

# The Swedish Monitoring of Pesticide Residues in Food of Plant Origin: 1999

Report concerning Directives 90/642/EEC, 86/362/EEC and  
Commission Recommendation 1999/333/EC

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# The Swedish Monitoring of Pesticide Residues in Food of Plant Origin: 1999

## EC and National Report

### Summary

In 1999, a total of 3 438 surveillance samples of fruits, vegetables, juices, fruit drinks, cereal grains, cereal products, vegetable oils, and oil seeds were analysed for residues of 202 pesticides (243 analytes). National and EU harmonised Maximum Residue Limits (EC-MRLs) were exceeded by 73 samples (2.1 %). None of the samples of domestically grown foods contained residues above the MRLs. No detectable residues were found in the 47 samples of foods for infants and young children.

Cauliflower, melons, peppers and wheat grains, in all 383 samples, were analysed in the 1999 EU co-ordinated programme. EC-MRLs were exceeded by 36 (9.4%) of these samples.

The highest violation rate was found in a (composite) sample of sweet peppers which contained 1.5 mg/kg of methamidophos. The MRL for methamidophos in peppers is 0.01mg/kg. The variability factor, calculated as the highest value divided by the mean of individual units in the sample varied between 2.3–6.6. The highest residue in a single unit was 4.2 mg/kg. The estimated short term intake of these peppers exceeds the acute reference dose for both toddlers and adults 360% and 130%, respectively.

The chronic dietary intakes, based on monitoring data, were calculated for 16 pesticides in 19 major foods. Ten of these pesticides exceeded 1 % of ADI.

Dimethoate/omethoate encountered for the highest figure, 5 % of ADI, when a conservative approach was applied in the calculations.

A total of 40 enforcement samples of fruits and vegetables were collected and 16 lots (38 tons) were prohibited from being sold.

## Introduction

Foods of plant origin are checked for pesticide residues by the Swedish National Food Administration (NFA). Annual reports have been published in English since 1986. The present report is our first combined European Commission (EC) and national report. It is aimed for the Commission, Member States in the European Union (EU) and all other interested parties. The report contains general information about the monitoring programme, sampling procedures and analytical methods as well as detailed information about residues found using a format requested by the European Commission (Table A–F). Certain results are also presented in percent of the MRL according to our usual format for reporting residues found (Appendices 4–5). Assessment of the chronic and acute intake has also been carried out.

A condensed version in Swedish will be available on NFA's website ([www.slv.se](http://www.slv.se)).

## Monitoring programme

The target number of samples to be collected of each food is roughly proportional to the food's consumption rate and takes into account both the amount of domestic production and the amount of imports from EU-countries and third countries. However, the number is also based on the importance of the foodstuff in the diets of infants and young children and if the food is consumed with or without the peel. In some cases, the number of samples of a specific food or a food from a particular country was increased based on residues found in prior samples (Table 1).

By analysis of 100 samples it can with 95 % confidence be predicted that the actual percentage of exceedances is less than 3 % provided that no exceedances was discerned.

**Table 1.** Target number of samples to be collected of each commodity.

| Amount of the commodity on the Swedish market, ton | Target number of samples of each commodity |     |     |     |    |
|--|--|-----|-----|-----|----|
|  | A*   | A   | B*  | B   | C  |
| < 3 000  |  |     |     |     | 25 |
| 3 000 – 10 000                                     | 50   | 25  | 50  | 25  |    |
| 10 001 – 25 000                                    | 100  | 50  | 50  | 25  |    |
| 25 001 – 50 000                                    | 200  | 100 | 100 | 50  |    |
| > 50 000   | 200  | 200 | 200 | 100 |    |

A\*: Commodities with edible peel, consumed  $\geq 1$  g per person and day, important in the diet of infants and children

A : Commodities with edible peel, consumed  $\geq 1$  g per person and day

B\*: Commodities with non-edible peel, consumed  $\geq 1$  g per person and day, important in the diet of infants and children

B : Commodities with non-edible peel, consumed  $\geq 1$  g per person and day

C : Commodities, consumed  $< 1$  g per person and day and have contained residues above MRLs

The Swedish monitoring programme for 1999, designed by NFA, included 3 438 samples of foods of plant origin. Table 2 shows the number of surveillance samples analysed by country of origin.

**Table 2.** Total number of surveillance samples by country, analysed in 1999.

| Country            | No. of samples | Country     | No. of samples | Country         | No. of samples |
|--------------------|----------------|-------------|----------------|-----------------|----------------|
| Argentina          | 52             | Honduras    | 4              | Puerto Rico     | 3              |
| Australia          | 14             | Hungary     | 4              | Slovenia        | 2              |
| Austria            | 9              | India       | 8              | South Africa    | 53             |
| Belgium            | 49             | Indonesia   | 2              | Spain           | 468            |
| Brazil             | 62             | Israel      | 70             | Sudan           | 1              |
| Canada             | 4              | Italy       | 373            | Sweden          | 1 037          |
| Chile              | 50             | Ivory Coast | 18             | Switzerland     | 1              |
| China              | 9              | Kenya       | 17             | Thailand        | 36             |
| Colombia           | 44             | Lebanon     | 1              | Turkey          | 26             |
| Costa Rica         | 107            | Mexico      | 2              | United Kingdom  | 46             |
| Cyprus             | 27             | Morocco     | 78             | United States   | 92             |
| Denmark            | 20             | Netherlands | 270            | Unknown country | 77             |
| Dominican Rep.     | 6              | New Zealand | 22             | Uruguay         | 5              |
| Ecuador            | 18             | Norway      | 3              | Venezuela       | 4              |
| Egypt              | 5              | Pakistan    | 3              | Yugoslavia      | 1              |
| France             | 58             | Panama      | 64             | Zambia          | 1              |
| Germany, Fed. Rep. | 64             | Peru        | 3              | Zimbabwe        | 8              |
| Greece             | 31             | Poland      | 2              |                 |                |
| Guatemala          | 3              | Portugal    | 1              |                 |                |
|                    |                |             |                | <b>Total</b>    | <b>3 438</b>   |

## Sampling procedures

### Surveillance monitoring

Samples collected in accordance with the monitoring programme were defined as surveillance samples, i.e. there were no suspicions about excessive amounts of pesticide residues in the lots prior to sampling.

### Enforcement sampling

When a surveillance sample contained a pesticide residue above the national or EC maximum residue limit (MRL), the NFA prescribed conditions for the offering for sale or other handling of the food or lot to which the food belonged. As a follow-up, the next lots were detained and enforcement samples were collected. The condition was cancelled either when a certain number of lots contained pesticide residues below the MRLs, or when other information showed that the residue problem did not exist any longer. Surveillance sampling was then once more resumed.

## Sample collection

Fresh fruit and vegetables were sampled at wholesalers' warehouses in the first trade channel. Normally, a sample includes three sub-samples, each of about 1–3 kg. The sub-samples were collected from at least three different boxes or places throughout the lot (1). The sample was sealed and labelled with a unique sample identity.

