds, PCB, musk compounds, bromocyclen
3. Pork liver**	Heavy metals
4. Fat from pig's belly**	Environmental contaminants: persistent organochlorine compounds, PCB, musk compounds, bromocyclen
5. Wild boar meat	Heavy metals
6. Wild boar fatty tissue	Environmental contaminants: persistent organochlorine compounds, PCB, musk compounds, bromocyclen
7. Carp	Environmental contaminants: persistent organochlorine compounds, PCB, musk compounds, bromocyclen, heavy metals
8. Smoked eel	Environmental contaminants: persistent organochlorine compounds, PCB, musk compounds, bromocyclen, heavy metals

**Also examined under the 1996 monitoring scheme

Reasons for selection

Cheese

Sheep cheese

Sheep cheese, which is increasingly becoming popular among consumers, is produced mainly in Mediterranean regions. The fact that, in the past, alarmingly high levels of persistent organochlorine compounds were found in this type of cheese gave rise to its examination for the whole spectrum of environmental contaminants considered as relevant.

Butter

Butter sold under brand names

As the most important product of milk fat, butter was examined under the monitoring schemes of 1996 as well as that of 1997. Milk fat is known to accumulate fat-soluble

compounds, in particular persistent organochlorine ones. In 1996 already, results proved butter to be contaminated to a minor degree only. These findings were to be confirmed by the 1997 monitoring scheme.

Meat

Edible offals (pork liver)

Liver is an organ accumulating heavy metals. As a consequence, this organ is often found to exhibit high levels of these. Therefore, pork liver was examined under the monitoring scheme of 1996 as well as that of 1997. Since 1996 already, it has become evident that the high levels detected in pork liver in the past are no longer found. This fact was to be confirmed by the monitoring results in 1997.

Fatty tissue (fat from pig's belly)

In the fatty tissue, there is an increased accumulation of fat-soluble compounds like chlorinated hydrocarbons. Thus, fat from pig's belly is a sample material generally representative of the contamination of foods derived from pork and was therefore examined under the monitoring schemes of 1996 as well as of 1997.

Wild boar meat

The special wildlife living and feeding situation of wild boars favours the intake of environmental contaminants. This gave rise to the examination of wild boar meat under the monitoring scheme of 1997.

Wild boar fatty tissue

For the examination of wild boar fatty tissue, the reasons mentioned above apply correspondingly.

Fish

Fresh water fish (carp)

The carp, which is a species of fish very popular among consumers, is mainly farmed under controlled conditions. Factors which are of particular importance concerning the contamination of carp with undesirable substances are water quality and feed quality.

Fish products

Smoked eel

The high fat content of eel is a factor promoting the potential accumulation of fat-soluble contaminants.

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

Food item	Substances and substance groups
1. Wheat grain	Pesticides, heavy metals, mycotoxins
2. Rye grain	Pesticides, heavy metals, mycotoxins
3. Peanuts roasted/salted	Pesticides, heavy metals, mycotoxins
4. Salad greens: head lettuce; oak leaf lettuce; lamb's lettuce*, Batavia lettuce; Lollo rosso*; iceberg lettuce*,**	Pesticides, heavy metals, nitrate
5. Kale	Pesticides, heavy metals, nitrate
6. Broccoli	Pesticides, heavy metals, nitrate
7. Zucchini	Pesticides
8. Table grape white*	Pesticides
9. Lemon**	Pesticides, preservatives for surface treatment
10. Banana	Pesticides
11. Kiwi	Pesticides
12. Paprika (powder)	Pesticides, heavy metals, mycotoxins

* Also examined under the 1995 monitoring scheme
**Also examined under the 1996 monitoring scheme

Reasons for selection

Cereals
Rye grain, wheat grain
Rye and wheat are the most important types of grain used for bread-making. This is why the examination of rye and wheat for contaminants is of paramount importance.

Oilseed, hard-shelled dry fruit
Peanuts roasted/salted
Similar to pistachios, also peanuts may become subject to formation of mould and of mycotoxins, i.e. aflatoxins, due to improper storage or transport conditions.

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

Leafy vegetables
Salad greens (head lettuce, lamb's lettuce, iceberg lettuce, oak leaf lettuce, Batavia lettuce, Lollo rosso)
Salad greens are consumed in large quantities especially by consumers who are particularly interested in healthy foods. The fact that salad greens are among the types of vegetables rich in nitrate gave rise to the examination of selected species of these vegetables for nitrate, in addition to pesticide residues and heavy metals, under each monitoring scheme since 1995.

Kale
Due to its curly surface, kale is particularly prone to contamination, mainly with heavy metals. In order to demonstrate this contamination, kale was examined for thallium, too, which is a contaminant occurring in special emission regions only.

Stalk vegetables
Broccoli
This type of vegetable was included in the spectrum of foods of vegetal origin to be examined because it is consumed frequently and in considerable amounts and is available throughout the entire year.

Fruiting vegetables
Zucchini
For zucchini, the reasons stated for Broccoli apply correspondingly.

Fresh fruit
The consumption of fruit as well as of vegetables has been particularly recommended for a wholesome diet. This is why continued monitoring of the occurrence of undesirable substances in fruit is necessary.

Berries
Table grape, white
The results of the 1995 monitoring showed table grapes to be considerably contaminated with pesticide residues. This was the reason for including this type of fruit in the monitoring scheme again.

Citrus fruit
Lemon
A special feature of lemons is that they are available either treated with surface preservatives or untreated. For the consumer, this is a criterion whether the aromatic peel may be used as a food or not. When including lemons in the monitoring scheme, the major intention was therefore to examine them for the presence of these surface preservatives, for which labelling is required, in addition to pesticide residues.

Exotic fruit
Banana, Kiwi
In tropical regions, the use of pesticides is determined by conditions different from those in temperate zones. This is why the monitoring was intended to detect the residue levels of a food imported from tropical regions.

Spices
Paprika (powder)
Contrary to the majority of spices, paprika is used in relatively large amounts. An additional argument for including this type of spice in the monitoring scheme has been that it is known to contain lead and also aflatoxins in high concentrations.

3.2 Sampling and quality of analysis

The sampling of foods was performed according to a sampling design developed by the Federal Institute for Health Protection of Consumers and Veterinary Medicine (BgVV) which allows representative statements about contamination levels in foods as sold on the German market. Samples were taken 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 are prepared for analysis (e.g. washing, cleaning, peeling) according to standardized methods 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 sometimes very large spectrum of organic substances, mainly multiple methods as required by the collection of methods under § 35 of the German Foods and Other Commodities Act (LMBG) were used, e.g. methods developed by the Deutsche Forschungsgemeinschaft (DFG). The reliability of test results was ensured by additional laboratory measures as e.g. the use of appropriate reference material or 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. Number of samples and origin

In 1997, a total of 4447 samples was examined. Figure 1 shows the absolute and relative shares of foods of animal and vegetal origin in the total number of samples. Figure 2 shows the shares of samples of domestic and foreign origin.

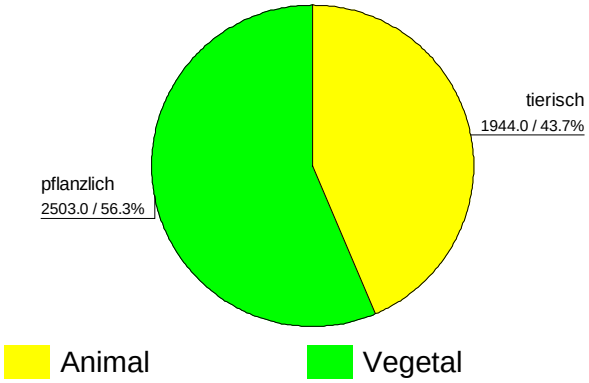


Fig. 1: Shares of samples by animal/vegetal origin

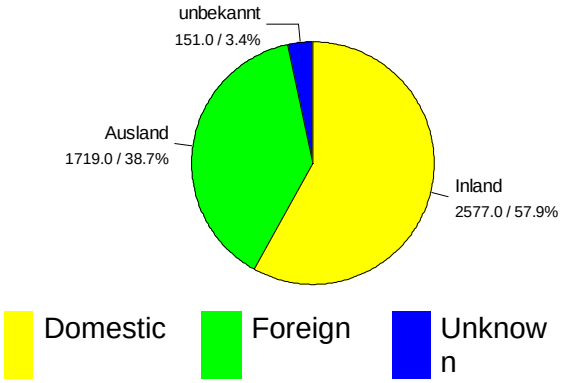


Fig. 2: Shares of samples by domestic/foreign origin

Table 3 shows the numbers of samples by domestic and foreign origin for each food examined.

Table 3: Numbers of samples by foods and origin

Food item	**Domestic**		**Foreign**		**Unknown**		**Total**
	no	**%**	**no**	**%**	**no**	**%**	no
Sheep cheese	53	21.8	187	77.0	3	1.2	243
Butter sold under brand names	217	82.8	45	17.2			262
Pork liver	279	94.9	8	2.7	7	2.4	294
Fat from pig's belly	307	95.3	8	2.5	7	2.2	322
Wild boar meat	213	100.0					213
Wild boar fatty tissue	209	100.0					209
Carp	161	98.2	1	0.6	2	1.2	164
Eel smoked	158	66.7	43	18.1	36	15.2	237
Wheat grain	228	100.0					228
Rye grain	231	100.0					231
Peanuts roasted/salted			26	100.0			27
Head lettuce	20	50.0	18	45.0	2	5.0	40
Lamb's lettuce	29	72.5	10	25.0	1	2.5	40
Kale	90	100.0					90
Iceberg lettuce	14	35.0	26	65.0			40
Oak leaf lettuce	24	61.5	13	33.3	2	5.1	39
Batavia lettuce	21	52.5	17	42.5	2	5.0	40
Lollo rosso	24	57.1	15	35.7	3	7.1	42
Broccoli	106	47.1	112	49.8	7	3.1	225
Zucchini	91	37.8	128	53.1	22	9.1	241
Table grape, white	10	4.0	240	96.0			250
Lemon			250	100.0			250
Banana			248	100.0			248
Kiwi			225	100.0			225
Paprika (powder)	92	37.2	98	39.7	57	23.1	247
Total	**2577**	**57.9**	**1719**	**38.7**	**151**	**3.4**	**4447**

The shares of foods of domestic and foreign origin differ for most of the items listed. Wild boar, cereal and kale samples were all of domestic origin while samples of peanuts, lemon, banana and kiwi were exclusively of foreign origin.
In addition, Figures 3 and 4 give a summary overview of the occurrence and shares of samples containing pesticide residue levels above fixed maximum levels for foods of domestic and such of foreign origin.

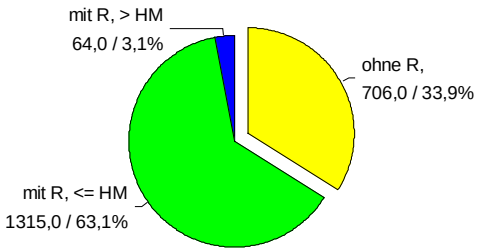


Fig. 3: Pesticide contamination of food samples of domestic origin

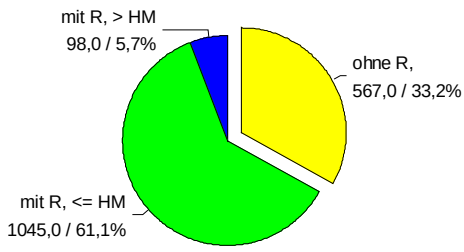


Fig. 4: Pesticide contamination of food samples of foreign origin

No residues Residues <= maximum levels Residues > maximum levels

5. Contamination of foods with undesirable substances

In this chapter the results of the examination of foods under the 1997 monitoring scheme are presented. Results are depicted for typical groups of foods.

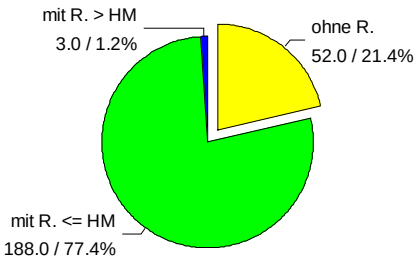
5.1 Foods of animal origin

5.1.1 Cheese (sheep cheese)

Sheep cheese is commonly understood to mean feta although it includes other types of cheese, e.g. roquefort or pecorino. In Germany, the production of sheep cheese is of minor importance only. Therefore, it is imported mainly from Mediterranean countries. Altogether, 243 samples originating from Germany, Bulgaria, France and Greece were examined for 26 substances. These substances were persistent organochlorine compounds including PCB, musk compounds, bromocyclen and the heavy metals, lead, cadmium and mercury.

Organic substances

Fig. 5 gives an overview of the level of contamination of sheep cheese with undesirable substances.



No residues Residues <= maximum levels Residues > maximum levels

Fig. 5: Contamination of sheep cheese with undesirable organic substances

In 21.4 % of samples, no contaminant was detected. Of the numerous substances under examination, only 3 were quantified fairly frequently, i.e. in more than 50 % of the samples, DDT

HCB
Lindane.

There were no levels found that could have raised alarm. While generally, low levels were found, slightly higher levels of DDT were detected only in sheep cheese originating from Bulgaria. Otherwise, there were no differences in the levels which could be attributed to origin. Fixed maximum levels were exceeded in 3 samples only. DDT levels did not exceed maximum levels in any of the samples.

