Ökomonitoring

ORGANIC MONITORING

Summary report

2002 - 2006

Die Chemischen und
Veterinäruntersuchungsämter
in Baden-Württemberg

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Organic monitoring of Baden-Württemberg (Germany)

Since 2002 the Federal State of Baden-Württemberg in southern Germany has been conducting a special monitoring program of **organic foods**. This program is being carried out within the scope of its official food control. Organic foods are systematically analyzed for residues of contaminants as well as the presence of genetically modified plants and irradiation.

The aims of the organic monitoring program are:

- Survey of the contaminant and residue situation in organic foods
- Control of misleading labelling: “Is it really organic if it says so on the packaging?”
- Strengthening of the consumers’ trust in the quality of organic foods by means of an efficient and reliable control system as well as transparency of its results
- Comparison of organic with conventional products

The organic monitoring project was carried out as a joint effort between the four official food control laboratories of the German Federal State of Baden-Württemberg (Chemische and Veterinärunter-suchungsämter) in Freiburg, Karlsruhe, Sigmaringen and Stuttgart.

Table 1 shows the range of subjects covered in the years 2002 to 2006. The results of the organic monitoring are shown in the summary following.

Table 1: Schema of the subjects covered within the scope of the organic monitoring

Parameter	2002	2003	2004	2005	2006
Pesticide residues in plant products	✱	✱	✱	✱	✱
Irradiation	✱	✱	✱	✱	✱
Genetically modified organisms (maize and soy varieties)		✱	✱	✱	✱
Mycotoxins		✱	✱	✱	✱
Dioxins und dioxin-like PCB		✱	✱	✱	✱
Organochlorine and organobromine contaminants in animal products		✱	✱	✱	✱
Nitrate in frozen spinach		✱	✱	✱	✱
Antibiotics in honey		✱			
Ochratoxin A and copper in wine		✱			
Pharmacologically active substances			✱	✱	✱
Shelf life of scalded sausages				✱	

Good marks for organic foods

In all surveyed fields the results showed good marks for organic products.

The survey showed that there is a significant difference between conventional and organic products concerning **pesticide residues in plant products**. On average, organically grown fruits and vegetables contained much lower pesticide residues than conventional ones (mean values: organic 0.01 mg/kg vs. conventional 0.4 mg/kg). Thus, to a great extent, organic fruits and vegetables can be considered residue free (residues < limit of detection). Only a small percentage of organic foods contains pesticide residues which, based on the kinds and the quantities of the detected active substances, can be traced back to an illegal use of pesticides or a blending with conventional products. The study shows that even if drift and environmental contaminations are considered, no residues above Baden-Württemberg's analytically designed "action threshold" of 0.01 mg/kg are to be expected in organic fruits and vegetables. A general maximum residue limit of 0.01 mg/kg for pesticide residues in organic plant products is reachable by producers and is desirable on the part of the food control. The action threshold of 0.01 mg/kg has already been put into practice as a limit for the merchantability of organic products by diverse trade associations.

For **foods of animal origin** no significant difference regarding residues and organic contaminants was noticed between organic and conventional products. This is due to the fact that the analyzed residues don't result directly from the production of the foods but indirectly from contamination of the environment or animal feed. These contaminants may then accumulate in the fatty tissues of the animals. Organic foods are generally affected the same way as conventional ones. In certain cases organic products of animal origin - just like conventional products - may have higher contents of residues than those with an average background exposure. Overall, the exposure of the consumer to organochlorine and organobromine contaminants, pesticides and nitromusk substances via foods of animal origin has clearly reduced in the last 20 years. The exposure to these substances dwells nowadays on a very low and unproblematic level. Furthermore, regarding the content of **dioxins**, no significant difference between organic and conventional was observed. This also applies to the comparison between organically and conventionally produced eggs: dioxins and dioxin-like PCBs contents don't differ.

Also, on a positive note were the analysis results of **pharmacologically active substances** as well as **irradiation**: in none of the analyzed organic samples were pharmacological active substances detected and only in 4 out of 193 (2 %) organic samples was irradiation verified (affected were only ayuverdic teas, spice teas).

The survey of frozen spinach showed no exceedances of the limit for **nitrate** in organic products - spinach belongs to the nitrate accumulating plants. Concerning the nitrate content, no significant difference between organic and conventional frozen spinach was observed either.