Most of the samples of processed or frozen fruit and vegetables, juices, fruit drinks, rice, cereal products, vegetable oils, and oil seeds were collected in retail shops or department stores. As a rule 2–4 consumer packets, weighing about 2 kg in all, were collected. However, if the weight of an individual packet was above 1.5 kg, only one packet was collected.

Samples of domestic cereal grains were collected at the milling plants. The imported cereal grains were sampled at the port where the shipment was discharged. Usually, one bulk sample of about 3–5 kg was collected by stream sampling technique.

Plant inspectors from the National Board of Agriculture collected most of the samples, but inspectors from the Municipal Environmental and Health Protection Committees were to some extent also involved.

## Quality assurance measures

The samples were taken by trained inspectors belonging to the National Board of Agriculture according to written instructions from the National Food Administration. The bags with the samples were sealed. A photo was taken of a box that had been sampled.

## Analytical procedures

### Methods and pesticide coverage

In all, by using both multi-residue methods and single residue methods it was possible to determine 202 pesticides corresponding to 243 analytes (Appendices 2–3). The analytical method codes and their sources are listed in Appendix 1.

A total of about 452 000 residues (analyte/commodity combinations) were sought (Table A2).

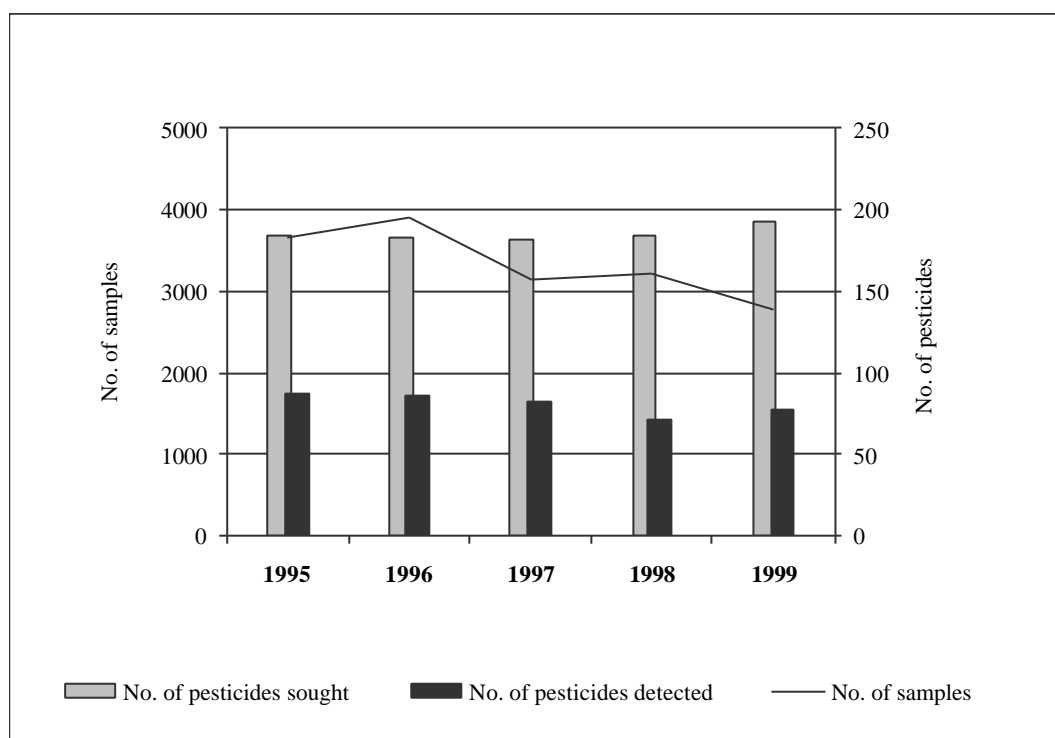
#### *Fruit and vegetables*

Practically all samples of fruit and vegetables were analysed by the multi-residue method (MRM) code 001. By this method, the samples were extracted with ethyl acetate, cleaned up on a S-X3 gel permeation column and determined by capillary gas chromatography. A total of 156 pesticides (182 analytes) were quantitatively covered by using this method.

Depending on commodity/country combination, the GPC cleaned-up extract was also determined by HPLC (method codes 101, 103 and 105) and HPLC with post-column

reaction (method code 104). For acidic commodities sodium hydroxide was added in the extraction step to enable quantitative determination of 3,5-dichloroaniline, the benzo-*m*yl group, thiabendazole and imazalil (method code 002 and 102). In all, using ethyl acetate extraction, GPC clean-up and the different detection systems 172 pesticides (211 analytes) were covered.

In addition to the MRM, 15 single residue methods were used and in all 192 pesticides (232 analytes) were sought in fruits and vegetables. Of these pesticides 77 were actually found. Figure 1 shows number of samples analysed and pesticides sought and detected during the last five years.



**Figure 1.** Number of pesticides (active substances) sought and detected, and number of samples of fruit and vegetables analysed, surveillance sampling between 1995–1999.

### ***Cereal grains and cereal products***

All samples of cereal grains and cereal products were analysed using MRM code 901. This method is similar to the multi-residue method (code 001) used for analysis of fruit and vegetables. Single residue methods were used for analyses of carbendazim, chloromequat, mepiquat, inorganic bromide, glyphosate and AMPA. In all, 69 pesticides (83 analytes) could be detected by the methods used.

### ***Vegetable oils and oil seeds***

The samples were extracted using hexane and acetonitrile. After clean-up on a S-X3 gel permeation column the residues were determined by GC, EC, FPD or N/P - detector. A total of 10 pesticides (12 analytes) were covered by the method used (code 018).

### **Quality control**

Among other procedures, the quality control included daily checks of the instruments' sensitivity and possible matrix effects by injection of test solutions. GC-determinations were in most cases carried out using standards in matrix extracts. The laboratory was supplied with most of the pesticide standards by the NFA. The EC guidelines "Quality Control Procedures for Pesticide Residue Analysis" (2) has been implemented as far as practicable. The laboratory has participated in two proficiency tests. One of these was organised by European Commission (EU-PT 3) and the other by CHECK (3).

### **Laboratory used and accreditation**

The analyses were carried out on a contract basis at AnalyCen Nordic AB, Lidköping. This laboratory was accredited by the Swedish accreditation authority SWEDAC for all analytical methods used for the NFA's official control of pesticide residues in food of plant origin.

### **Reporting levels**

The majority of the pesticide residues were measured and reported from the limit of quantitation (determination), generally in the range of 0.01–0.2 mg/kg. Reporting levels for each of the pesticides are given in Table A2. For certain pesticides, e.g. cypermethrin, daminozide, imazalil, iprodione, methamidophos, procymidone and thiabendazole the EC-MRLs set at the LODs were not achievable in our routine monitoring.