Heavy metals
Of the heavy metals considered here, only lead was found to exceed the guide value of 0.01 mg/kg in ca. 5 % of the samples. No accumulation was found of samples in which guide values were exceeded which could have been attributed to origin. In relation to guide values, the median levels of heavy metals were classified as low (see Table 4).

Table 4: Heavy metals in sheep cheese (mg/kg)

	Median	Max. value	Guide value	Share of samples >guide value (%)
Lead	0.028	0.390	0.250	0.4
Cadmium	0.001	0.059	0.050	0.4
Mercury	0.004	0.072	0.010	4.8

Conclusion
Among the foods of animal origin, sheep cheese was found to be contaminated with undesirable ubiquitous substances to a relatively low extent. Differences related to the origin were not established except for slightly higher DDT levels in Bulgarian sheep cheese.

5.1.2 Butter sold under brand names

In the 1997 monitoring, butter was examined for the same spectrum of substances as in 1996. Altogether, 262 samples of butter were examined for 23 organic substances. These were persistent organochlorine compounds including PCB, musk compounds and bromocyclen.

Organic substances
In spite of its capacity of accumulating fat-soluble substances, butter was found to be contaminated with the substances under examination to a minor extent only. This is a result confirming the corresponding findings for 1996 (cf. Fig. 6).

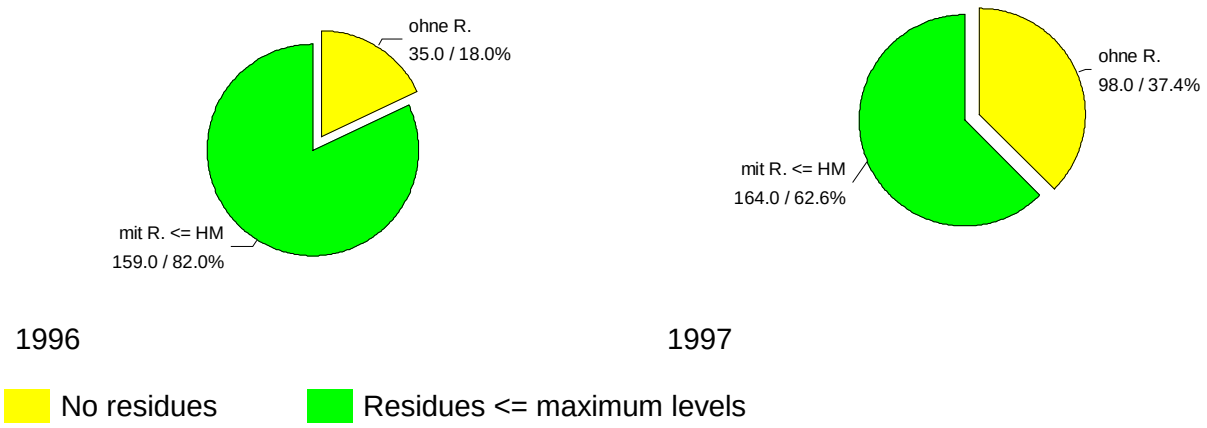


Fig. 6: Contamination of butter with undesirable organic substances in 1996 and 1997

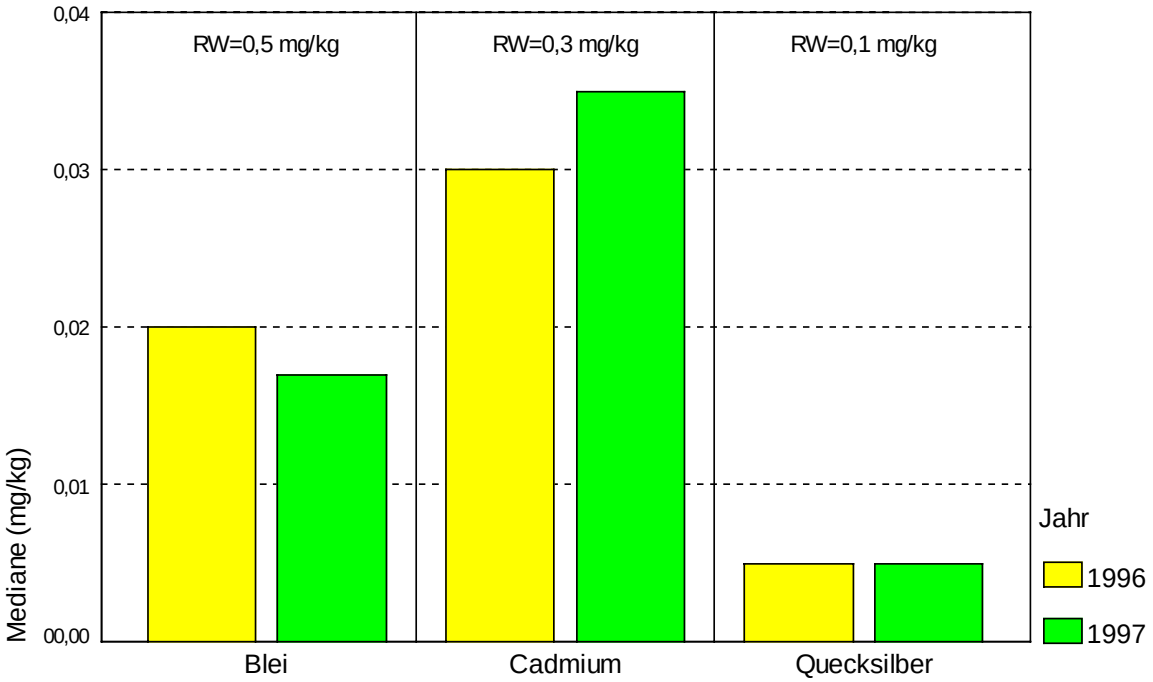
In 1997, none of the substances was detected frequently, i.e. in more than 50 % of all samples. The share of samples containing no contaminants at all increased from 18 % in 1996 to 37.4 % in 1997. If any contaminants were detected, their levels were low, i.e. far below the maximum levels fixed for these substances. This means that neither in 1996 nor in 1997, a single sample was found to contain contaminants exceeding maximum levels.

Conclusion
Butter was found to be contaminated with undesirable substances to a minor extent only. This is confirmed by the monitoring results for 1996 and 1997.

5.1.3 Edible offals (pork liver)

In 1997 as well as in 1996, the monitoring scheme included the examination of pork liver for heavy metals. In the reporting year, 294 samples of pork liver were examined exclusively for the heavy metals, lead, cadmium and mercury to see whether the 1996 results could be confirmed.

Heavy metals
As compared to the guide values, the levels detected were low. There were no alarming findings. The guide values for lead, 0.5 mg/kg, and for mercury, 0.1 mg/kg, were exceeded in one sample each. The results for the monitoring years of 1996 and 1997 were almost identical (cf. Fig. 7).



Englische Bildbeschriftung:
Mediane (mg/kg) – Medians (mg/kg)
Blei – Lead
Cadmium – Cadmium
Quecksilber – Mercury
Jahr – Year

Fig. 7: Median levels of heavy metals in pork liver in 1996 and 1997

Liver is known to be an organ accumulating heavy metals. A positive result was established insofar as levels of heavy metals in pork liver were found to give no reason for concern in two consecutive monitoring years. With reference to the high levels of heavy metals, particularly of cadmium, detected in the past it can now be stated that in the light of these results, pork liver does no longer belong to the group of foods being highly contaminated with heavy metals.
The improved situation has been attributed to a lower contamination of feeds and to a stricter control of imported feeds.

In the past, high levels of cadmium and mercury in particular, led to special recommendations for the consumption of liver and kidney. Although these recommendations have been maintained for precautionary reasons, they appear to have proved unnecessary with regard to liver from this animal species.

Conclusion
The contamination of pork liver with the heavy metals, lead, cadmium and mercury was low. This has been confirmed by the results of the monitoring examinations in 1996 and 1997.

5.1.4 Fatty tissue (fat from pig's belly)

322 samples of fat from pig's belly were examined exclusively for persistent organochlorine compounds including PCB, for bromocyclen and musk compounds as in 1996. Altogether, the spectrum comprised 24 organic substances.

Organic substances

Like fat in general, fat from the belly accumulates fat-soluble substances, for which the samples were examined. Therefore the result has to be rated as favourable that in 1996, 43.4 % and in 1997, 61.5 % of the samples examined did not contain any of these undesirable substances (cf. Fig. 8).

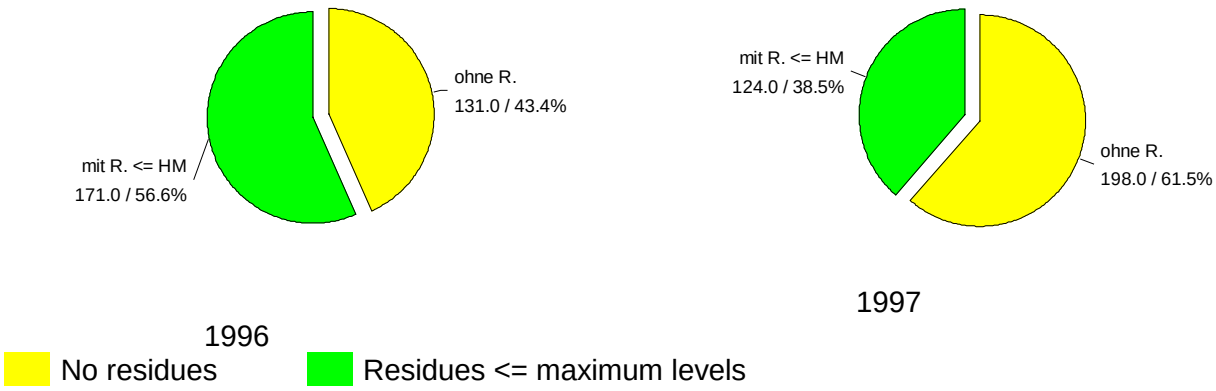


Fig. 8: Contamination of fat from pig's belly with undesirable organic substances in 1996 and 1997

As in 1996, the levels detected were low, i.e. within the range of the lowest measurable quantities. Neither in 1996 nor in 1997, any of the substances was detected frequently, i.e. in more than 50% of all samples. There was no case of exceeded maximum levels of undesirable substances in both of these years. These results for two monitoring years have led to the conclusion that fat from pig's belly is contaminated to a minor degree only.

Conclusion

The contamination of fat from pig's belly and, consequently, of pork products containing fat, with the undesirable substances mentioned above has been classified as being low. This has been confirmed by the monitoring results of 1996 and 1997.

5.1.5 Wild boar meat

As the special living and feeding situation of wild boars may result in a contamination of wild boar meat with heavy metals, the examination of this type of game was included in the monitoring scheme of 1997.

Heavy metals

Under the monitoring scheme of 1997, wild boar meat was examined exclusively for heavy metals. In Table 5, the results of the examination for lead, cadmium and mercury have been summarized.

Table 5: Heavy metals in wild boar meat (mg/kg)

	Number	Median	95th perc.	Max. level detected	Guide value	Share of samples > guide value (%)
Lead	207	0.034	164.5	19300.0	0.250	18.0
Cadmium	213	0.002	0.010	0.031	0.100	
Mercury	213	0.005	0.050	0.340	0.030	8.9

Cadmium levels in wild boar meat were low. There were no alarming findings. This corresponds to the fact that levels found did not exceed the guide value for cadmium in any of the samples.

As compared to cadmium, mercury levels in meat from wild boar are slightly higher (cf. Table 5). Mercury levels found were not alarming, however, in 9 % of the samples, they exceeded the guide value.
Quite varying results have been established concerning lead levels. The average lead content of wild boar meat, expressed as median, can be characterized as low. Levels in muscle tissue of above 1 mg/kg were probably caused by secondary contamination. Extremely high values as depicted in Table 5 by the 95th percentile and the maximum level detected occur at bullet entry sites and are to be attributed to secondary contamination by bullet particles (cf. box 'Hunting ammunition'). It can no longer be excluded that the consumption of game containing such high lead levels may involve acute health risks. Therefore, it is of utmost importance to generously remove the meat surrounding bullet entry sites. Also in parts of meat already cut, bullet entry sites can be identified by their surrounding tissues which are suffused with blood and heavily destroyed.

Conclusion
The conclusion to be drawn from the examination results is that cadmium and mercury levels in meat of wild boars shot in unenclosed hunting grounds do not involve health risks. The same holds true for lead levels provided that parts of meat surrounding bullet entry sites which may be affected by secondary contamination due to bullet particles have been generously removed.

Hunting ammunition
Bullets used for the professional shooting of game have a high-energy impact on the animal's body, thus ensuring the animal to die quickly and without unnecessary suffering. For the shooting of wild boars, partly jacketed bullets are preferentially used. When entering the animal's body, the front part of these projectiles may deform and disintegrate. As a consequence, single bullet particles may penetrate into the tissue surrounding the gunshot canal thus causing local contamination. As a precautionary measure, it is therefore recommended to remove generously the tissue surrounding the gunshot canal.

5.1.6 Wild boar fatty tissue
The presence of persistent organochlorine compounds in the fatty tissue of wild boars may also serve as an indicator for the assessment of the contamination of the environment in which the animals have been living.

Organic substances
The examination comprised 209 samples of wild boar meat. It revealed that wild boar fatty tissue was frequently contaminated with persistent organochlorine compounds. Only in 5.7 % of samples, no contaminants were detected (cf. Fig. 9).