In all organic products containing soy or maize, the percentage of **genetically modified plants** was less than 0.1 %. Thus, all organic products which have been analyzed in Baden-Württemberg (Germany) contained much smaller amounts of genetically modified maize and soy varieties than the EU-wide limit of 0.9% established in June 2007. In comparison to conventional products, significant differences were observed for organic products containing soy. Only a slight difference was observed between conventional and organic products containing maize. Over the course of the last few years, fewer and fewer organic foods have been contaminated with genetically modified soy or maize varieties.

Regarding the content of **mycotoxins**, no significant difference was observed between organic and conventional production so far. However, on the basis of this data, a final statement on this subject can not yet be given. The weather conditions during the time of blooming in the field (fusarium toxins) as well as the storage conditions after harvest (aflatoxins, ochratoxin A) are actually the decisive stages for the occurrence of mycotoxins. Hence, also in organic products can the maximum levels for mycotoxins be exceeded on certain occasions.

Individual survey items within the scope of the organic monitoring gave the following results:

- **Antibiotics in honey**: 6 out of 26 analyzed organic honey samples contained residues of antibiotics. The use of antibiotics for the treatment of bees is generally forbidden in Germany and thus in neither organic nor in conventional honey should antibiotics be detectable.
- In none of the analyzed organic **wine and grape juice** samples was **ochratoxin A** detected. The quantified **copper** contents were all below the limit.
- Shelf life of scalded sausages: organically produced, pre-packaged scalded sausages which are produced without nitrite pickling salt showed a high number of microorganisms at the end of their labelled “best before date”. However, pathogens were not found. The reduced shelf life of these organic scalded sausages was obviously not considered by the manufacturers of these products when setting the shelf life.

Detailed results of pesticide residues in plant products

Within the scope of the organic monitoring from 2002 to 2006, a total of 1958 organic foods of plant origin were tested for pesticide residues.

Organic fruits and vegetables can be regarded to a large extent as virtually pesticide residue free (= residues below limits of detection). The results from the past 5 years show good marks for the producers of organic foods of plant origin. About 95 % of the surveyed trade samples were rightfully labelled with the official seal for organic foods. Just a small percentage of organic foods contain pesticide residues which, due to the type and quantity of the residues can be traced back to illegal use of the pesticides or a blending with conventional foods which were treated with pesticides.

Table 2: Summary of the analysed organic samples (2002 - 2006)

Year	2002	2003	2004	2005	2006	Sum	in %
Number of samples	366[1]	360[2]	334	394	504	1958	
Samples without residues [3]	267	289	248	264	301	1369	70 %
Samples with individual residues above 0.01 mg/kg [4]	35	26	21	39	74	195	10 %
Violative samples	27	14	13	28	28	110	5.6 %
Samples with multiple residues	7	27	23	49	105	211	11 %
Samples with MRL violations [5]	8	2	5	6	2	23	1.2 %

For the most part (70 %), the analyzed samples were free of pesticide residues (= all residues were below limits of detection). This was so, even though the array of analyzed active substances has continually increased from about 200 substances in 2002 to more than 500 analyzed substances currently.

[1] In part of the samples only chlormequat (plant growth regulator) or methyl bromide (soil sterilant) residues were analyzed; without these special samples the number of regular samples was 175
[2] In part of the samples only chlormequat residues were analyzed; without these special samples the number of regular samples was 318
[3] In part of the samples only individual pesticide residues were analyzed (methyl bromide, chlormequat, mepiquat, nitrofen)
[4] Except for residues of bromide, piperonyl butoxide, pyrethrins and rotenone
[5] According to the EU-wide or the national maximum residue levels (MRL)

If pesticide residues were detected, they were frequently residues of one active substance far below the trace level of 0.01 mg/kg and thus below the usual concentrations which come about in plant products after pesticide treatment.

Only in 1 % of the organic samples were the maximum residue levels, which also apply to conventional foods of plant origin, exceeded (= MRL violation).

The analyzed samples included agricultural products which arrive practically unprocessed from the field to the consumer (fresh fruits and vegetables including mushrooms), a well as processed foods such as cereal products, dried fruits, infant foods, oils and teas. The residue situation in the analyzes organic samples is shown in *table 3*.

A significant difference was observed in the pesticide residues of organic samples of plant origin compared to the conventional ones.