### **Maximum Residue Limits**

The National Food Administration's Regulations on Pesticide Residues in Food, sets MRLs for 165 individual substances or group of substances (according to the residue definition in the regulation) in fresh, frozen and dried fruits and vegetables as well as in cereals and some cereal products (1).

The MRLs, including national and EC-MRLs, apply equally to domestic and imported commodities whether or not the pesticide is authorised in Sweden. When regulations concerning a certain pesticide or a certain group of food products are not given in the regulations, the NFA can decide the maximum level to be applied in each individual case.

## Results and discussion

### Surveillance monitoring

In 1999, a total of 3 438 surveillance samples of fresh, frozen or processed fruit and vegetables, juices, fruit drinks, cereal grains, cereal products, vegetable oils and oil seeds, were analysed for pesticide residues. National and EU harmonised Maximum Residue Limits (EC-MRLs) were exceeded by 73 (2.1 %) of the samples. About 68 % of the samples originated from imports from 53 countries (Table 2).

Out of 3 046 samples of fresh or frozen fruits and vegetables and cereal grains 1 152 samples (37.8%) contained residues and 73 samples (2.4%) exceeded national and EC-MRLs (Tables A1 and D1–2).

In all, 7 703 analyses were carried out using 25 different analytical methods. The number of surveillance samples, analysed by the different analytical methods and arranged by food-groups, is shown in Appendix 3. Out of the 202 pesticides (active substances) sought in all foodstuffs 78 were actually detected. The total numbers of findings of each pesticide in fruits, vegetables and cereal grains are shown in Table A2.

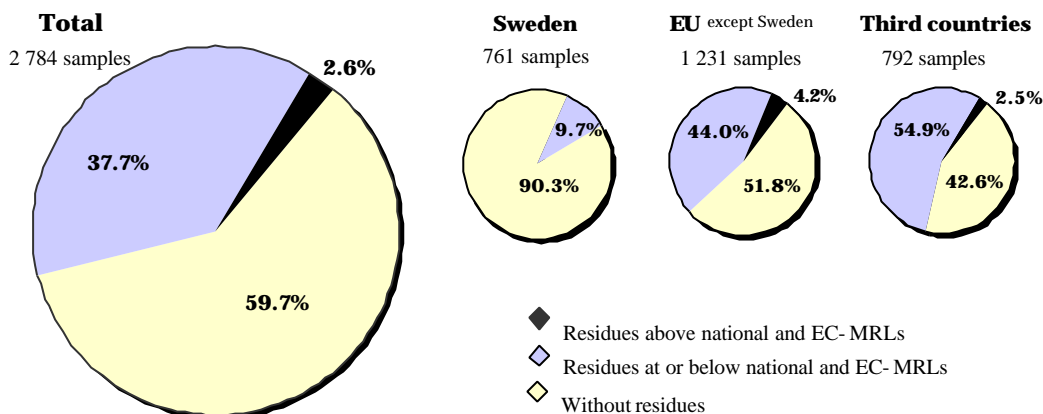
The most commonly found pesticides in fresh or frozen fruit, vegetables and cereal grains are presented in Table 3. The fungicides imazalil and thiabendazole were among those most often found in fruits, while the insecticide endosulfan was most often found in the vegetable samples. Out of the six different pesticides detected in cereal grain, inorganic bromide was most often found.

**Table 3.** Pesticides most commonly found in fruits, vegetables and cereal grains, surveillance sampling in 1999.

| Fruits<br>(1 362 samples) |                        | Vegetables<br>(1 422 samples) |                        | Cereal grains<br>(262 samples) |                        |
|---------------------------|------------------------|-------------------------------|------------------------|--------------------------------|------------------------|
| <i>Pesticide</i>          | <i>No. of findings</i> | <i>Pesticide</i>              | <i>No. of findings</i> | <i>Pesticide</i>               | <i>No. of findings</i> |
| Imazalil                  | 294                    | Endosulfan                    | 109                    | Bromide, inorganic             | 14                     |
| Thiabendazole             | 239                    | Methamidophos                 | 52                     | Chlorpyrifos-methyl            | 9                      |
| Methidathion              | 116                    | Chlorothalonil                | 43                     | Malathion                      | 9                      |
| Tolylfluanid              | 82                     | Dithiocarbamates              | 23                     | Pirimiphos-methyl              | 6                      |
| Chlorpyrifos              | 71                     | Procymidone                   | 17                     | Glyphosate                     | 3                      |
| Azinphos-methyl           | 62                     | Bromide, inorg.               | 15                     | Dichlorvos                     | 1                      |
| Captan                    | 60                     | Vinclozolin                   | 15                     |                                |                        |
| Bromopropylate            | 43                     | Methomyl                      | 13                     |                                |                        |
| Dithiocarbamates          | 40                     | Acephate                      | 12                     |                                |                        |
| Procymidon                | 36                     | Tolylfluanid                  | 10                     |                                |                        |

### *Fruits and vegetables - fresh or frozen*

A total of 2 784 samples of fresh or frozen fruit and vegetables including potatoes were analysed for residues of 192 pesticides. Residues were found in 40% of the samples and 2.6% exceeded national and EC-MRLs (Figure 2).