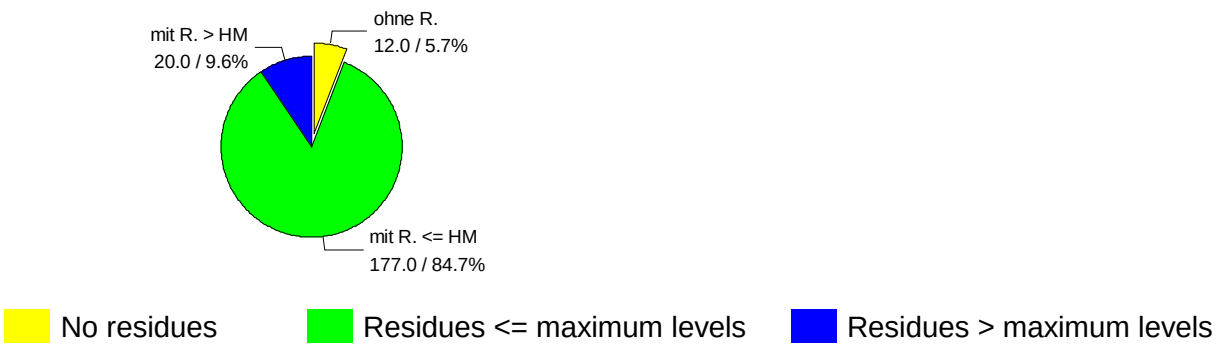


Fig. 9: Contamination of wild boar fatty tissue with undesirable organic substances

Organochlorine compounds detected most frequently were

DDT
HCB
PCB 180
PCB 153
PCB 138

As shown in Fig. 10, higher levels of DDT have been detected mainly in samples from the new federal Länder while, as shown in Fig. 11 for PCB 180 as an example, higher PCB levels were predominantly found in samples from the old federal Länder. This phenomenon can be explained by the fact that in the GDR (east Germany), which after reunification has been referred to as the new federal Länder, DDT was used for a longer period than in the old federal Länder and that the use of PCP was wide-spread in the latter. The use of both substances has meanwhile been banned in the EU.

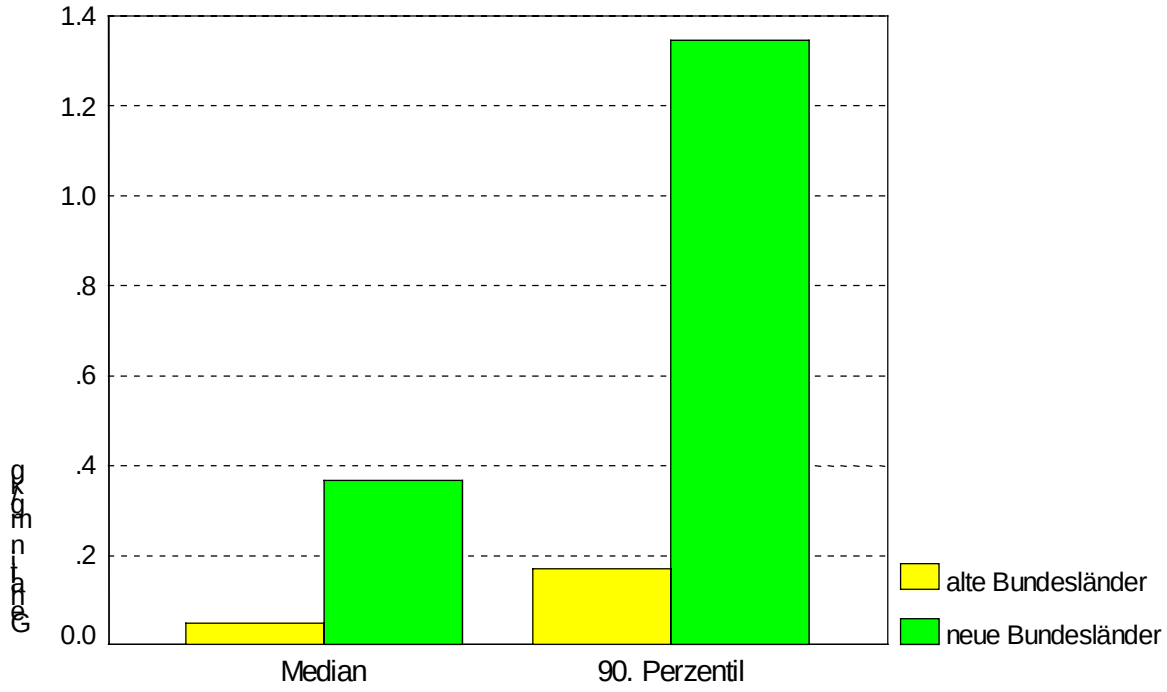


Fig. 10: DDT contents in fatty tissue samples of wild boars from the old and the new federal Länder

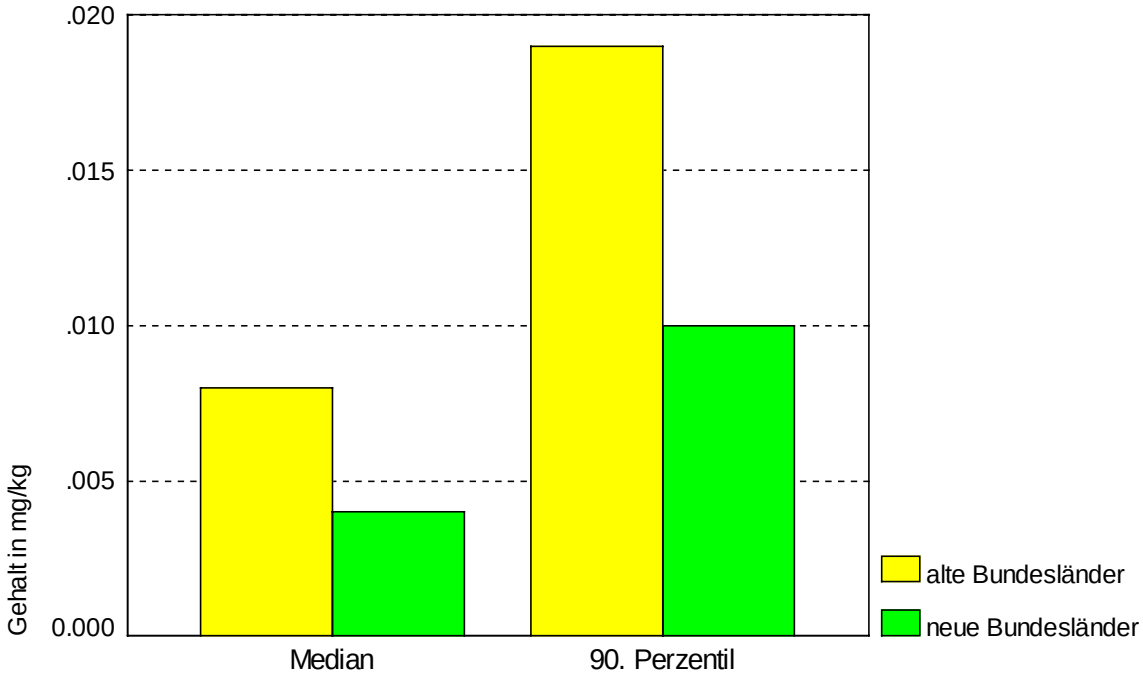


Fig. 11: PCB 180 contents in fatty tissue samples of wild boars from the old and the new federal Länder

Englische Bildbeschriftung Fig. 10/11:
Gehalt in mg/kg – Levels (mg/kg)
Median – Median
90. Perzentil – 90th percentile
alte Bundesländer – Old federal Länder
Neue Bundesländer – New federal Länder

In general, no alarming levels were detected of the substances mentioned above as well as of the other undesirable substances under examination. Nevertheless, the share of samples in which fixed maximum levels were exceeded was a considerable 9.6 %. It has to be added that maximum levels were found to have been exceeded for DDT and PCB only. For DDT, maximum levels were found to be exceeded in samples from the new federal Länder, those for PCB in samples from the old federal Länder only.

Conclusion
Fatty tissue from wild boars may serve as an indicator of the presence of ubiquitous organochlorine compounds in the animals' environment. This has been demonstrated by the examination results concerning DDT levels in the new and PCB levels in the old federal Länder. Although no alarming levels were measured, there was a considerable 9.6 % of samples in which maximum levels were exceeded.

5.1.7 Fish (carp)

164 samples of this very popular species of fish originating mainly from domestic farming under controlled conditions (cf. box 'The production of carp and eel') were examined for ubiquitous organic substances and heavy metals.

Organic substances
The contamination of carp samples with detectable levels of undesirable organic substances was relatively high, i.e. 90.9 % (cf. Fig. 12).
Among the substances detected most frequently were

DDT
HCB
Lindane
PCB 138
PCB 153

The levels of these and also of the other substances under examination were low. This implies that in none of the samples maximum levels were found to have been exceeded (cf. Fig 12). Detected levels of bromocyclen and musk being compounds typical of the aquatic environment were inconspicuous as well.

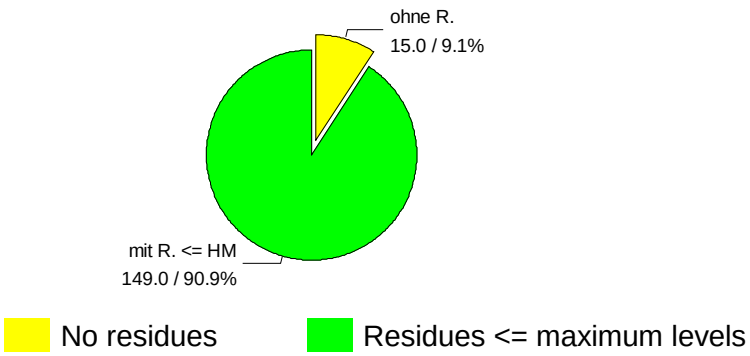


Fig. 12: Contamination of carp with undesirable organic substances

Heavy metals
The levels detected of the heavy metals, lead, cadmium and mercury were inconspicuous as well. There was no single value among the levels detected of lead and cadmium that exceeded the guide values for these heavy metals nor of mercury that exceeded the fixed maximum level.

Conclusion
In carp samples, ubiquitous substances were found to be present relatively frequently. However, levels detected of organic substances as well as of heavy metals were low. There were no levels found to exceed maximum levels or guide values.

5.1.8 Fish products (smoked eel)

This fish product, which is highly estimated among connoisseurs as a delicacy, is particularly prone to contamination with fat-soluble substances due to its high fat content. 237 samples of smoked eel were examined for relevant ubiquitous substances including heavy metals.

Organic substances
As expected, smoked eel was contaminated with ubiquitous substances to a considerable extent. Undesirable substances could not be detected in a mere 1.7 % of samples (cf. Fig 13). Substances detected frequently, i.e. in more than 50 % of the samples, were
DDT
Dieldrin
HCB
alpha-HCH
Lindane
PCB 138
PCB 153
PCB 180

In 4.6 % of the samples, maximum levels were found to have been exceeded (cf. Fig. 13). Particularly high levels were found for DDT and PCB components. Thus, in some samples, DDT levels were found to be 6 to 14 times higher than the maximum level of 5.0 mg/kg. In some samples, levels of PCB compounds were found to be up to 36 times higher than the maximum level of 0.3 mg/kg.

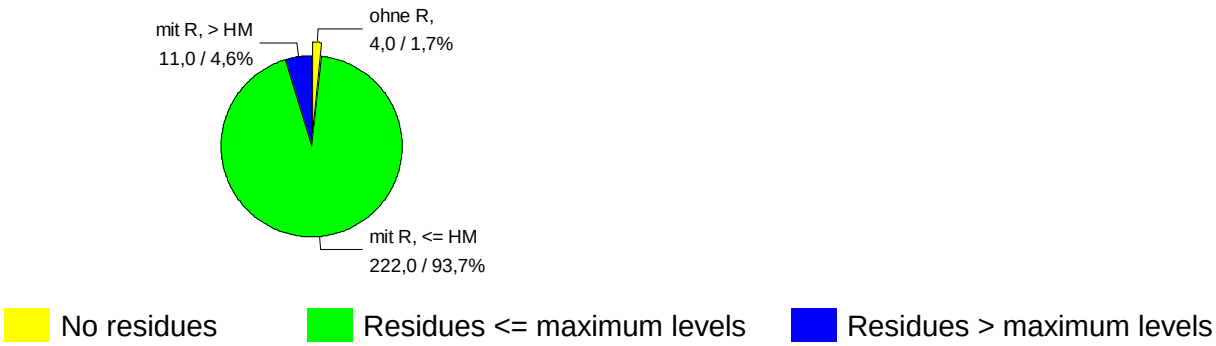


Fig. 13: Contamination of smoked eel with undesirable organic substances

Heavy metals

Of the heavy metals under examination, i.e. lead, cadmium and mercury, mercury and its presence in fish, particularly in eel, is known to constitute a potential problem.

However, present examination results have shown that this contaminant is not of the importance assumed (cf. Table 6). Generally, mercury levels were low. The share of samples in which maximum mercury levels had been exceeded was gratifyingly low, namely 0.9 %.