The analyzed fruits and vegetable samples labelled as “organic” have a mean level of 0.01 mg/kg[6]. If the samples labelled as “organic”, but which were suspected not to be organic (due to blending with conventional products of illegal pesticide treatments), are not considered in the calculation, the mean pesticide level for the organic samples results in 0.002 mg/kg. In comparison, the mean pesticide level of conventional samples is 0.4 mg/kg[7].

[6] Except for residues of bromide, piperonyl butoxide, pyrethrins and rotenone
[7] In the calculation residues of bromide and post harvest treatment substances (citrus fruits) were not included

Table 3: Residue situation in organic foods (2002-2006)

Commodity	Number of samples	No. of violative samples	No. of residue free samples (< LOD)	No. of samples with residues > 0.01 mg/kg[8]	No. of samples with multiple residues
Non-processed fresh fruits and vegetables					
Leafy vegetables	163	4	122	6	13
Solanaceae	264	18	178	19	32
Sprout vegetables	27	1	21	2	2
Root vegetables	121	9	83	15	21
Cultivated mushrooms	49	7	14	12	8
Potatoes	31	1	17	10	4
Berries	95	4	68	4	5
Grapes	161	8	111	14	26
Pome fruits[9]	108	1	83	3	0
Stone fruits	26	2	19	2	1
Citrus fruits	164	15	112	23	17
Exotic fruits	40	2	29	2	4
Other commodities	57	1	51	1	1
Sum	**1306**	**73 (5.6 %)**	**908 (69.5 %)**	**113 (8.7 %)**	**134 (10.3 %)**
Processed goods					
Plant oils and oil seeds	45	1	17	8	12
Cereal products, flour, pastry, Pasta[10]	158	15	130	17	15
Dried fruits	111	10	50	24	31
Tea	31	1	20	7	5
Wine, grape juice, grapes for winemaking	77	5	63	5	6
Infant food[9]	133	5	103	18	0
Other commodities	97	0	78	3	8
Sum	**652**	**37 (5.7 %)**	**461 (70.7 %)**	**82 (12.6 %)**	**77 (11.8 %)**
Total sum	**1958**	**110 (5.6%)**	**1369 (69.9%)**	**195 (10.0%)**	**211 (10.8 %)**

[8] Except for residues of bromide, piperonyl butoxide, pyrethrins and rotenone
[9] Pears and infant foods were only tested for chlormequat and mepiquat residues in 2002
[10] These foods were only tested for chlormequat, mepiquat and nitrofen in 2002 and 2003

Comparison via sample origin - German products come off well

The analyzed organic samples originated from 34 different countries. As shown in *figure 1*, most of the organic products of plant origin which are sold in Baden-Württemberg were produced in Germany, Italy and Spain. Of all the violative organic samples, 35 % of the Italian products, 33 % of the German goods along with 5 % of Spanish, Turkish and Dutch were non-conform with the law. *Table 4* gives an overview of the analyzed organic samples' results of the last 5 years distinguished by the products' origin countries. Fresh fruits and vegetables of German origin show good results: only 2 % of the tested samples contained residues that indicate an illegal pesticide treatment. That means only about every 50th sample of fresh fruits and vegetables from Germany does not rightfully carry the labelling "organic". *When comparing data with other countries, it should be noticed that the data basis for some countries is quite small and that samples were partly taken risk-oriented.*