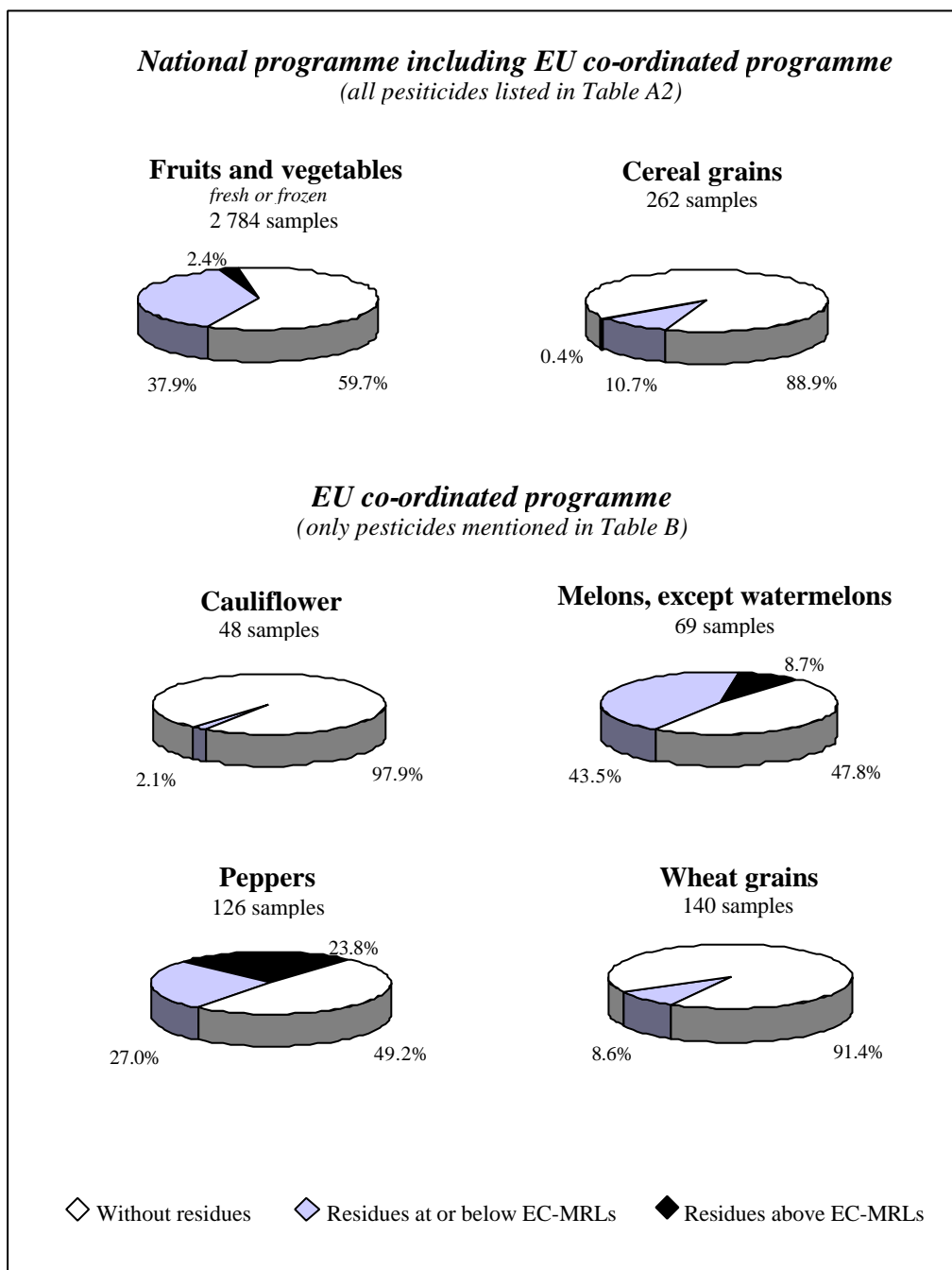
**Figure 2.** Summary of results for fruits and vegetables, surveillance sampling in 1999.

In general, the imported commodities contained considerably more often residues than the domestic, but in most cases the residues were below the MRLs. Most samples (90%) of domestically grown fruit and vegetables contained no residues. The corresponding figures for EU-countries (except Sweden) and third countries were 52% and 43%, respectively. No exceedances were found in domestic products while 4.2% of the samples of fruits and vegetables from EU countries (except Sweden) and 2.5% from third countries exceeded national and EC-MRLs.

Number of samples of each fruit and vegetable and the pesticide residues found (in per cent of the MRL) are presented in Appendix 4.

### The EU co-ordinated programme

The EU co-ordinated programme for 1999 consisted of four commodities which should be analysed for 20 pesticides (2). All Member States (MS) have to analyse these pesticide/crop combinations. The minimum number of samples to be analysed by each of the member states varied between 12 to 93 depending on the population size in the MS. In Sweden the EU co-ordinated programme is included in the national monitoring programme. In all 383 samples of cauliflower, peppers, melons and wheat grains were analysed. Residues, all below the MRLs, were found in one out of 48 samples of the cauliflower and in 12 out of 140 samples of wheat grains. The MRLs however, were exceeded by 30 out of 126 samples of sweet peppers and 6 out of 69 samples of melons (Figure 3 and Table B).

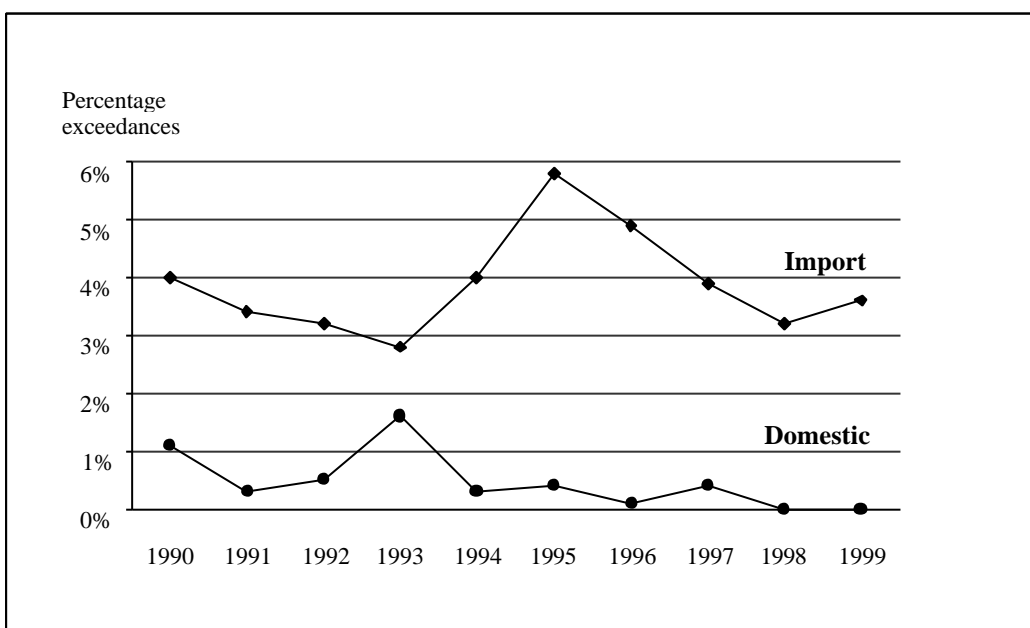


**Figure 3.** Summary of results for the national and the EU co-ordinated programme, EC-MRLs, surveillance sampling in 1999.

Table D1 gives detailed information about pesticide residues found and action taken for those 68 samples that exceeded EU harmonized MRLs. In four of the samples, two pesticides in each sample exceeded the EC-MRLs. These combinations were dithiocarbamates/iprodione in papaya, acephate/methamidophos in grapes and methamidophos/methidathion in peppers.

A total number of 523 samples of fruit and vegetables contained residues of two or more pesticides in a single sample. The highest figure found in a single sample was seven pesticides in one sample of lemons. Detailed information is given in Table E for samples with two or more pesticide residues in a single sample.

The frequency of samples of fruit and vegetables with pesticide residues above national and EC-MRLs the last ten years is shown in Figure 4. In 1995, the percentage of exceedances in imported fruit and vegetables reached 5.8%, the highest figure since beginning of the 1980s. However, the violation rate has then decreased and amounted to 3.6 % in 1999. There were no exceedances of the MRLs among the domestic samples in 1998 and 1999.



**Figure 4.** Violation rate of pesticide residues in samples of fresh or frozen fruits and vegetables, national and EC-MRLs, surveillance sampling between 1990–1999.