Table 6: Heavy metals in smoked eel

	Levels (mg/kg)			Guide value / maximum level (mg/kg)	Share of samples >guide value / maximum value (%)
	Median	90th percentile	95th percentile		
Lead	0.010	0.030	0.430	0.500	0.0
Cadmium	0.002	0.010	0.017	0.100	0.4
Mercury	0.060	0.300	0.570	1.00*	0.9

* Maximum level

Conclusion

Due to its fat content, smoked eel is a food considerably contaminated with ubiquitous organic substances. However, contamination with heavy metals has proved to be gratifyingly low. As smoked eel, being a delicacy, is consumed only occasionally its consumption may be classified as acceptable as far as consumer health protection is concerned.

The production of carp and eel
Ca. 74 % of the market share of **carp** originate from domestic fish farming under controlled conditions. The number of carp caught in natural waters is of no importance practically. In carp production, industrial feed pellets specifically optimized for this fish species are used which may have a persistent influence on the quality and taste of the fish. Of the **eels** available on the market, ca. 84 % are imported, mainly from Italy, Denmark and the Netherlands. The majority of eel is no longer farmed in conventional ponds but in concrete or plastic containers (aquaculture). The number caught in natural waters is of minor importance only. Ca. 80 % of eel available on the market are consumed as smoked eel. In order to make production as effective as possible, optimized industrial feed pellets are used. This feed is enriched with fish oil with the intention to achieve the high fat content desired in eels on the one hand and on the other, to enhance food intake by the animals resulting in faster growth.

5.2 Foods of vegetal origin

5.2.1 Cereals (wheat grain, rye grain)

228 samples of wheat grain and 231 samples of rye grain were examined for residues of 36 pesticides, for the heavy metals, lead and cadmium and for the mycotoxin, ochratoxin A.

Pesticides

Wheat and rye, which are the cereals most important for human nutrition, are contaminated with pesticides to a very low degree. Wheat as well as rye samples were practically free from detectable residues of pesticides. Levels found in the few samples containing detectable residues could be classified as low. This has also been proved by the fact that in none of the wheat or rye samples, levels detected were found to exceed maximum residue levels.
Levels of bromide are not included in Figs. 14 and 15 as, within low ranges of concentration, residues of active substances containing bromide which have possibly been used cannot be distinguished from levels due to its natural occurrence.

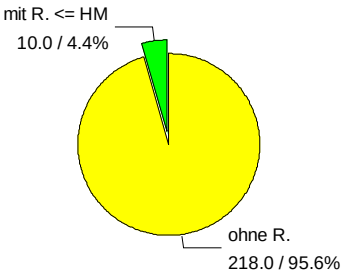


Fig. 14: Pesticide contamination of wheat

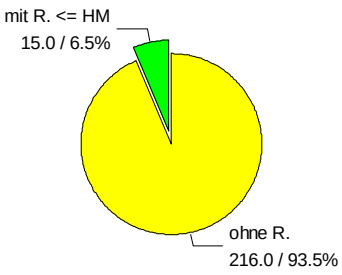


Fig. 15: Pesticide contamination of rye

No residues Residues <= maximum levels

Ochratoxin A

Concerning the occurrence of ochratoxin A in wheat and rye, the situation found was almost identical for both cereals. In both types of cereals, ochratoxin A was detected in ca. 20 % of samples. The levels are depicted in Fig. 16.

Ochratoxin A
Cereals and cereal products affected by mould may contain the mycotoxin, ochratoxin A. This is a substance harmful to the liver and the kidneys which has been carcinogenic in animal experiments. In almost the entire population, ochratoxin A occurs in the blood. However, levels detected have been very low. Preventive health protection of consumers calls for a minimization of ochratoxin A levels in food. This requires optimization of harvesting, storage and transport conditions for cereals including control of the results of respective measures by regular examinations for ochratoxin A. In addition, regulations fixing maximum levels are being prepared on the EU level.

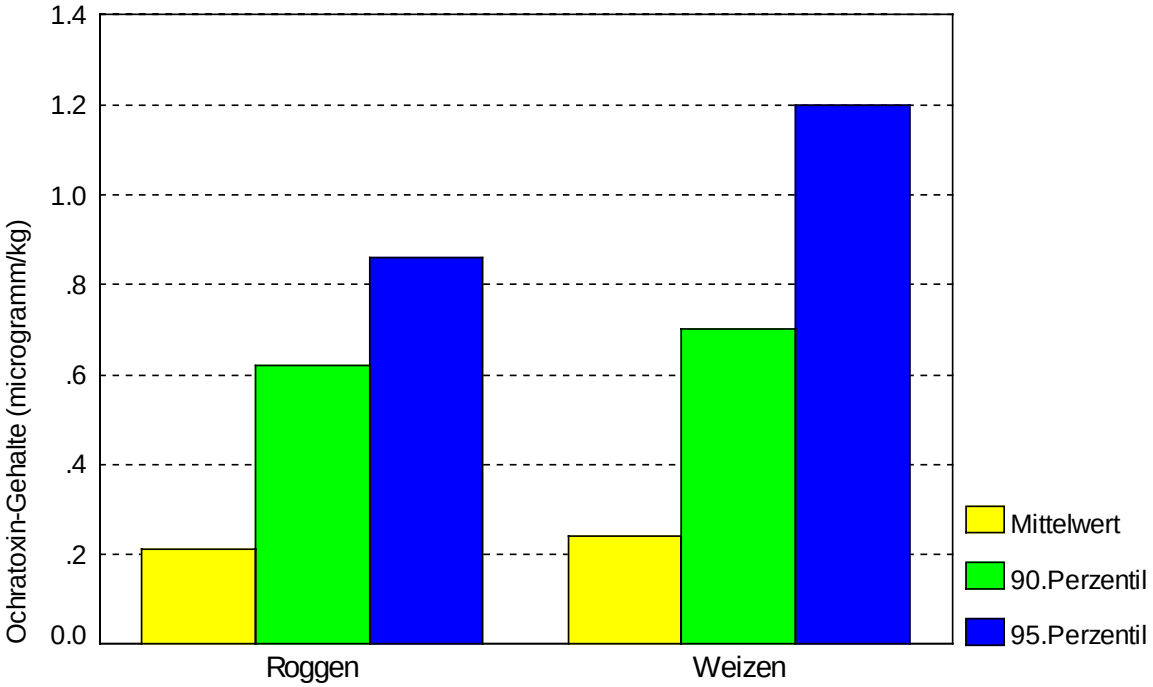


Fig. 16: Ochratoxin in wheat and rye
Englische Bildbeschriftung:
Ochratoxin-Gehalte – Ochratoxin levels (micrograms/kg)
Roggen – Rye
Weizen – Wheat
Mittelwert – Mean value
90. Perzentil – 90th percentile
95. Perzentil – 95th percentile

Heavy metals
The presence of heavy metals in wheat and rye is characterized by plant-specific differences. There was a tendency towards levels of cadmium to be slightly higher in wheat and of lead, in rye. This fact has been depicted in the diagrams of Figs. 17 and 18.

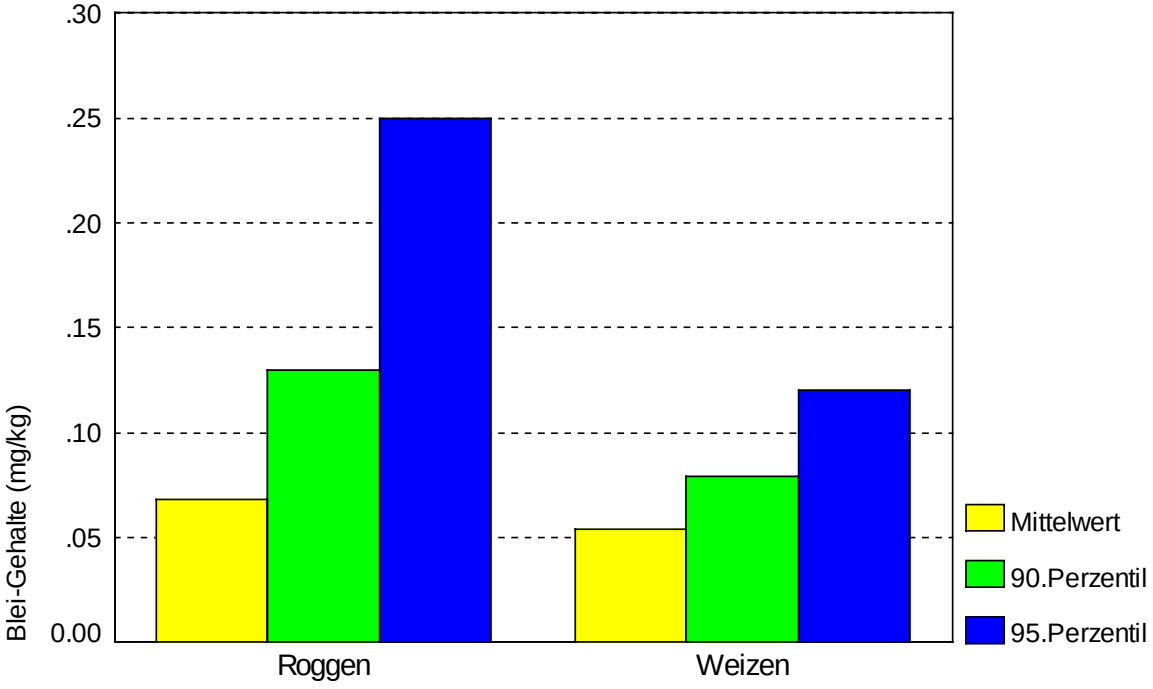


Fig. 17: Comparison of lead levels in rye and wheat

Englische Bildbeschriftung:
Blei-Gehalte – Lead levels (mg/kg)
Roggen – Rye
Weizen – Wheat
Mittelwert – Mean value
90. Perzentil – 90th percentile
95. Perzentil – 95th percentile

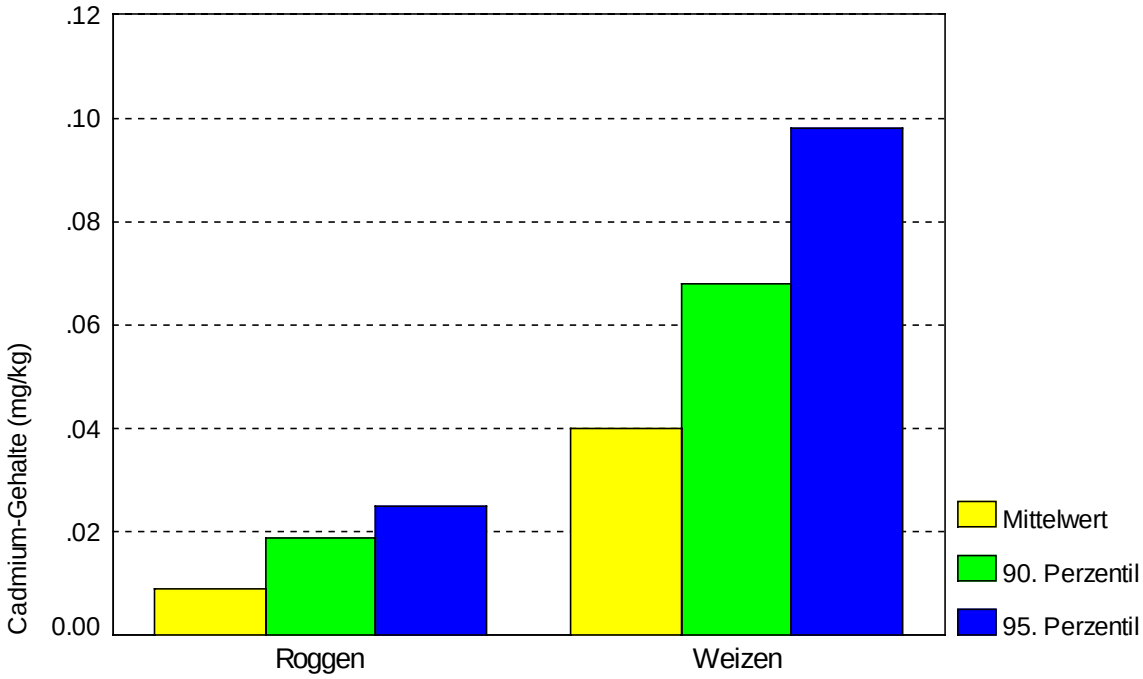


Fig. 18: Comparison of cadmium levels in rye and wheat
Englische Bildbeschriftung:
Cadmium-Gehalte – Ochratoxin levels (mg/kg)
Roggen – Rye
Weizen – Wheat
Mittelwert – Mean value
90. Perzentil – 90th percentile
95. Perzentil – 95th percentile

While the levels found were not alarming, the shares of samples in which levels exceeded the guide value differed for each type of cereal (cf. Table 7).

Table 7: Shares of wheat and rye samples in which guide values were exceeded

Type of cereal	**Cadmium**		**Lead**	
	Guide value mg/kg	Share of samples >guide value (%)	Guide value mg/kg	Share of samples >guide value (%)
Wheat	0.10	3.1	0.30	1.3
Rye	0.10	-	0.40	3.0

Conclusion
Rye and wheat were practically not contaminated with pesticides. In none of the samples, levels were found to exceed maximum residue levels. The fact that in ca. 20 %, i.e. in a relatively high share, of samples of wheat and rye ochratoxin A was detected requires continued attention. There was a higher contamination with cadmium specific to wheat and with lead specific to rye. Levels found may be classified as not alarming.