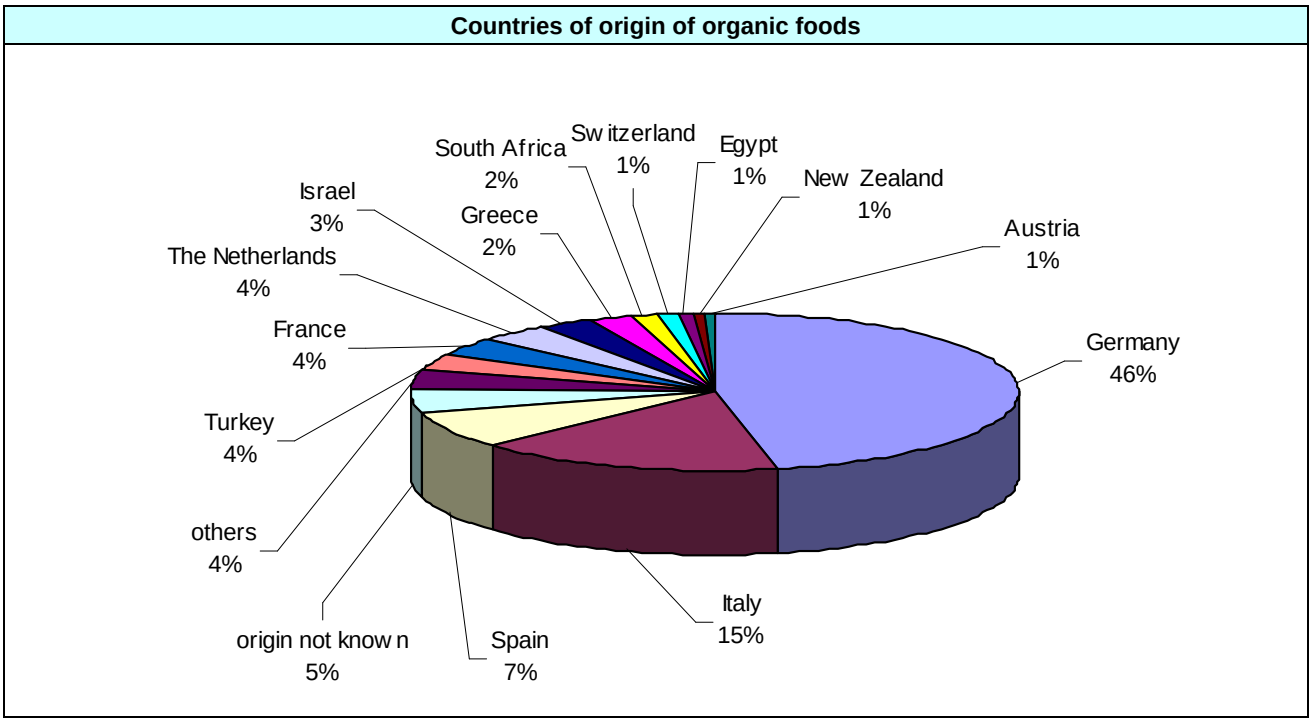

Figure 1: percentage of the countries of origin of the analyzed samples (pesticide analysis in organic foods of plant origin)

A summary of the results of different commodities distinguished by country of origin and number of violative samples is shown in *Table 5.* Organic samples with a noticeable high percentage of nonconformity were found to be carrots, tomatoes and sweet peppers from Italy as well as cultivated mushrooms from The Netherlands. Especially the detection of herbicides in organic carrots from Italy were often reason for a violation in the last 3 years.

Table 4: Organic samples analyzed 2002-2006 - distinguished by country of origin

Country of origin	Number of analyzed samples	Number of violative samples[11]	violative samples [%]
Non-processed fresh fruits and vegetables			
Germany	451	10	2.2
Italy	308	39	12.7
Spain	141	6	4.3
The Netherlands	63	5	7.9
France	62	-	-
Israel	60	2	3.3
Greece	35	4	11.4
South Africa	29	2	6.9
Egypt	15	2	13.3
New Zealand	11	-	-
Morocco	9	-	-
Argentina	2	1	[12]
Other countries	120	2[13]	1.7
Sum	**1306**	**73**	**5.6**
Processed goods (dried fruits, infant food, teas, oil, cereal products, wine)			
Deutschland	462	26	5.6
Turkey	72	5	6.9
Switzerland	21	1	4.8
Italy	12	-	-
France	9	-	-
Austria	7	-	-
Spain	7	-	-
Tunisia	7	2	[2]
The Netherlands	6	-	-
Greece	5	-	-
Other countries	44	3[14]	6.8
Sum	**652**	**37**	**5.7**

[11] Samples with assured residues above the action threshold of 0.01 mg/kg; the labelling as „organic“ was judged as misleading to the consumer
[12] Due to the low sample number a percentual statement is not possible
[13] Origin not known
[14] 2 samples from Tunisia, 1 sample from Japan

Table 5: Summary of organic samples - distinguished by commodity and country of origin