#### ***Fruits and vegetables – processed***

103 samples of canned fruits and vegetables were analysed (Table C2). The fungicide vinclozolin was found in one of the samples. The level was very low, 0.08 mg/kg, which can be compared with the MRL of 2 mg/kg applicable for fresh beans with pods.

Nine out of 36 samples of potato chips and two out of 11 samples of other fried potato products contained residues of the sprout inhibitor chlorpropham. None of the samples exceeded the national MRL of 1 mg/kg (Table C2).

Inorganic bromide was found in all three samples of dried figs. The highest residue found was 22.3 mg/kg. The MRL for inorganic bromide in fresh figs is 30 mg/kg (Table C2).

### ***Juices and fruit drinks***

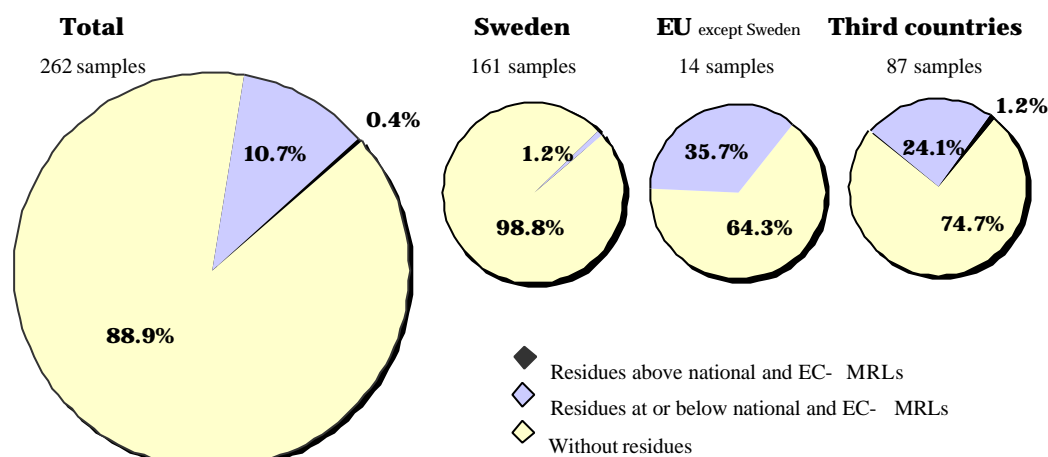
A total of 74 samples of juices and fruit drinks, mainly orange and apple juices, were analysed. No residues were found in these samples (Table C2).

### ***Foods intended for infants and young children***

None of the 47 samples of caned fruits, vegetables, fruit and vegetable drinks contained any residues.

### ***Cereal grains***

A total of 262 samples of cereal grains, mainly wheat, rice and rye, were analysed. One of these samples, rice from India containing 91 mg/kg of inorganic bromide, exceeded the EC-MRL. However, most of the samples (89%) were free from residues (Figure 5 and Table C1).



**Figure 5.** Summary of results for cereal grains, national and EC-MRLs, surveillance sampling in 1999.

### ***Cereal products***

A total of 90 samples of cereal products, mainly pasta, wheat flour and cornflakes, were analysed. No residues were found in any of the samples (Table C2).

### ***Vegetable oils and oil seeds***

Olive oil, rape seed oil, maize oil, sunflower oil and mixed oils, 47 samples in all, were analysed for residues of ten pesticides (method code 018). Furthermore, 25 samples of peanuts were analysed for residues of inorganic bromide. No residues were found in these products (Table C2).

## Enforcement

Enforcement samples were collected as a follow-up, when excessive amounts of pesticide residues were found in surveillance samples. Ten out of 40 enforcement samples exceeded EC-MRLs and 12 samples exceeded national and EC-MRLs (Tables C3 and D3–4).

A total of 16 lots (37.9 tons) of different foods were prohibited for sale in 1999 (Table 4) compared with 7 lots (19.6 tons) in 1998 (4). These lots had to be either destroyed or returned to the supplier.

The number of samples analysed, grouped by food commodity, country of origin and residues found, expressed in per cent of the MRL, are shown in Appendix 5.

**Table 4.** Lots prohibited for sale in 1999.

| Food         | Country | No. of lots | Weight, ton |
|--------------|---------|-------------|-------------|
| Grapes       | Brazil  | 1           | 0.08        |
| Lemons       | Turkey  | 1           | 20.0        |
| Mangoes      | Brazil  | 2           | 1.8         |
| Papaya       | Brazil  | 1           | 0.01        |
| Peppers      | Spain   | 11          | 16.0        |
| <b>Total</b> |         | <b>16</b>   | <b>38</b>   |

## Chronic dietary intake

The chronic dietary intake of pesticide residues in certain major fruits, vegetables and cereals on the Swedish market was calculated by using monitoring data from 1998 and 1999. A two year period was selected in order to achieve a reasonable amount of samples, and also to include a variety of imported countries.

### Foodstuffs and consumption data

Fruits, vegetables, cereals and juices, altogether 19 different foodstuffs were studied (Table 5). The commodities chosen are consumed in considerable amounts in Sweden, and several are by experience known to contain pesticide residues.

The consumption figures were based on data from several sources. Swedish production and total consumption figures were collected from the Swedish Board of Agriculture (5, 6). For imported foods the figures were based on import statistics derived from Statistics Sweden. The consumption figures chosen also took into account two dietary surveys carried out in 1989 and 1997–1998 by Statistics Sweden and the National Food Administration. The consumption figures were subdivided into domestic and imported foodstuffs. The 90<sup>th</sup> percentile consumption was then derived from the average consumption.

**Table 5.** Average and 90<sup>th</sup> percentile food consumption figures for foodstuffs included in the chronic dietary intake estimates.

| Foodstuff                        | Consumption (grams/day and person) |        |            |                             |        |              |
|----------------------------------|------------------------------------|--------|------------|-----------------------------|--------|--------------|
|                                  | Average                            |        |            | 90 <sup>th</sup> percentile |        |              |
|                                  | Domestic                           | Import | Total      | Domestic                    | Import | Total        |
| Apples                           | 5.4                                | 25     | 30.4       | 11                          | 52     | 63           |
| Bananas                          | -                                  | 52     | 52         |                             | 108    | 108          |
| Grapes                           | -                                  | 6.5    | 6.5        |                             | 14     | 14           |
| Mandarins                        | -                                  | 13     | 13         |                             | 26     | 26           |
| Oranges                          | -                                  | 22     | 22         |                             | 45     | 45           |
| Peaches/nectarines               | -                                  | 4.2    | 4.2        |                             | 9      | 9            |
| Pears                            | 0.4                                | 9.5    | 9.9        | 0.8                         | 19.5   | 20.5         |
| Strawberries                     | 3.1                                | 1.6    | 4.7        | 6.6                         | 3.3    | 9.9          |
| Carrots                          | 26                                 | 1.4    | 27.4       | 48.5                        | 2.5    | 51           |
| Cucumbers                        | 6.2                                | 4.0    | 10.2       | 11.5                        | 7.5    | 19           |
| Lettuce                          | 4.5                                | 8.4    | 12.9       | 8.4                         | 15.8   | 24.2         |
| Peppers                          | -                                  | 6.0    | 6.0        |                             | 11     | 11           |
| Potatoes (incl. potato products) | 149                                | 8      | 157        | 262                         | 14     | 276          |
| Tomatoes                         | 6.0                                | 18     | 24         | 11                          | 34     | 45           |
| Rice                             | -                                  | 10     | 10         |                             | 24     | 24           |
| Rye                              | 12                                 |        | 12         | 18                          |        | 18           |
| Wheat                            | 125                                | 5.6    | 131        | 184                         | 8.2    | 192          |
| Apple juice                      | -                                  | 20     | 20         |                             | 58     | 58           |
| Orange juice                     | -                                  | 60     | 60         |                             | 175    | 175          |
| <b>Total</b>                     |                                    |        | <b>613</b> |                             |        | <b>1 189</b> |