5.2.2 Hard-shelled dry fruit, oilseed (peanuts)

Aflatoxins are counted among the potentially problematic substances in peanuts. Therefore, 26 samples of roasted peanuts were examined for aflatoxins, pesticides and the heavy metals, lead and cadmium. For technical reasons, a relatively small number of samples was examined. In order to ensure a representative character of the single samples, each sample to be examined has to consist of 30 kg batches at present.

Pesticides
As far as the substances under examination are concerned, the presence of pesticides in roasted/salted peanuts is insignificant (cf. Fig. 19). In one sample only, alpha-HCH and beta-HCH levels were detected which exceeded the maximum level.

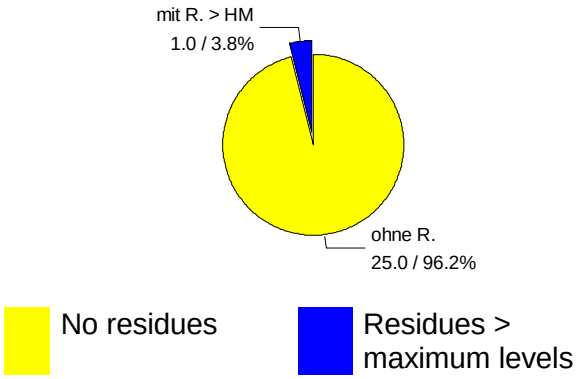


Fig. 19: Contamination of roasted/salted peanuts with pesticides

Aflatoxins
In contrast to previous assumptions, it appears that there is no aflatoxin problem in peanuts. As shown in Fig. 20, more than 80 % of samples did not contain any detectable amounts of aflatoxins. In 3 samples, however, levels exceeded the maximum level of 4 µg/kg for total aflatoxin. The establishment of a possible relationship between origin and aflatoxin levels has to be left to future examinations.
In the text box below, a description is given of the colour sorting process applied to remove peanuts containing aflatoxins.

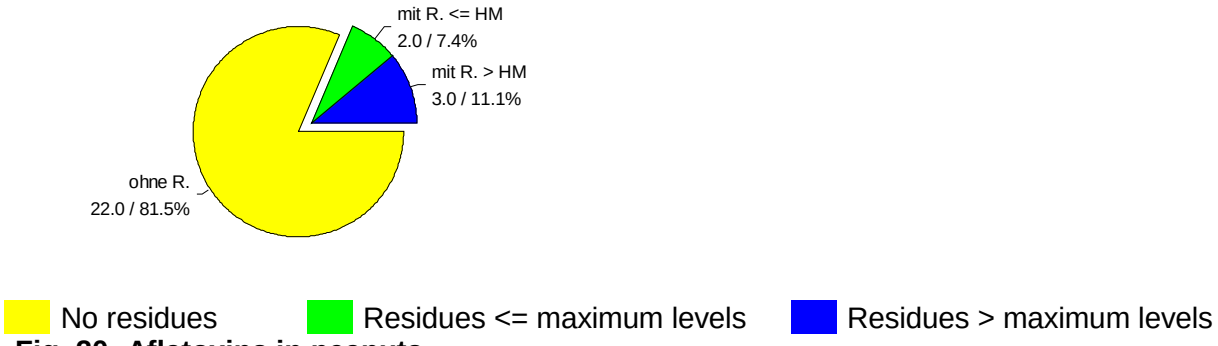


Fig. 20: Aflatoxins in peanuts

Colour sorting of peanuts for removing kernels containing aflatoxin
During transport, peanut kernels are normally covered with their brown seed skin. The batches imported in this state are then industrially processed as follows. *Blanching* The brown seed skin is removed by mild roasting under an airflow. Together with the skin, also part of the cadmium contamination is removed. *Colour sorting* The blanched kernels are sorted in large-scale colour sorting machines. This is possible as kernels unaffected by mould are of beige to cream colour while those affected are of darker, e.g. brownish colour. The latter are optically identified and removed by the machine. Optical sorting by means of modern technology can help to reduce aflatoxin contamination to levels far below 2 µg/kg .

Heavy metals
Concerning heavy metals in peanuts, cadmium has turned out to be problematic. It is already the median that is close to the guide value. The results were surprising, especially as, according to the instructions for the preparation of samples, the brown skin containing particularly high amounts of cadmium had to be removed prior to analysis. Nevertheless, 50 % of the samples were found to contain levels exceeding the guide value (cf. Table 8).

Table 8: Heavy metals in roasted/salted peanuts

	Levels (mg/kg)			Guide value	Share of samples
	Median	**90th percentile**	**95th percentile**	**mg/kg**	**>Guide value (%)**
Lead	0.0910	0.1700	0.4650	0.500	3.8
Cadmium	0.0990	0.2600	0.4600	0.100	50.0

Conclusion
The occurrence of pesticides in roasted peanuts did not raise concern. In a majority of peanut samples there was no or only minor contamination with aflatoxins. Although in some samples maximum levels for aflatoxins were exceeded, this fact does not appear to constitute a major problem. As far as the contamination with heavy metals is concerned, cadmium turned out to be a problem.

5.2.3 Leafy vegetables (salad greens, kale)

Salad greens: head lettuce, lamb's lettuce, iceberg lettuce, oak leaf lettuce, Batavia lettuce and Lollo rosso
Salad greens are of particular importance as a low-calorie food rich in minerals. However, they have been known to contain considerable amounts of undesirable substances which gave rise to their examination under each monitoring scheme since 1995. In 1997, a broader spectrum of salad greens was examined than in the past. The intention was to draw comparisons and evaluate contamination with undesirable substances among the different types of salad greens as well as between present results and those established in the past.

In 1997, 40 samples of each variety of salad green were examined for an extended spectrum of substances comprising 55 pesticides and for lead, cadmium and nitrate.

Pesticides
Fig. 21 gives an overview of contamination levels found.

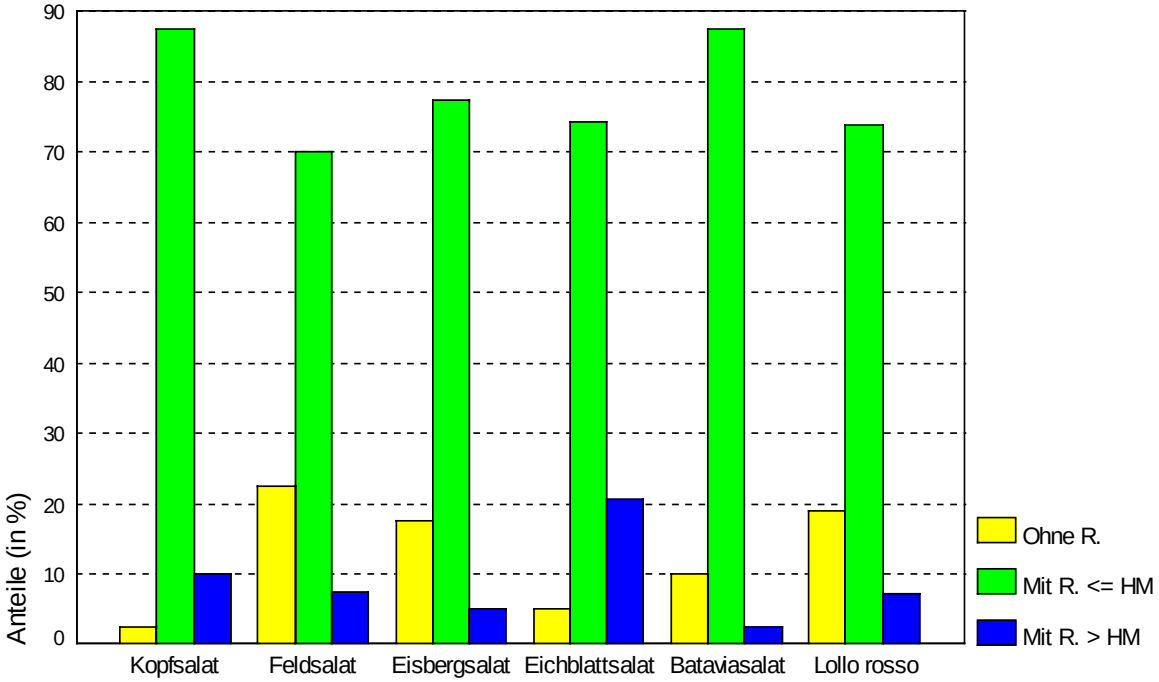


Fig. 21: Pesticide contamination of salad greens
Englische Bildbeschriftung:
Anteile – Shares (%)
Kopfsalat – Head lettuce
Feldsalat – Lamb's lettuce
Eisbergsalat – Iceberg lettuce
Eichblattsalat – Oak leaf lettuce
Bataviasalat – Batavia lettuce
Lollo rosso – Lollo rosso
Ohne R. – No residues
Mit R. <=HM – Residues <=maximum levels
Mit R. > HM – Residues > maximum levels

The contamination levels of the salad greens examined were comparable as to the share of samples in which residues were detected but were below maximum residue levels. This share was equally high for all types of salad greens, i.e. 70-85 %. Pesticides detected frequently in all or almost all types of salad greens were

Bromide
Dithiocarbamates
Iprodione
Metalaxyl
Oxadixyl
Procymidone
Propyzamide
Vinclozolin

There were clear differences between the types of salad greens concerning the share of samples in which the levels detected exceeded maximum levels. While the lowest shares were represented by Batavia lettuce (2.5 %) and iceberg lettuce (5.0 %), the highest shares were reached by head lettuce (10 %) and oak leaf lettuce (20.5 %) (cf. Fig. 21).
Levels above maximum residue levels were detected for 10 substances. This occurred, as a rule, only in single cases in various types of salad greens (cf. Table 9).

Table 9: Numbers of samples of salad greens in which maximum levels were exceeded

Substance	Head lettuce	Lamb's lettuce	Iceberg lettuce	Oak leaf lettuce	Batavia lettuce	Lollo rosso	Total
Bromide	3					1	4
Carbendazim*				1		1	2
Captan / folpet		3		1			4
Chlorpyrifos				1	1		2
Chlorthalonil			1				1
Deltamethrin				1			1
Endosulfan				1			1
Iprodione				2		1	3
Metalaxyl			1	2			3
Methamidophos	1			1			2
Vinclozolin				1			1
Total (of substances)**	**4**	**3**	**2**	**11**	**1**	**3**	**24**
Total (of samples)**	**4**	**3**	**2**	**8**	**1**	**3**	**21**

* Sum of benomyl, carbendazim and thiophanat-methyl
** This differentiation is necessary as, in some samples, maximum levels were exceeded for more than one substance.

In Fig. 22, a summary is presented of the examination results for all types of salad greens.

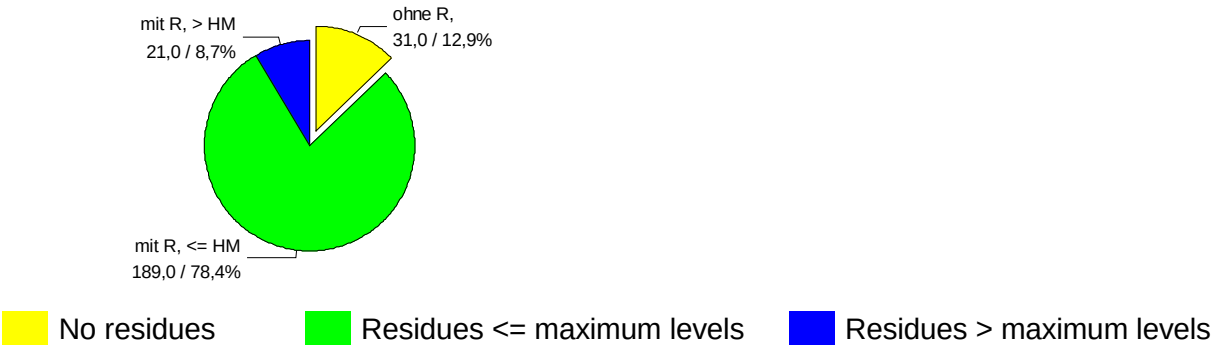


Fig. 22: Pesticide contamination of salad greens (head lettuce, lamb's lettuce, iceberg lettuce, oak leaf lettuce, Batavia lettuce, Lollo rosso) in 1997

Evaluation of examination results under the aspect of quarterly differences in the contamination levels has shown an accumulation of cases of exceeded maximum levels in the winter quarters, i.e. in the IV. and particularly the I. quarter of the year. (cf. Table 10).

Table 10: Share of samples in which maximum levels (ML) were exceeded, by quarters

Quarter	Number of samples >ML	relative (%)
I/97	9	14.8
II/97	3	4.8
III/97	4	6.8
IV/97	5	8.5

Salad greens have been examined under each monitoring scheme since 1995. Fig. 23 draws a comparison between the residue levels in the types of salad greens detected in the individual years.
In order to ensure comparability, Fig. 23 comprises only those substances which have been under examination in each of the 3 years. (This fact accounts for certain deviations from the diagram of Fig. 21).