	No. of samples	violative samples[15]	No. of samples	violative samples	No. of samples	violative samples	No. of samples	violative samples
Country of origin	**Italy**		**The Netherlands**		**Spain**		**Germany**	
Salads	8	2	-	-	-	-	86	1 (1 %)
Other leafy vegetables	3	-	-	-	-	-	24	-
Sweet peppers	35	6 (17 %)	20	1 (5 %)	21	2 (10 %)	10	-
Tomatoes	18	4 (22 %)	12	-	38	2 (5 %)	13	-
Other solanaceae	3	-	4	-	10	-	9	-
Carrots	29	7 (24 %)	8	-	3	-	70	1 (1 %)
Mushrooms	0	-	16	4 (25 %)	-	-	31	3 (10 %)
Potatoes	6	-	-	-	-	-	8	-
Fresh herbs	2	-	-	-	-	-	15	-
Other vegetables	8	1[16]	2	-	5	-	13	-
Pome fruits	10	-	1	-	-	-	90	1 (1 %)
Grapes	84	7 (8%)	-	-	3	-	8	-
Berries	12	-	-	-	12	-	67	4 (6 %)
Citrus fruits	69	9 (13 %)	-	-	46	1 (2 %)	-	-
Other fruits	21	3 [17](14 %)	-	-	3	1[18]	7	-
Sum	**308**	**39 (13%)**	**63**	**5 (8%)**	**141**	**6 (4%)**	**451**	**10 (2%)**
	Greece		**South Africa**		**Egypt**		**Israel**	
Tomatoes	-	-	-	-	-	-	10	-
Sweet peppers	-	-	-	-	2	1	35	2 (6 %)
Other solanaceae	-	-	-	-	1	-	-	-
Carrots	-	-	-	-	-	-	4	-
Potatoes	-	-	-	-	10	1	2	-
Other vegetables	-	-	-	-	-	-	2	-
Grapes	10	1 (10 %)	16	-	2	-	1	-
Citrus fruits	24	3 (13 %)	13	2	-	-	5	-
Other fruits	1				-	-	1	-
Sum	**35**	**4 (11%)**	**29**	**2 (7%)**	**15**	**2 (13%)**	**60**	**2 (3%)**

[15] Samples with assured residues above the action threshold of 0.01 mg/kg; the labelling as „organic“ was judged as misleading to the consumer
[16] 1 broccoli sample
[17] 1 sample each of prickly pear, kiwi and nectarine
[18] 1 peach sample

The residue situation for organic sweet peppers and tomatoes has greatly improved in the last years. While in 2006 there were only 3 violative samples from 51 samples (6 %), in 2005 11.6 % (5 out of 43 samples), in 2004 7.7 % (4 of 52 samples), in 2003 7.6 % (6 of 79 samples) and in 2002 30 % (3 of 10 samples) of the analyzed samples were violative (non-conform to the organic standards).

Some samples of cultivated organic mushrooms from The Netherlands were found to be contaminated with chlormequat, a plant growth regulator used in the conventional agriculture of cereals. Chlormequat probably originated from the substrate on which the mushrooms were cultivated. According Council Regulation (EEC) No 2092/91 on organic production of agricultural products, the substrate used for organic mushrooms must also originate from organic agriculture. In 2005 23 % of the cultivated mushrooms were violative samples. In 2006 only 4 % were violative. This shows that in the meantime adequate measures have been taken which lead to this big improvement of the residue situation.

In comparison to conventional foods of plant origin, organic foods have much lower residue levels. With 88 % of fruits from conventional agriculture containing residues of pesticides (average number of active substances detected per sample: 3.9) and with 10 % of these samples exceeding at least one maximum residue level, the organic fruits showed a completely different residue situation: organic fruits were mostly residue free (only 27 % contained residues above the LOD, but generally only in traces). In organic fruit samples on average only 0.5 active substances per sample were detected. The comparison between organic and conventional vegetable samples demonstrated similar results (*Tables 6 and 7*).

Table 6: Residue situation in fruits - organic vs. conventional

	2002	2003	2004	2005	2006
Fruits - conventional					
Number of samples	806	781	844	926	883
Samples with residues above LOD	73 %	85 %	93 %	94 %	95 %
Number of different pesticides found	121	124	149	165	170
Active substances per sample	2.8	2.9	3.9	4.8	5.3
Samples with MRL violations[19]	11 %	9 %	12 %	8.5 %	7.7 %
Fruits - organic					
Number of samples	139	98	125	122	138
Samples with residues above LOD	32 %	11 %	21 %	32 %	38 %
Number of different pesticides found	29	12	17	37	46
Active substances per sample	0,5	0,2	0,3	0,6	0,8
Samples with MRL violations	1.4 %	0	0.8 %	0.8 %	0.7 %