## Pesticides and residue levels

The 17 pesticides chosen for the dietary intake assessment are shown in Table 6. These are the same as in the previous report (4). The average pesticide residue level was calculated by using residue data from the surveillance sampling 1998 - 1999 and negative samples were taken into account using three different approaches, i.e.:

- negative samples were assigned the reporting level (Table 6)
- negative samples were assigned half of the reporting level
- the pesticide was assumed to be absent (zero) in negative samples

A certain pesticide/food commodity combination was included in the intake estimation only if residues at or above the reporting level were found in at least one of the samples from that commodity. Otherwise the intake contribution from that pesticide/commodity combination was assumed to be zero

By experience it is known that imported foodstuffs of plant origin more often contain residues than domestic products. Therefore, in order to refine the estimates the cal-

culations were therefore carried out separately for domestic and imported foodstuffs. The amounts were then summed-up for each pesticide.

**Table 6.** Reporting levels and ADI for the pesticides included in the study.

| Pesticide                         | Reporting level<br>mg/kg | ADI<br>mg/kg bw<br>and day |
|-----------------------------------|--------------------------|----------------------------|
| Acephate                          | 0.02                     | 0.03                       |
| Azinphos-methyl                   | 0.05                     | 0.005                      |
| Carbendazim                       | 0.1                      | 0.03                       |
| Chlormequat                       | 0.3                      | 0.05                       |
| Chlorpropham                      | 0.1                      | -                          |
| Dimethoate/omethoate <sup>1</sup> | 0.02                     | 0.002                      |
| Diquat                            | 0.01                     | 0.002                      |
| Dithiocarbamates (mancozeb)       | 0.1                      | 0.03                       |
| Ethion                            | 0.02                     | 0.002                      |
| Methamidophos                     | 0.02                     | 0.004                      |
| Mevinphos                         | 0.02                     | 0.0008                     |
| Monocrotophos                     | 0.02                     | 0.0006                     |
| Thiabendazole                     | 0.2                      | 0.1                        |
| Tolyfluanid                       | 0.3                      | 0.1                        |
| Triazophos                        | 0.02                     | 0.001                      |
| Vinclozolin                       | 0.05                     | 0.01                       |

<sup>1</sup>these two pesticides were determined separately

## Recalculation of certain residues

As the ADI for dimethoate is expressed as the sum of dimethoate and omethoate (7) the levels of omethoate had to be converted to dimethoate.

The residue levels of dithiocarbamates, expressed as CS<sub>2</sub>, were converted to mancozeb in order to enable comparison with an ADI. Mancozeb was chosen since the compound is widely used.

## Correction factors

In order to refine the intake calculations, correction factors (when available) were applied to foodstuffs that normally are peeled, washed or cooked before consumption (Table 7). Since monitoring data reflect residue level found in the products on the market rather than in consumed foodstuffs, these correction factors are important in cases where most of the residues are to be found in the non-edible part of the foodstuff, e.g. in the peel of citrus fruit. (8).

**Table 7.** Correction factors used in the study.

| Pesticide             | Foodstuff | Correction factor |
|-----------------------|-----------|-------------------|
| Dimethoate/ omethoate | Mandarins | 0.26              |
| - “ -                 | Oranges   | 0.26              |
| Thiabendazole         | Mandarins | 0.1               |
| - “ -                 | Oranges   | 0.13              |
| - “ -                 | Potatoes  | 0.09              |

## Calculation of the chronic dietary intake

The national estimated (chronic) daily intake (NEDI) was calculated using the following equation.

$$NEDI = \dot{a} F_i * R_i * C_i * P_i$$

**F<sub>i</sub>** = Food consumption for the relevant commodity (kg/day), subdivided on domestic and imported products

**R<sub>i</sub>** = Average pesticide residue level (mg/kg) in the foodstuff, derived from monitoring data and subdivided on domestic and imported products

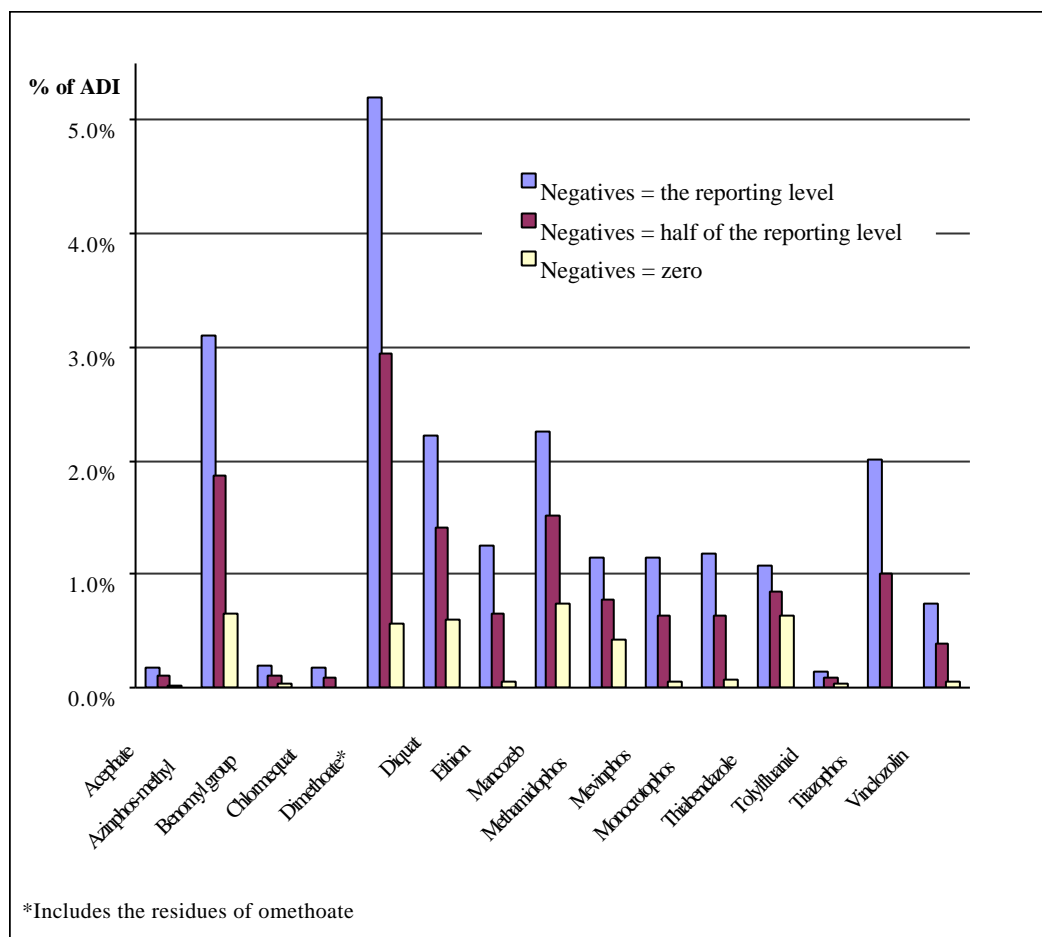
**C<sub>i</sub>** = A correction factor for transforming residues on whole commodity to edible portion (e.g. bananas, citrus)