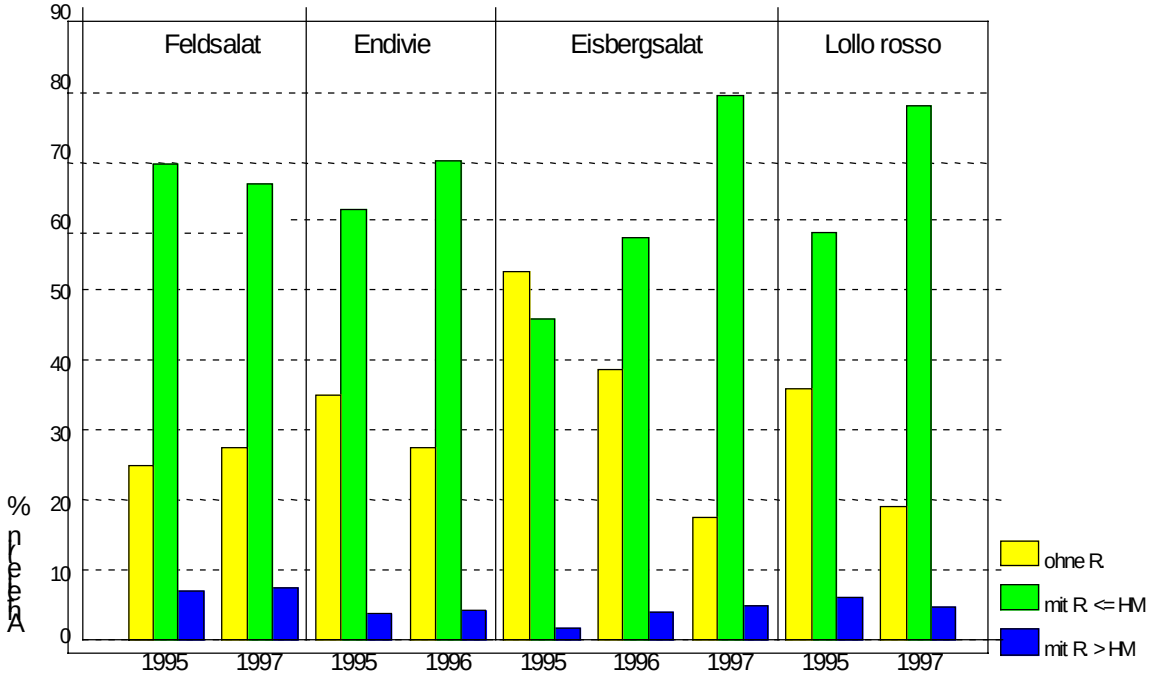


Fig. 23: Pesticide contamination of salad greens as compared over the years
Englische Bildbeschriftung:
Anteile – Shares (%)
Feldsalat – Lamb's lettuce
Endivie – Endive var.
Eisbergsalat – Iceberg lettuce
Lollo rosso – Lollo rosso
Ohne R. – No residues
Mit R. <=HM – Residues <=maximum levels
Mit R. > HM – Residues > maximum levels

The comparison shows that the contamination of salad greens has hardly changed over the years between 1995 and 1997 as to the shares of samples in which maximum residue levels were exceeded. There was a striking decrease of the number of samples without quantifiable contents and a corresponding increase of the number of samples with quantifiable contents in iceberg lettuce and Lollo rosso in 1997 as compared to the other years. This fact cannot yet be explained.

Heavy metals

Table 11 shows the medium levels of lead and cadmium in salad greens. The levels found were low and therefore not alarming. In none of the samples, levels exceeded the guide value for lead. Merely 2 samples of oak leaf lettuce showed levels of cadmium exceeding the guide value (0.1 mg/kg).

Table 11: Median levels of heavy metals in salad greens (mg/kg)

	Head lettuce	Lamb's lettuce	Iceberg lettuce	Oak leaf lettuce	Batavia lettuce	Lollo rosso
Lead	0.010	0.030	0.010	0.020	0.010	0.030
Cadmium	0.021	0.002	0.010	0.027	0.024	0.026

Nitrate

Fig. 24 shows nitrate levels of salad greens differentiated according to times of harvesting. They show a natural tendency to be slightly higher during the winter season than during the summer season. For lamb's lettuce, results to the contrary have been established which cannot be explained at present. On principal, however, median nitrate levels are as high as is typical of lettuce. Fortunately, nitrate levels found in head and leafy lettuces did not exceed maximum levels in any of the samples (cf. box 'Regulations on nitrate in vegetables'). Only 5 % of samples of lamb's lettuce harvested during the summer season and 10 % of those harvested during the winter season showed nitrate levels above the guide value.

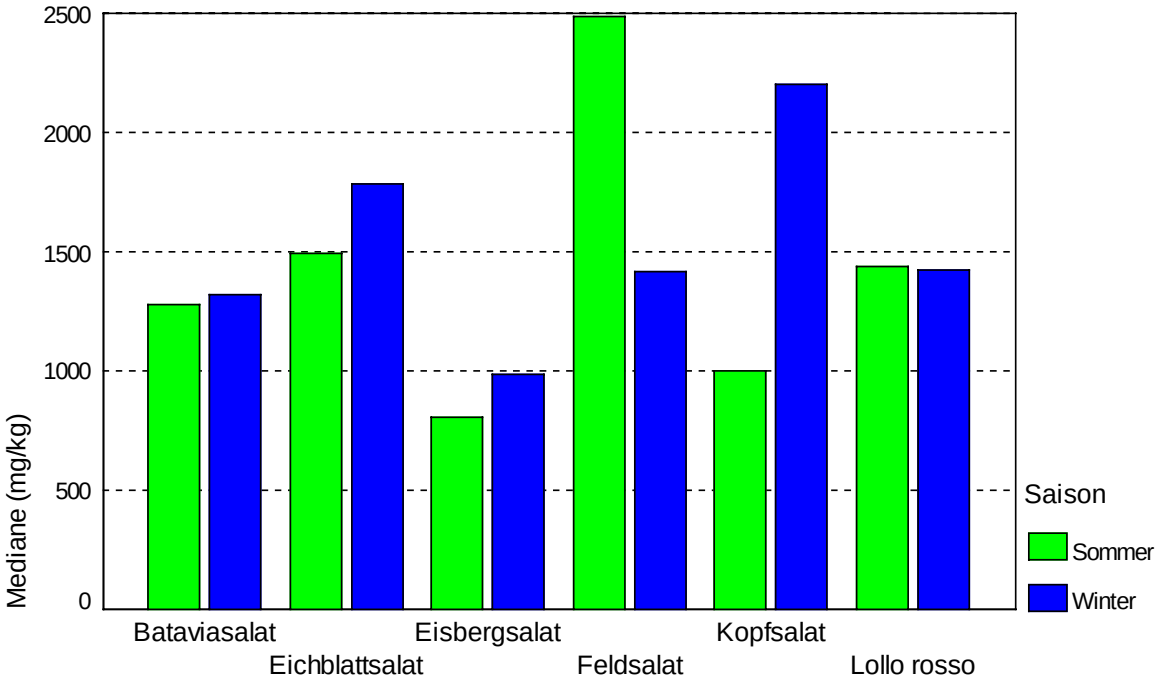


Fig. 24: Median nitrate levels of salad greens during summer and winter seasons

Englische Bildbeschriftung:
Mediane – Medians (mg/kg)
Bataviasalat – Batavia lettuce
Eichblattsalat – Oak leaf lettuce
Eisbergsalat – Iceberg lettuce
Feldsalat – Lamb's lettuce
Kopfsalat – Head lettuce
Lollo rosso – Lollo rosso
Saison – Season
Sommer – Summer
Winter - Winter

Conclusion
Pesticide contamination of salad greens must be rated as high. This is emphasized by a share of 8.7 % of samples containing residues above maximum residue levels. The level of contamination depends on the time of harvesting and is generally higher during the winter season than during the summer season. The examination results for the years of 1995-1997 did not exhibit any change in contamination levels.

Nitrate levels, which are also generally higher in winter than in summer, showed ranges typical of leafy and head lettuces. Maximum levels were not surpassed.

The levels of lead and cadmium detected may be rated as low and therefore not alarming.

Regulations on nitrate in vegetables

For some types of vegetables, the EU has established maximum nitrate levels. Since, in addition to climatic conditions, mainly production procedures such as fertilization and greenhouse or outdoor cultivation have an influence on nitrate levels in vegetables, these factors were taken into account when maximum levels were fixed.
Moreover, guide values have been introduced for some other types of vegetables in Germany.

Vegetables	**Time of harvesting**	**Maximum level**
Lettuce (except for outdoor lettuce)	from 1 October to 31 March from 1 April to 30 September	4500 mg/kg 3500 mg/kg
Outdoor lettuce	from 1 May to 31 August	2500 mg/kg
Spinach, fresh		2500 mg/kg
Spinach, deep-frozen		2000 mg/kg

Vegetables		**Guide value**
Lamb's lettuce		2500 mg/kg
Radishes		3000 mg/kg
Beetroot		3000 mg/kg

In addition to different maximum levels according to season, attention is drawn to the specific labelling of greenhouse lettuce. Greenhouse lettuce is labelled with a corresponding note (‘aus geschütztem Anbau’ – ‘cultivated under protected conditions’) in order to enable consumers to take the type of cultivation into account when buying lettuce.
Lettuces included in this regulation are, among others, head lettuce, iceberg lettuce, Lollo rosso / bianco, escarole and other endive varieties.

Kale
Concerning contamination with **pesticides**, kale is among the foods of vegetal origin being least affected. 90 samples of kale were examined for 33 pesticides of which residues were detected in a few cases only. In none of the samples, levels were found to exceed maximum residue levels.

Heavy metals
Kale is particularly prone to accumulate contaminants adhering to the plants’ surface due to its strongly curled leaves. In addition, kale selectively absorbs the heavy metal, thallium, via its roots which applies to all plants of the cabbage family. Therefore, this plant is an indicator of site-specific environmental contamination, particularly by lead and thallium. Corresponding sampling and evaluation of the samples according to potentially exposed and non-exposed regions has not shown statistically confirmed differences in thallium levels.

In 10 samples (11.1 %), thallium levels found were above the guide value (0.1 mg/kg). Otherwise, levels were found not to be alarming. Table 12 classifies samples in which guide values were exceeded according to regions of origin (potentially exposed/non-exposed). This classification demonstrates that no such influence is recognizable.

Table 12: Thallium levels (TL) above the guide value (0.1 mg/kg), by potentially exposed/non-exposed regions of sampling

Federal Land	TL exposure	Level (mg/kg)
Brandenburg	Non-exposed region	0.160
Schleswig-Holstein	"	0.130
Lower Saxony	"	0.310
Lower Saxony	"	0.109
Lower Saxony	"	0.203
Saxony-Anhalt	Exposed region	0.276
Schleswig-Holstein	"	0.210
Schleswig-Holstein	"	0.136
Schleswig-Holstein	"	0.336
Lower Saxony	"	0.414

Levels of lead and cadmium were rated as low. The guide value for cadmium was not exceeded in any of the samples while, for lead, it was exceeded in one sample.

Nitrate
Medium nitrate levels in kale were 250 mg/kg which is within the lower range of common nitrate levels.

Conclusion
According to this examination, kale has proved to contain low contamination levels concerning pesticides, thallium, lead, cadmium and nitrate. There were not found any site-specific differences in the contamination, particularly with regard to thallium.

5.2.4 Stalk vegetables (broccoli)

225 samples of broccoli were examined for 42 pesticides and for lead, cadmium and nitrate.

Pesticides
Broccoli was examined for a variety of pesticides. Nevertheless, residues of no more than two of these (dithiocarbamates, bromide) were found frequently, i.e. in more than 10 % of the samples. No statistically confirmed correlation could be established between the occurrence of these substances and the origin or the time of harvesting of the samples. Residues of the remaining pesticides were not found at all or in shares of well below 10 % of the samples. Nevertheless, maximum residue levels of 11 substances were found to have been exceeded. Most frequently, this was the case for

Chlorthalonil
Dithiocarbamates
Procymidone

On the whole, the share of samples in which fixed maximum levels were exceeded was a considerable 9.3 %. Fig. 25 gives an overview of contamination levels found in broccoli.

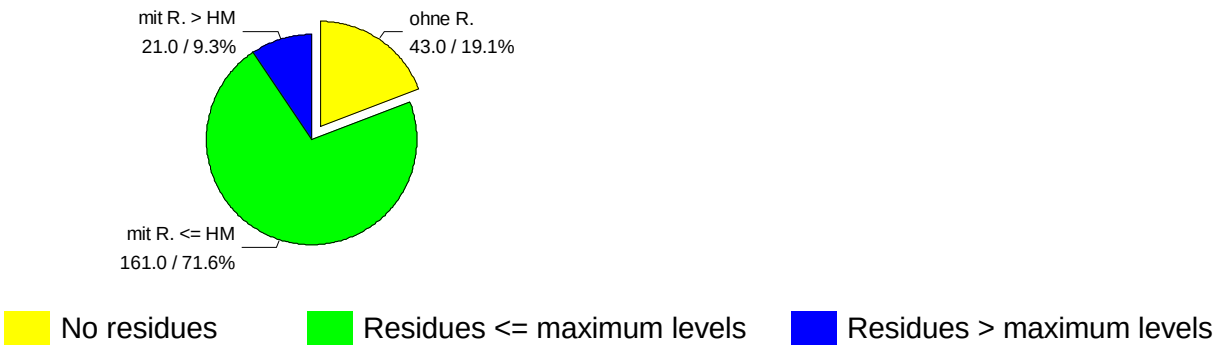


Fig. 25: Pesticide contamination of broccoli

Heavy metals
Levels of heavy metals in broccoli are low. The 95th percentiles are by ca. one log lower than the respective guide value of 0.5 mg/kg for lead and 0.1 mg/kg for cadmium. Levels above guide values for the two heavy metals were found in one sample each.

