Department for Environment, Food and Rural Affairs

The Expert Committee on Pesticide Residues in Food (PRiF)

Report on the pesticide residues monitoring programme: Results of Quarter 1 2023

This publication is available at Expert Committee on Pesticide Residues in Food

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Summary: Quarter 1 2023 findings

Chair's comments

During this year's surveillance programme, we are measuring up to 415 different pesticides in each of the foods we survey. The Quarter 1 programme surveyed 509 samples of 20 different foods (see contents page for a full list). The majority of samples were collected between the beginning of January and the end of March 2023. During this quarter there are fewer survey results reported than planned for some food collected in Northern Ireland. This is due to the transition to the new EU laboratory that will be used to test NI samples in the future.

Of the 509 samples, we found residues in 261 of them and of these, 13 samples contained residues over the Maximum Residue Level (MRL). HSE undertakes screening and detailed risk assessments, as required, for the pesticide residues found. This is to determine whether the residues present could lead to someone eating an amount above a level that is considered safe. HSE also produces detailed risk assessments for every case where the actual residue level found could lead to an intake above the safety levels.

We needed to consider the potential short-term health effects of only a small minority of the residues found in more detail. Following screening assessments, we concluded that effects on health were either unlikely or not expected. A short term health based guidance value is not available for ethylene oxide, and therefore based on its toxicity profile a detailed long term risk assessment was conducted. Based on this assessment, we concluded that the single residue of ethylene oxide found in rice is unlikely to be of concern to human health. Full details are presented in section 3. All other residues found did not cause any concern for health.

Following screening assessment, we considered detailed combined risk assessments for 3 different samples (black eye bean, beans with pods and pineapple) each containing 2 organophosphate pesticides which share a known effect from exposure to these residues, where we concluded that a short term effect is unlikely.

We also needed to consider the potential genotoxic health effects of dimethoate and its metabolite omethoate (several samples of beans with pods and one black eye beans sample), and chlorpyrifos (one sample of black eye beans) and ethylene oxide (one sample of rice). These pesticides are not authorised in the UK but can on occasion be found in some imported food. We concluded that at the levels present, a risk of an adverse effect on health due to genotoxicity would be low.

For long term assessment, none of the other pesticide and individual commodity long-term exposure screening assessments performed in this quarter (for each of the pesticides found in this report) indicated any potential for adverse long-term health effects. This was based on the assessment of dietary intakes as below the ADI or other established long-term health based reference values.

These detailed considerations as well as links to underlying information are covered in our reports for dried beans, beans with pods, oranges, pineapples, rice and soft citrus.

Full details of suppliers and retailers of the food sampled, and full analytical results, are available on data.gov.uk as ODS (Open Document Spreadsheet) files. We hope this data format is useful for people wanting to look at the individual results in more detail.

Since the UK left the EU, we report the results for samples collected in Great Britain (GB) separately from those collected in Northern Ireland (NI). Surveys have been titled throughout the report as either GB or NI to make clear where the samples were collected. Samples collected in GB are subject to GB MRLs. GB MRLs are set by inclusion in a new GB MRL statutory Register, implemented and updated by means of a database[1]. For samples collected in NI, certain aspects of EU food law, including compliance with EU set MRLs, continue to apply under the terms of the Windsor Framework. In the detailed data files HSE is, for 2023 results, still separating out EU from non-EU origin foods in the results.

We asked suppliers and the authorities of the exporting countries for an explanation of our findings. Any responses we have received specifically for publication are available in Section 2 sample details and supplier responses.

If you have any feedback or comments on the monitoring programme or the reports produced, please send them to our secretariat at prif@hse.gov.uk.

Ann Davison
Chair of the Expert Committee on Pesticide Residues in Food

[1] GB MRL Register (pesticides.gov.uk)

Consumer risk summary

HSE screens each residue detected for any consumer health issues to identify which need to be considered in more detail. We comment on any risks HSE considered in detail in our full report, and HSE's risk assessments are also published.

HSE liaises with the Food Standards Agency (FSA) on consumer risk assessment and the FSA also takes part in our meetings.

Table 1: Overview of the survey results with links to detailed information

Survey title (where samples collected)	Number of pesticides sought	Samples tested	Detailed risk assessment presented?	MRL exceedances (samples)
Beans (dried) (GB)	414	12	2 (and 1 combined risk assessment)	2
Beans with pods (GB)	405	25	1 (and 1 combined risk assessment)	6
Carrot (GB)	385	30	No	1
Cauliflower (GB)	382	30	No	0
Fish (oily) (NI)	39	12	No	0
Grapes (GB)	406	30	No	0
Kiwi fruit (GB)	384	24	No	0
Lemons (GB)	377	24	No	0
Liver (GB)	114	33	No	1
Milk (GB)	112	66	No	0
Milk (NI)	39	19	No	0
Onions (GB)	405	18	No	0
Oranges (GB)	409	30	4	1
Pears (GB)	413	30	No	1
Peas edible pods (GB)	380	30	No	0
Pineapples (GB)	381	24	1 (and 1 combined risk assessment)	0
Potato (GB)	406	37	No	1
Poultry meat (GB)	116	24	No	0
Poultry meat (NI)	43	13	No	
Rice (GB)	415	18	1	0
Soft citrus (GB)	405	24	2	0

Samples collected in GB must comply with GB set MRLs unless the goods are qualifying Northern Ireland goods and are subject to unfettered access under the terms of the UK

Internal Market Act 2020. For samples collected in NI, under the Windsor Framework, certain aspects of EU food law, including compliance with EU MRLs apply.