**P<sub>i</sub>** = A correction factor that takes into account reduction or increase in the level of the residue on commercial processing, preparation or cooking of the food

## Assessment of chronic dietary intake

The intake of dimethoate/omethoate was relatively high compared with the intake of the other pesticides. The 90<sup>th</sup> percentile consumer reached 5% of ADI for the most conservative estimate (Figure 6). This is a substantial decrease compared with 18%, achieved in the 1998 calculation(4). Dimethoate is relatively widely used on fruits and vegetables. As the selected fruits and vegetables in this study cover the most important commodities, the contribution from other foodstuffs is probably of less significance.

For ten of the pesticides, the intakes were above one per cent of the ADI when the most conservative estimate (negative samples were assigned the reporting level) was applied. If instead zero is applied on the negatives, the estimated intakes for all the pesticides are below one percent of the ADI. This might, however, be an underestimation of the real intake.



**Figure 6.** Estimated dietary intake of pesticide residues for the Swedish 90<sup>th</sup> percentile consumer, calculated by using average residue level, surveillance sampling in 1998-1999.

**Table 8.** Total intake of certain pesticides ( $\mu\text{g}/\text{day}$  and person) in 19 selected foodstuffs. The calculations were based on monitoring data from 1998–1999 and “negative samples” were assigned the reporting level.

| Pesticide               | Intake (mg/day and person) |   |
|-------------------------|----------------------------|---|
|                         | 1998 – 1999                |   |
|                         | Average consumption        | 90 <sup>th</sup> percentile consumption |
| Acephate                | 1.6                        | 3.2                                     |
| Azinphos-methyl         | 4.5                        | 9.3                                     |
| Carbendazim             | 5.8                        | 12.1                                    |
| Chlormequat             | 3.6                        | 5.3                                     |
| Chlorpropham            | 16.5                       | 29.0                                    |
| Dimethoate <sup>1</sup> | 3.1                        | 6.2                                     |
| Diquat                  | 1.5                        | 2.7                                     |
| Ethion                  | 0.7                        | 1.5                                     |
| Mancozeb                | 20.3                       | 40.7                                    |
| Methamidophos           | 1.4                        | 2.7                                     |
| Mevinphos               | 0.3                        | 0.6                                     |
| Monocrotophos           | 0.2                        | 0.4                                     |
| Thiabendazole           | 30.9                       | 64.4                                    |
| Tolyfluanid             | 4.1                        | 8.3                                     |
| Triazophos              | 0.6                        | 1.2                                     |
| Vinclozolin             | 2.2                        | 4.4                                     |
| <b>Total</b>            | <b>97</b>                  | <b>192</b>                              |

<sup>1</sup>includes residues of omethoate

Table 8 presents the intake in  $\mu\text{g}/\text{day}$  and person for the selected pesticides. The total intake, based on the 90<sup>th</sup> percentile consumption, is 192  $\mu\text{g}/\text{day}$ . This is a small decrease compared with the amount reported in 1998 (4). An advantage in comparing the intake in  $\mu\text{g}/\text{day}$  instead of per cent of the ADI is that the figure is independent on changes in the ADIs and that comparisons could be performed for pesticides without an established ADI, e.g. chlorpropham.

### **General conclusion**

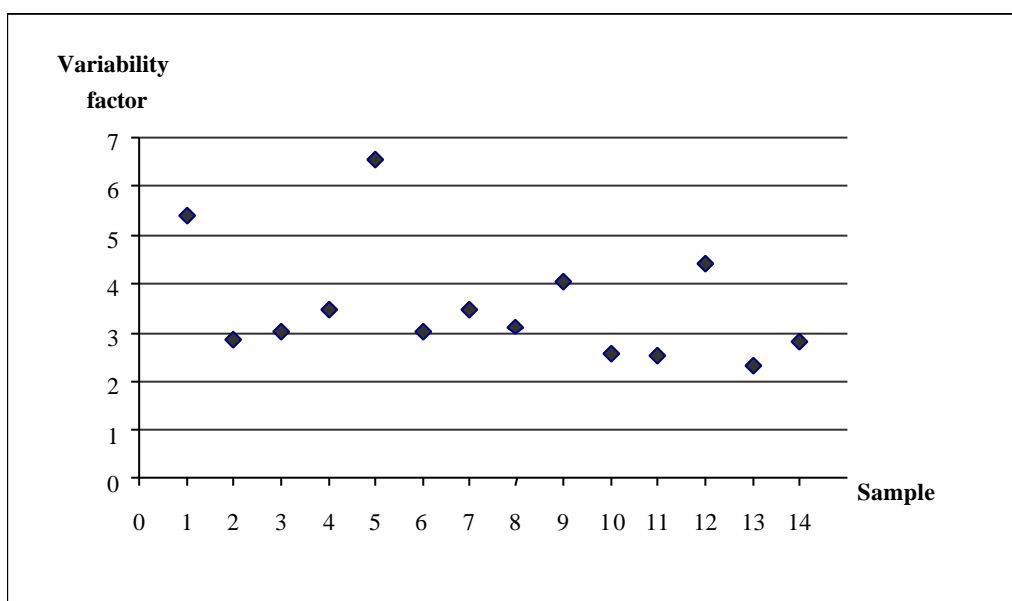
Although this study includes a limited number of foodstuffs and pesticides a reasonable conclusion would be that no chronic health risks could be associated with the pesticide residues in fruit, vegetables and cereals on the Swedish market in 1999.