[19] Violation according to the EU-wide or the German national maximum residue levels (MRL)

Table 7: Residue situation in vegetables- organic vs. conventional

Lebensmittel	2002	2003	2004	2005	2006
Vegetables - conventional					
Number of samples	433	545	641	791	866
Samples with residues above LOD	70 %	73 %	78 %	80 %	85 %
Number of different pesticides found	100	121	144	158	199
Active substances per sample	2.9	3.0	3.3	3.2	4.3
Samples with MRL violations[20]	24 %	20 %	22 %	12 %	13 %
Vegetables - organic					
Number of samples	50	103	124	175	232
Samples with residues above LOD	36 %	23 %	23 %	39 %	37 %
Number of different pesticides found	13	19	26	45	61
Active substances per sample	0.3	0.3	0.4	0.7	0.7
Samples with MRL violations in [%]	2 %	2 %	3 %	3 %	0.4 %

The following figures show a summary of different pesticide residue situations for different food groups where conventional products are compared to organic ones.

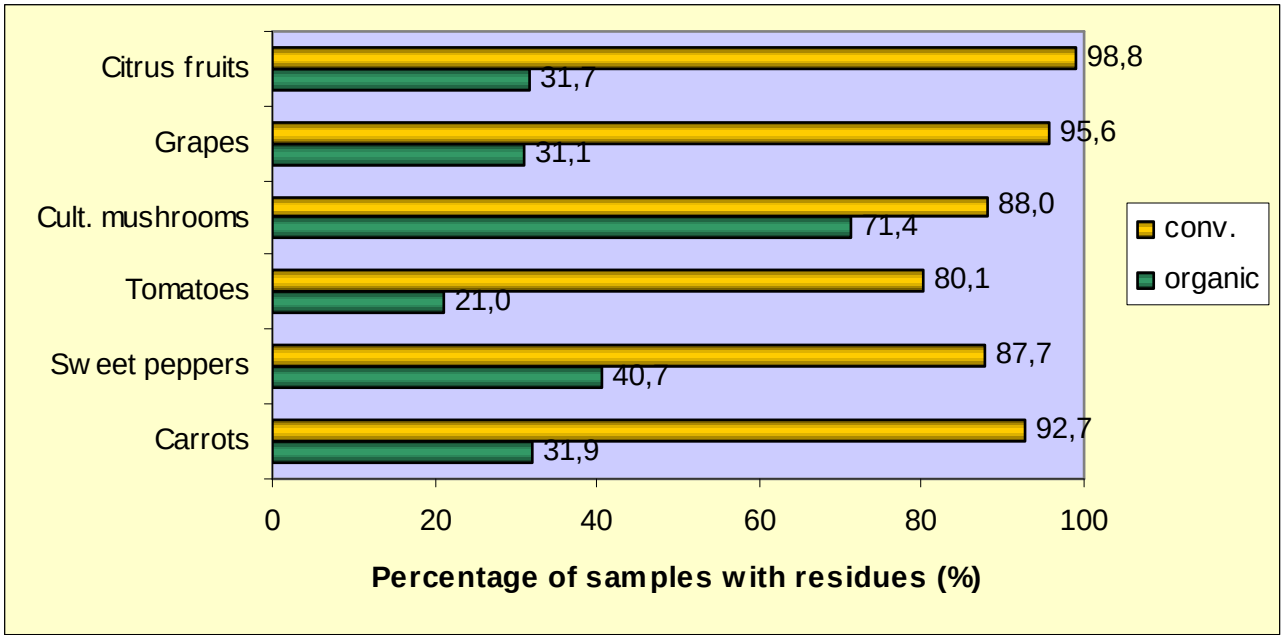

Figure 2: Percentage of the samples of the food groups with residues 2002-2006 - comparison between conventional (conv.) and organic

[20] Violation according to the EU-wide or the German national maximum residue levels (MRL)