Nitrate
As in most other plants of the cabbage family, nitrate levels of broccoli were in the medium range (500-1000 mg/kg). There was no recognizable correlation between nitrate levels and time of harvesting.

Conclusion
Broccoli often showed pesticide levels exceeding the maximum residue levels, and residues were found in more than 80 % of the samples. Therefore, the general level of contamination has to be classified as unfavourable. The contamination with heavy metals was low. Nitrate levels were in the intermediate range (500-1000 mg/kg).

5.2.5 Fruiting vegetables (zucchini)

241 samples of zucchini were examined for residues of **pesticides**. The results have been depicted in Fig. 26.

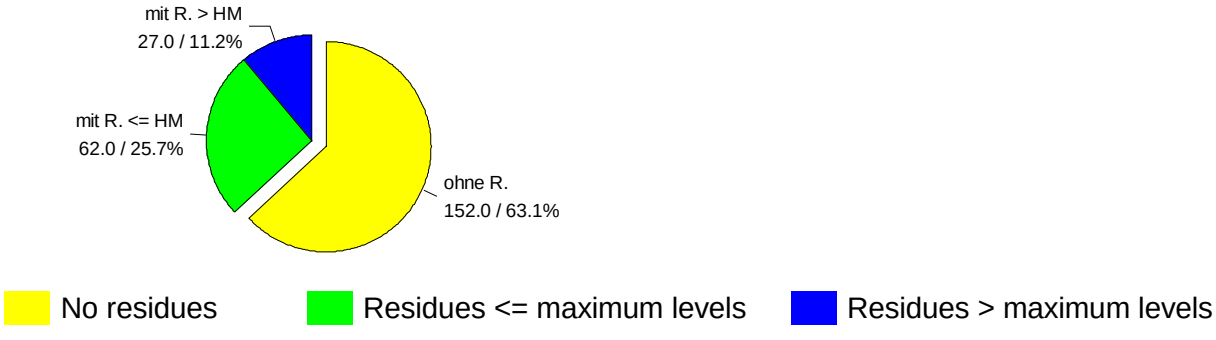


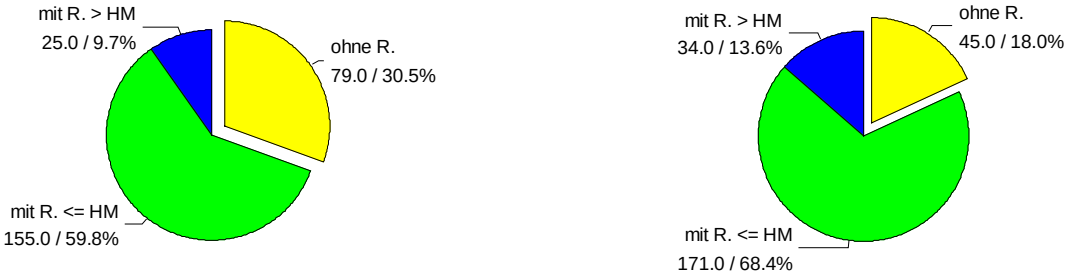
Fig. 26: Pesticide contamination of zucchini

On the whole, contamination with residues of pesticides of zucchini was low. 63.1 % of the samples did not contain any measurable residues. Only aldrin / dieldrin and endosulfan were detected frequently, i.e. in more than 10 % of the samples. While maximum levels for aldrin / dieldrin were exceeded quite often, this was only sporadically the case for other pesticides. The high share of samples with concentrations above maximum residue levels (11.2 %) was mainly due to residues of aldrin / dieldrin.

Conclusion
Zucchini were contaminated with pesticides to a minor extent only. Alarming findings were made for aldrin / dieldrin only, particularly concerning the high share of samples containing levels above the maximum level.

5.2.6 Berries (table grape)

In table grapes, residues of pesticides were detected quite frequently, as was already the case in 1995. In Fig. 27 an overview is given of the results for the two years, 1995 and 1997.



1995 **1997**

Fig. 27: Pesticide contamination of table grapes, comparison between the results of 1995 and 1997

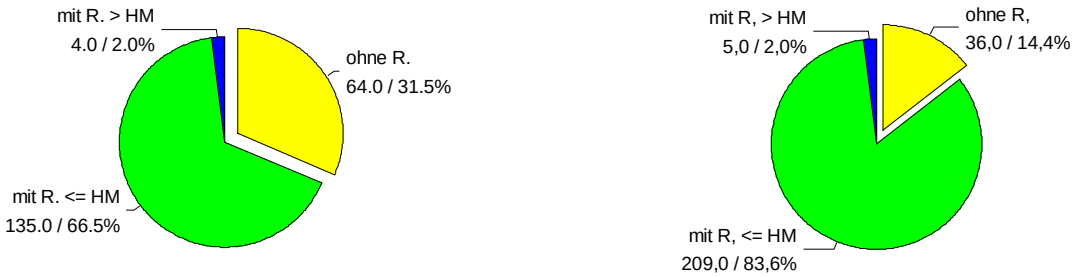
No residues | Residues <= maximum levels | Residues > maximum levels

The two diagrams do not indicate any improvement of the contamination situation during the 1995 to 1997 period. There was even a rise in the share of samples containing residues from ca. 70 % in 1995 to more than 80 % in 1997.
The same applies to samples in which maximum levels were exceeded. Their share increased from 9.7 % in 1995 to 13.6 % in 1997. This result is partly due to the fact that the spectrum of substances under examination in 1997 was broader than that in 1995.

Conclusion
The results for the monitoring years of 1995 and 1997 have shown that table grapes are considerably contaminated with residues.

5.2.7 Citrus fruit (lemon)

Lemons were already examined for **pesticides** under the 1996 monitoring scheme. The spectrum of substances under examination was widely identical in both years. The findings made in 1996 and 1997 and depicted in Fig. 28 were identical concerning the share of samples in which maximum levels had been exceeded.

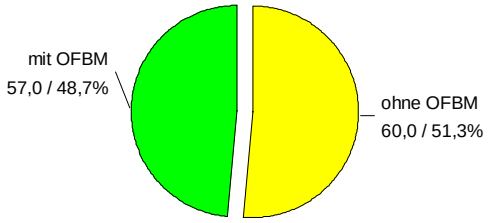


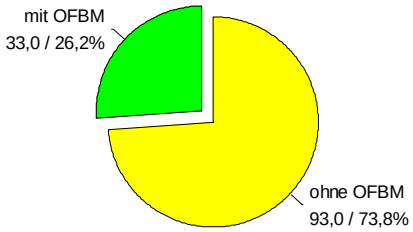
1996 **1997**

Fig. 28: Pesticide contamination of lemon, comparison between the results for 1996 and 1997

No residues | Residues <= maximum levels | Residues > maximum levels

In addition, the 1997 examination was concentrated on the preservatives used for surface treatment, orthophenylpenol, thiabendazol and biphenyl (cf. box 'Surface treatment of citrus fruit') The result of this special examination was that the use, i.e. the presence of one or more preservatives for surface treatment was proved in 48.7 % of samples labelled as treated with preservatives (cf. Fig. 29). In the case of samples labelled as not treated with surface preservatives, such substances were detected in 26.2 %. This means that surface preservatives have been detected in every fourth lemon labelled as not treated (cf. Fig. 29).





Labelled as treated with preservatives **Labelled as not treated with preservatives**

Fig. 29: Presence of preservatives for the surface treatment on lemons

No surface preservatives found

Surface preservatives found

Conclusion

There were no alarming findings as to the pesticide contamination of lemons, a fact that has been confirmed by the monitoring results both in 1996 and 1997. The share of samples in which maximum levels had been exceeded was low.

The presence of preservatives for surface treatment in ca. one fourth of lemons labelled as not treated with preservatives constitutes an obvious infringement of food legislation.

Surface treatment of citrus fruit

After harvesting, the surface of citrus fruit is often treated in order to prevent rotting during storage and transport and extend shelf life. For this type of preservation, the substances, biphenyl (E230), orthophenylphenol or sodium orthophenylphenate (E231 or E232) and thiabendazol (E233) are used. As these substances are known to affect the taste, the peel of treated fruit is not suitable for consumption. Therefore, treated fruit should be labelled accordingly. The labelling should read as follows

Preservative for surface treatment	Labelling
Biphenyl Orthophenylphenol or Sodium orthophenylphenate Thiabendazol	*"konserviert"* (preserved) or *"mit Konservierungsstoff"* (containing preservative) *"konserviert mit Thiabendazol"* (preserved with thiabendazol) This information should be displayed e.g. on a tag placed next to the product or on the label
If citrus fruit is labelled as *"Schale nicht behandelt"* (peel untreated) or *"unbehandelt"* (non-treated) it is not admissible that substances for post-harvest treatment, i.e. the preservatives	

for surface treatment mentioned above, or residues of pesticides are detectable.
Cases of detected infringements of these provisions of food legislation will be punished (e.g. admonition, fine) by the authorities of official food control. Irrespective of this, importers have an obligation, on principle, to ensure the correctness of product labelling by examination and documentation of the corresponding results on their own initiative.

5.2.8 Exotic fruit (banana, kiwi)

Banana
Bananas were exclusively examined for **pesticides**. The entire fruit was examined, i.e. also the peel. The resulting findings have shown that bananas are contaminated with pesticides to a minor extent (cf. Fig. 30).
Special examinations have shown that banana peel contains an amount of pesticides approximately 6 times higher than that in the flesh (cf. box 'How are fruit and vegetables examined for pesticides?')

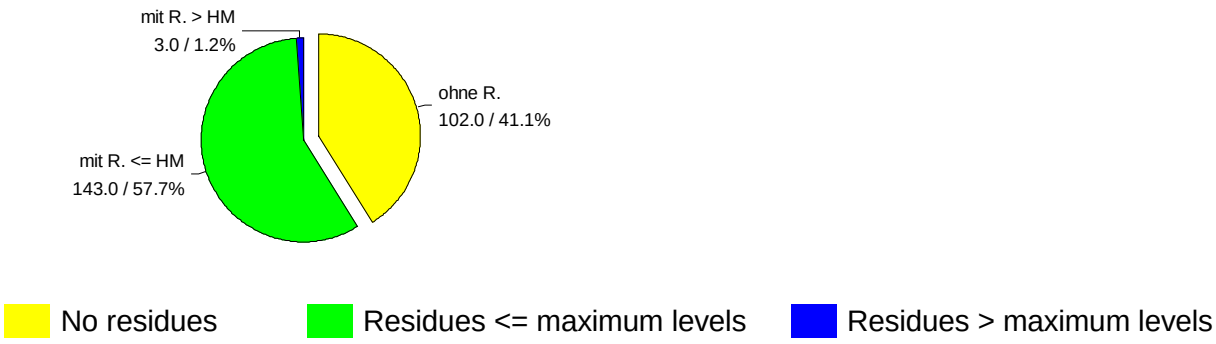


Fig. 30: Pesticide contamination of bananas

Conclusion
Of bananas, the entire fruit is examined. By peeling prior to consumption, pesticide residues possibly present are largely removed. Therefore it may be assumed that the intake of pesticides via banana consumption is negligible.

How are fruit and vegetables examined for pesticides?
For the official examination for pesticides, fruit and vegetables are not washed or peeled as commonly done in the household. Therefore, the amount of pesticide residues adhering to the surface is not reduced by washing and peeling. This deliberate feature of the procedure provides for examination of the worst case of contamination. Authorities of official food control are thus enabled to identify producers who are responsible for contamination problems, by detecting infringements of the relevant provisions of food legislation and tracing back trade routes. In addition, by examination of the worst case, a risk assessment can be made for those consumers who, in defiance of all recommendations, refrain from washing fruit and vegetables prior to consumption.

Kiwi

225 samples of kiwis originating from the main exporting countries, New Zealand and Italy, were examined for **pesticides.** The results are depicted in Fig. 31. Although residues were found to exceed maximum levels in 4.4 % of the samples, kiwis were contaminated with pesticides to a minor extent only as 60 % of the samples did not contain any detectable pesticide residues.

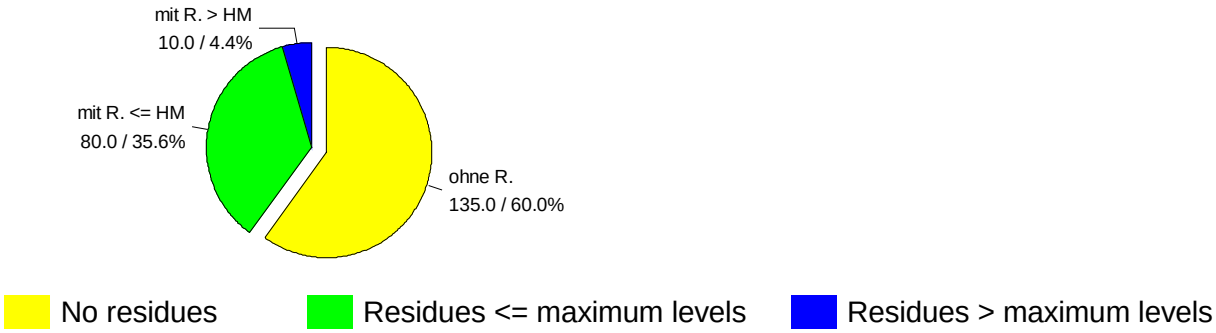


Fig. 31: Pesticide contamination of kiwi

Conclusion

The contamination of kiwi with residues of pesticides was low.