## Variability factor for methamidophos in peppers

The variability factor, defined as the quotient between the maximum and the mean residue of individual units in a sample, was determined in sixteen samples of pepper. This “specific exercise” was a part of the EU co-ordinated programme for 1999. Analysis of individual units was done when the composite sample of peppers contained residues of methamidophos. In two of the samples more than 50% of the units contained no residues (< LOD) and were for that reason not included in the calculation of the variability factor.

In the remaining 14 samples, each consisting of 12 units (in one sample 10 units), the variability factor varied between 2.3–6.6 with a median of 3.0 and a mean of 3.5 (Figure 7 and Table F). Units containing no residues were assigned zero in the calculations. The highest residue in a single unit in these samples amounted to 4.2 mg/kg (12).

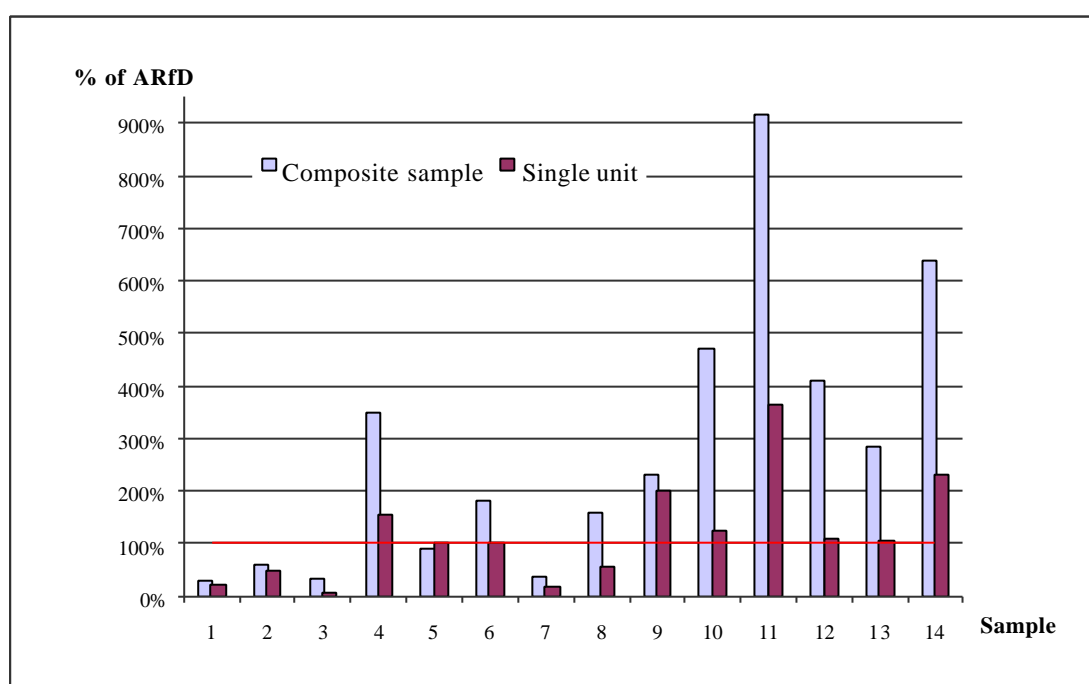


*Figure 7. Variability factor for methamidophos in different samples of peppers.*

## Estimated acute dietary intake of methamidophos in peppers

The national estimated short term intake (NESTI) was calculated for residues of methamidophos in those 14 samples of peppers for which the actual variability factor was determined.

A median commodity weight of 0.160 kg was used for the peppers. The large portion size for adults was fixed to 0.089 kg and for toddlers to 0.050 kg (10). The calculations were done both for the highest residue level found in individual units and the residue levels found in the composite samples using point estimate and an acute RfD of 0.004 mg/kg for methamidophos. This is the same figure as for the ADI. WHO has not yet proposed an ARfD for methamidophos but is expected to do so in the near future.



**Figure 8.** Comparison of estimated acute intake (in % of ARfD) for toddlers of methamidophos in 14 samples of peppers using composite mean, variability factor =7, and the highest residue in a single unit, respectively.

When using the residue levels in the composite samples and a variability factor of seven, the estimated acute intakes for toddlers exceeded the acute reference dose in nine of the 14 samples. The highest intake figure was about 900% of ARfD.

In the refined estimate, where the highest residue level in an individual unit (one pepper) is used, eight out of the 14 samples exceeded the ARfD. The highest intake for toddlers exceeded the ARfD by 360%.

The estimated acute intake for adults exceeded in six out of the 14 samples the acute RfD when the calculations were based on residue levels in composite samples. However, even a refined estimate, using the actual highest residue level in a single unit, showed an intake (134%) above the ARfD in one of the samples. The comparison of acute intakes using the two methods is shown in Table 9.

**Table 9.** Comparison of the acute intake of methamidophos in peppers, calculated for adults and toddlers using the residue level in the composite sample and the highest residue level found in a single unit.

| Sample | Composite mean | Max. residue, single unit | Acute intake, % of ARfD       |         |             |         | Actual variability factor <sup>2</sup> |
|--------|----------------|---------------------------|-------------------------------|---------|-------------|---------|--|
|        |                |                           | Composite sample <sup>1</sup> |         | Single unit |         |  |
|        |                |                           | Adult                         | Toddler | Adult       | Toddler |  |
| 1      | 0.047          | 0.24                      | 10                            | 28      | 8           | 21      | 5.4                                    |
| 2      | 0.099          | 0.58                      | 22                            | 60      | 18          | 50      | 2.9                                    |
| 3      | 0.057          | 0.098                     | 13                            | 34      | 3           | 8       | 3.0                                    |
| 4      | 0.58           | 1.77                      | 129                           | 350     | 56          | 153     | 3.5                                    |
| 5      | 0.15           | 1.16                      | 33                            | 91      | 37          | 100     | 6.6                                    |
| 6      | 0.3            | 1.20                      | 67                            | 181     | 38          | 103     | 3.0                                    |
| 7      | 0.059          | 0.20                      | 13                            | 36      | 6           | 17      | 3.5                                    |
| 8      | 0.26           | 0.63                      | 58                            | 157     | 20          | 54      | 3.1                                    |
| 9      | 0.38           | 2.34                      | 84                            | 229     | 74          | 202     | 4.0                                    |
| 10     | 0.78           | 1.44                      | 173                           | 471     | 46          | 124     | 2.6                                    |
| 11     | 1.52           | 4.21                      | 338                           | 917     | 134         | 363     | 2.5                                    |
| 12     | 0.68           | 1.26                      | 151                           | 410     | 40          | 109     | 4.4                                    |
| 13     | 0.47           | 1.22                      | 104                           | 284     | 39          | 105     | 2.3                                    |
| 14     | 1.06           | 2.69                      | 236                           | 640     | 85          | 232     | 2.8                                    |

<sup>1</sup> A variability factor of 7 is used for the calculations

<sup>2</sup> Details are given in Table F

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