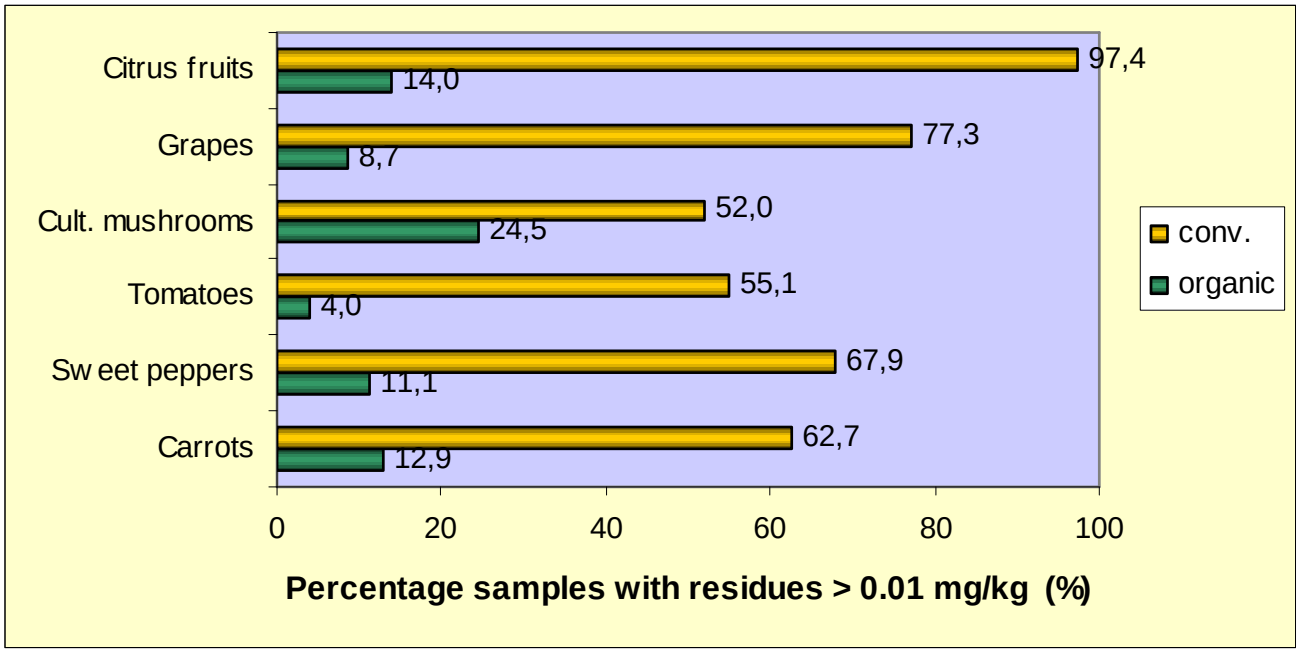

Figure 3: Percentage of the samples of the food groups with certain residues > 0.01 mg/kg 2002-2006 - comparison between conventional (conv.) and organic