5.2.9 Spices (paprika)

247 samples of paprika powder were examined for pesticide residues, aflatoxins and heavy metals.

Pesticides

Of the pesticides, bromide (cf. Terminology) was among the substances quantified most frequently, namely with an extremely high share of 84.7 % of samples. Above-maximum levels were found, also mainly for bromide, in 6 % of samples.

Aflatoxins

Aflatoxins, particularly aflatoxin B1, were quantified quite frequently, i.e. in ca. 40 % of the samples. Levels detected in paprika have been listed in Table 13.

Table 13: Aflatoxins in paprika (µg/kg)

	Mean value*	90th perc.	Max.	Maximum level	% samples > maximum level

Aflatoxin B1	0.710	2.00	13.20	2.00	9.1
Aflatoxin B2	0.030		1.70		
Aflatoxin G1	0.150	0.40	6.70		
Aflatoxin G2	0.001				
Aflatoxins total	0.860	2.40	14.50	4.00	5.2

* Concerning the mean value and the median cf. Terminology

The levels of aflatoxin B1 and the total aflatoxin listed in Table 13 are relatively high. A differentiation of aflatoxin levels according to origin of the samples has shown that high levels were mainly found in samples originating from Turkey (cf. Fig. 32).

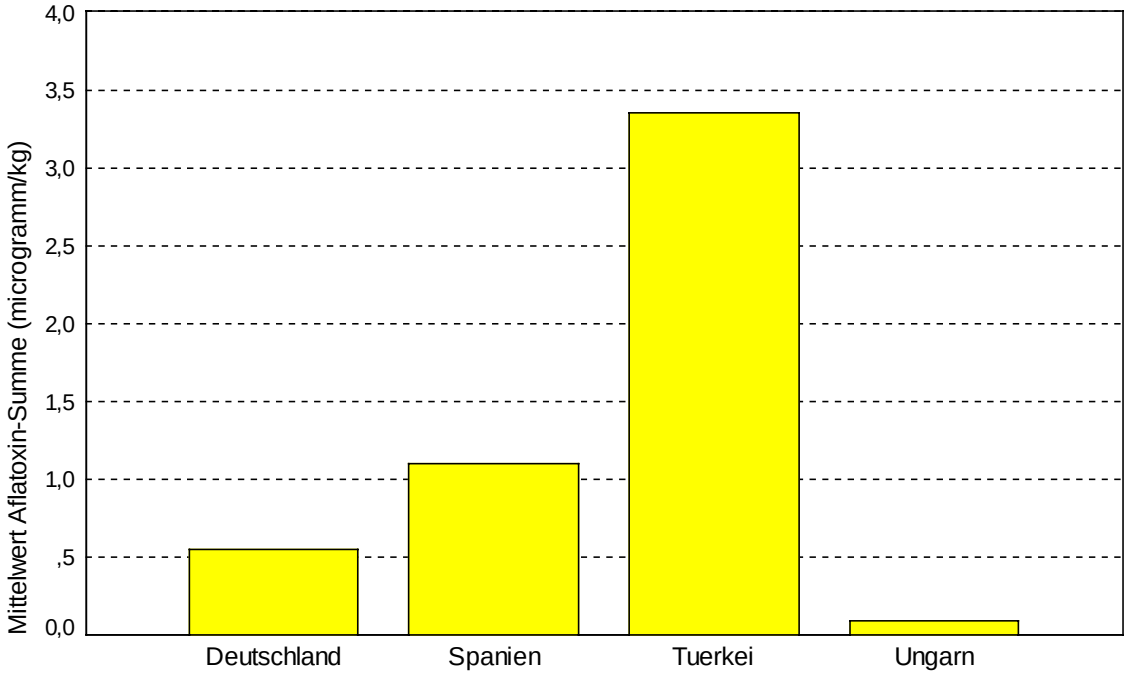


Fig. 32: Median aflatoxin levels in paprika according to origin
Englische Bildbeschriftung:
Mittelwert Aflatoxin-Summe – Mean value of total aflatoxins (micrograms/kg)
Deutschland – Germany
Spanien – Spain
Tuerkei – Turkey
Ungarn - Hungary

Heavy metals

Among the findings for heavy metals, those for lead, in particular, were alarming. Even the 90th percentile reached twice the guide value, which is 0.25 mg/kg (cf. Table 14). A criminal addition of lead compounds in order to increase the weight of paprika - as known in the past – could definitely be excluded even if the maximum level found was 8.8 mg/kg. It is assumed that the relatively high lead levels and the resulting high share of 20.2 % of samples in which guide values were exceeded are to be attributed to hygienic deficiencies (adhering soil particles) of the raw products used.

Table 14: Lead in paprika powder* (mg/kg)

	Median	**90th perc.**	**Max.**	**Guide value**	**% of samples > guide value**

Lead	0.066	0.520	8.800	0.250	20.2

***** The levels stated are calculated for fresh peppers as the guide value applies to these only.

Conclusion

Paprika is mainly contaminated with bromide, aflatoxins and lead. Alarming findings requiring immediate action were made concerning aflatoxins (in addition to lead). High aflatoxin levels were detected especially in samples of Turkish origin. In order to protect the health of consumers, a compulsory inspection was introduced. It implies that, on principle, paprika powder originating from Turkey has to be examined prior to import in order to ensure that maximum aflatoxin levels are not exceeded.

Short review of the monitoring results gained in previous years

Food item	Year	Substances under examination	Results
Cheese Gouda Emmenthal	1995	Organochlorine comp.; PCB Musk	One fifth of the samples examined was not contaminated. If contaminants were found, levels were low, i.e. far below the maximum levels fixed for these substances.
Butter	1996	Organochlorine comp.; PCB musk, bromocyclen	Butter was contaminated with the substances under examination to a minor extent. There were no alarming findings.
Meat			
Edible offals			
Pork liver	1996	Organochlorine comp., PCB, musk, bromocyclen, Pb, Cd, Hg	Low contamination with organic substances and particularly with heavy metals. Only single cases of levels above PCB maximum levels.
Lamb liver	1996	Organochlorine compounds; PCB, musk, bromocyclen, Pb, Cd, Hg	As for pork liver.
Fatty tissue			
Fat from pig's belly	1996	Organochlorine comp., PCB, musk, bromocyclen	Fat from pig's belly was barely or not contaminated. No alarming findings.
Kidney fat (suet) of lamb	1996	Organochlorine comp., PCB, musk, bromocyclen	As for fat from pig's belly
Fish			
Marine fish			
Herring Fillet of saithe	1995	Organochlorine comp., PCB, musk, bromocyclen, Pb, Cd, Hg	No alarming findings The contamination of saithe was low. Herring was contaminated more frequently.
Herring Fillet of saithe	1996	as in 1995	As in 1995
Freshwater fish			
Rainbow trout	1995	Organochlorine comp., PCB, musk, bromocyclen, Pb, Cd, Hg	Contamination of trout was low in general.
Rainbow trout	1996	As in 1995	As in 1995

Food item	Year	Substances under examination	Results
Crustaceans / molluscs			
Crustaceans Brown shrimps pink shrimps, prawns, deepwater prawns, northern shrimps	1995	Organochlorine comp., PCB, musk, Pb, Cd, Hg	Crustaceans were generally contaminated to a minor extent. Cadmium levels only were slightly higher but not alarming.

Fresh vegetables			
Leafy vegetables			
Iceberg lettuce Endive var. Lamb's lettuce Lollo rosso Celery	1995	Pesticides, nitrate, Pb, Cd	Only few cases of contamination with pesticides were detected, except for fungicides and bromide. Nitrate levels were within the high ranges typical of these vegetables. The contamination with heavy metals was low.
Iceberg lettuce Endive var.	1996	Pesticides, nitrate, Pb, Cd	Moderately contaminated with pesticide residues. Nitrate levels were within the usual ranges. Levels of heavy metals were low.
Stalk vegetables			
Kohlrabi	1996	Pesticides, nitrate, Pb, Cd	Kohlrabi was hardly contaminated with pesticides and heavy metals. Nitrate levels were in the medium to high range.
Fruiting vegetables	1995		Contamination with pesticides and heavy metals was low in both years.
Green beans	1996		
Green beans	1995	Pesticides, Pb, Cd	
Cucumber Pickling cucumber	1996	Pesticides, Pb, Cd	In both years, findings showed a very low contamination with pesticides and heavy metals of cucumbers and pickling cucumbers.
		Pesticides, Pb, Cd	
		Pesticides, Pb, Cd	
Fresh vegetables			
Roots			
Radishes	1995	Nitrate	Vegetables showing very high nitrate levels.
Radishes	1996	Nitrate	As in 1995
Fresh fruit			
Berries			
Table grape	1995	Pesticides	Often contaminated with pesticides.
Strawberry	1996	Pesticides	Strawberries grown for picking by consumers (sampling exclusively in such farms) were contaminated with pesticides to a minor extent.
Currants	1996	Pesticides	Low contamination with pesticides.
Citrus fruit			
Orange	1996	Pesticides	

Lemon			High share of samples containing pesticide residues
Fruit products			
Apple sauce	1995	Pesticides, patulin	Practically not contaminated with pesticides. Patulin was detected in ca. 5% of samples.
Fruit juice			
Apple juice Apple juice	1995 1996	Pesticides, patulin Pesticides,	Practically free from pesticide residues in both years. Patulin was detected in a small share of samples.
Orange juice	1996	patulin Pesticides	Practically free from pesticides.
Hard-shelled dry fruit	1995	Aflatoxins	Pistachios (originating from Iran) were heavily contaminated with aflatoxins in both years. In a major part of the samples, aflatoxin maximum levels were exceeded.
Pistachios Pistachios	1996	Aflatoxins	

Legend:

Cd	Cadmium
Hg	Mercury
Musk	Musk compounds
Organochlorine comp.	Persistent organochlorine compounds
Pb	Lead

Terminology:

Acaricides
Substances intended to destroy mites.

Aflatoxins
Metabolic products of moulds. Formation of aflatoxins is promoted by a hot and humid environment. Aflatoxins are a group of chemically related compounds, which include the aflatoxins B1, B2, G1 and G2. Aflatoxins, particularly aflatoxin B1, are those mycotoxins which have shown the strongest carcinogenic effect in animal experiments. Up to now, 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 and for the total amount of aflatoxins, at 4 µg/kg) in order to avoid health hazards caused by food contaminated with aflatoxins. These German maximum levels are the lowest in the world.

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 and used for soil treatment.

Bromocyclen (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 may accumulate in the food chain. Therefore, it is found in wildlife fish from contaminated inland waters as well as in 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.

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 a mixture consisting of more than 200 components (chlorinated compounds).
Due to its high persistence and broad scope of use it occurs in almost any environment. Particularly high concentrations may occur 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 belonging to the group of insecticides. In EU countries, its use as a pesticide has been banned for many years.

Contaminant
Each 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, stockbreeding 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 substances.

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

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 pesticide has been banned for many years. This is why, in the natural environment, DDT occurs practically no longer in a form other than that of its metabolites.
The analysis of DDT is done by detection of its main metabolites in addition to DDT itself. The DDT content of the sample is expressed as the sum of DDT and the metabolites detected.

Dithiocarbamates
The compounds of this group are used as fungicides.

Fungicides
Substances inhibiting or preventing the growth of 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. In EU countries, its use as a pesticide (e.g. as 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-, delta-, epsilon-, and gamma-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 accumulate especially in high-fat foods of animal origin via the food chain.

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 absorbed by plants into their juice from the soil. Mercury levels, if any, occur on the surface of fruit and vegetables. 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.

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 the 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.

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 does not accumulate.

Matrix
The sample material examined is referred to as matrix.

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. In addition, safety factors are taken into account which means that if these levels are exceeded occasionally, no risk for the health of consumers will be involved. Responsibility for compliance with fixed maximum levels lies with the manufacturer or, in the case of food of foreign origin, with the importer. The control of compliance with fixed maximum levels in foods sold on the market is exercized by official food control authorities using randomly selected samples.

Mean
A statistical measurement for a brief 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.

Median
The numerical value that divides a set of measurements arranged according to their magnitude into two halves. This means that one half of the measurements is below the median and the other one above it.

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

Musk compounds
The synthetic musk fragrances (=substitute substances for natural musk) mostly used are nitro musk compounds and polycyclic musk compounds. The substances included in the monitoring scheme, i.e. xylene musk and ketone musk, belong to the group of nitro musk compounds.
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 as well as in human fatty tissue and in breast milk fat. Similar to bromocyclen, musk compounds were detected for the first time in food samples taken under the 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 can become very high. Nitrate levels can, however, also be influenced by the species-specific factors, time of harvesting, weather and climatic conditions. Light is a factor is of decisive importance. 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 chemical reaction with amines. Nitrosamines have been carcinogenic in animal experiments.

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

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 with different degrees of chlorination.
PCBs are slowly degradable, and they enter the human food chain via soil, water and feeding stuffs. 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 which is higher than 90 % of the measurements while it is exceeded by 10 % of them.

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

Pesticides
Pesticides are used in agricultural production in order to protect plants from pests and diseases. They help to 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.

Reference material
In reference material, the substance to be analyzed in the monitoring samples is contained in a defined concentration. It serves to determine the reliability of the analytical method applied. It should be identical with the samples taken for monitoring as far as the matrix and composition are concerned.

Toxicity
The capacity of a substance to cause injury to a living organism.

Ubiquitous
Having the ability to be everywhere, omnipresent.