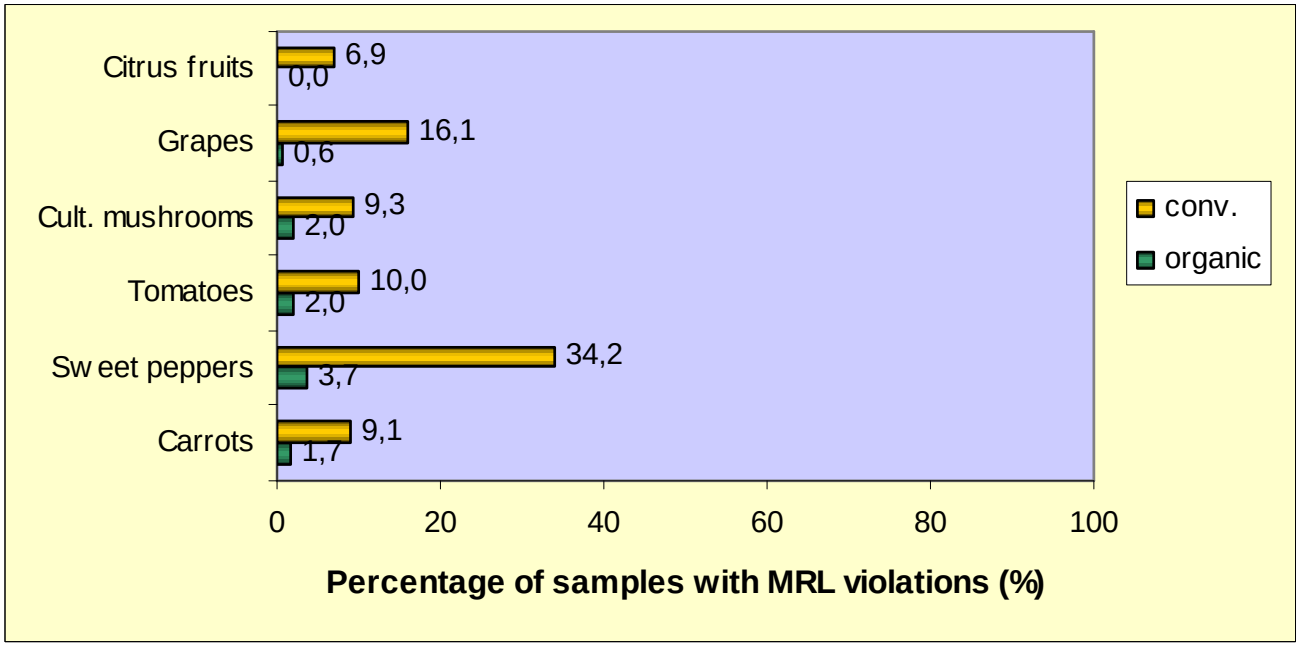

Figure 4: Percentage of the samples of the food groups with MRL violations 2002-2006 - comparison between conventional (conv.) and organic

Residue situation in processed organic goods of plant origin

In total, 652 samples of processed organic food of plant origin from 21 different countries were tested. Most of the samples were from German (71 %) and Turkish producers (11 %, dried fruits). It should be considered that for example for products from German producers, the raw ware (fresh fruits and vegetables) may not always have its origin in Germany, thus in this case Germany being only the production and/or packaging site.

70 % of the violative samples were German products, 14 % Turkish products and 3 % Swiss products. In total 6 % of the organic samples tested had violations of maximum residue levels - mainly cereal products and dried fruits. A summary of the results of different commodities of 4 countries of origin (according to the label on the packaging) is shown in *Table 8.*

Table 8: Summary of sample results - processed organic foods of plant origin from Germany, Turkey, Switzerland and Tunisia

	No. of samples	Violative samples[21]	No. of samples	Violative samples	No. of samples	Violative samples	No. of samples	Violative samples
Country of origin	**Germany**		**Turkey**		**Switzerland**		**Tunisia**	
Dried fruits	11	2 (18%)	71	5 (7%)	-	-	7	2
Plant Oils	25	1 (4%)	-	-	1	-	-	-
Infant food	114	4 (4%)	-	-	20	1 (5%)	-	-
Cereal products, flour, pastry, pasta	158	14 (9%)	-	-	-	-	-	-
Grapes for wine-making, grape juice	65	5 (8%)	-	-	-	-	-	-
Tea	16	-	1	-	-	-	-	-
Others	73	-	-	-	-	-	-	-
Sum	**462**	**26 (5.6%)**	**72**	**5 (6.9%)**	**21**	**1 (4.8 %)**	**7**	**2**

The main emphasis of the tests in 2002 was put on infant foods. Due to the fact that the misuse of the plant growth regulator chlormequat in pears and carrots in the conventional agriculture was detected at that time, infant foods with the ingredients of pears, carrots and cereals were surveyed. In 2002, samples from 5 different companies were conspicuous because chlormequat residues above 0.01 mg/kg were detected. In the following years, measures had been taken and no chlormequat residues were detected in any infant food samples anymore.

[21] Samples with assured residues above the action threshold of 0.01 mg/kg; the labelling as „organic“ was judged as misleading to the consumer

In 2002, chlormequat was also detected in 5 (6.8 %) of 74 organic flour samples. In Germany, chlormequat is only authorized in the conventional cereal agriculture. The main contamination source was found to be the successive milling of conventional and organic cereals. To thwart such a contamination of the flour, concrete model tests were run in a mill. Hence, appropriate measures were taken, so that in the following years no more chlormequat residues above 0.01 mg/kg were detected in organic flours.

In 2006, crisp breads produced from organic products was contaminated with chlormequat. 8 out of 10 samples contained chlormequat residues above 0.01 mg/kg. Here the source of contamination was the production of conventional and organic crisp breads on the same machine without an appropriate intermediate cleaning of the machine.

The survey of the last 5 years demonstrated how the contamination of organic processed foods happens in different ways due to concurrent processing of conventional and organic goods. This shows, how important it is for the producer to be diligent in the manufacturing of processed goods in order to avoid cross-contamination.