Other issues

Suspected unauthorised uses

HSE passed details to the enforcement team of samples grown in GB or NI that contained a residue which does not have a plant protection product (PPP) with that active authorised for use on that crop, in GB and NI. These samples were:

- one UK Conference pear that contained diuron. After examination of spray records, HSE concluded that there was no evidence of misuse
- one UK Carrot that contained linuron. After examination of spray records, HSE concluded that there was no evidence of misuse

Details of possible unauthorised uses from previous surveys are provided in section 4 of this report.

Organic samples with residues

HSE writes to the suppliers of samples of organic produce if they contain a pesticide residue which is not permitted under retained organic regulation Commission Regulation (EC) No 889/2008. Defra's Organic Farming branch and the organic certification organisation are also informed.

Further information

You can find further information on the individual sample details in an accessible format by looking at the Pesticide Residues in Food Quarterly Data.

This includes:

- brand name, sampling point and origin information
- pesticides sought and residues found
- HSE detailed risk assessments

Introduction to the work of the Expert Committee on Pesticide Residues in Food (PRiF)

The PRiF's role is to give Ministers, the Director of the Health and Safety Executive (HSE) and the Chief Executive of the Food Standards Agency (FSA) independent advice on the UK government's national rolling programme of surveys, in particular:

- the planning of surveillance programmes for pesticide residues in the UK food supply and the evaluation of the results
- procedures for sampling, sample processing, new methods of analysis, the assessment of variability of pesticide residues in food and related issues

The Expert Committee on Pesticide Residues in Food was established in 2011. Our members have a broad range of expertise relating to the food supply industry. The main function of the committee is to oversee government's £2 million pesticide residues surveillance programme. Previously this work was carried out by the Pesticide Residues Committee.

Our chair, Ann Davison has worked in consumer affairs for most of her career, running consumer organisations and networks. The committee also includes members with expertise in food science, food production and supply as well as 2 public interest experts.

You can find more information on the membership of the PRiF committee's page.

UK National Monitoring Programmes

HSE, working under Defra, and the Scottish and Welsh governments authority has official responsibility to organise a monitoring programme of GB food for pesticide residues. Similarly, HSE working under the Department of Agriculture, Environment and Rural affairs authority has official responsibility to organise a monitoring programme of NI food for pesticide residues, including participating in the EU multi-annual control programme.

The programmes are made up of a risk-based rolling programme of surveys and statutory programmes required by GB or EU law. It is a surveillance programme, which is designed based upon evidence gathered in the previous years, including previous results, PRiF advice and border control information. For efficiency reasons, the Northern Ireland programme may differ in that some lower priority (primarily imported) foods or processed foods are not included. If the GB survey identifies issues in these foods, then they would be included in future testing in Northern Ireland.

These surveys are not an enforcement programme, and the survey design is generally not adjusted during the year. HSE are responsible for considering the safety of people who eat the food (in co-operation with the Food Standards Agency if necessary) and for following up adverse or unexpected results. HSE are also responsible for determining whether food is compliant with the law, specifically, whether any pesticide residue found is within the Maximum Residue Level.

Maximum Residue Levels (MRLs) reflect levels of pesticides that could occur in food which has been treated in accordance with good agricultural practice. Where pesticides do not give rise to readily detectable residues, or are not authorised for use on particular commodities, MRLs are set at the lowest level which can be identified in routine laboratory

analysis. This provides a mechanism for statutory controls on pesticides in food which is put into circulation and for monitoring the correct use of these chemicals.

HSE assessment of risk

HSE conducts a screening assessment of all the residues we find in the PRiF programme. If screening identifies any dietary intakes exceeding the relevant health based reference values, then we present more detailed risk assessments, to consider whether there are any implications for health. Detailed risk assessments, where needed, are presented in section 3. If we understand that a pesticide residue has a risk of genotoxicity (has potential to cause damage to genetic material), we will include this in the commentary.

Pesticide dietary intakes are assessed using models that combine data on the levels of residues in food with food dietary consumption values. If intakes are within the health based reference values, then taking account of the precautions built into the model assessments we conclude that an effect on health is not anticipated. If dietary intakes exceed the reference values this does not automatically mean, there are expected adverse health effects. However, this acts as a 'trigger' for HSE to consider these cases more thoroughly.

HSE conducts both short-term (acute) and long-term (chronic) assessments based on the residues found in the PRiF surveys. Each of these is tailored accordingly. Further information on the nature of HSE's assessments and approach is provided in the following sections, and in more detail, with reference to international assessment contexts in section 3 and on HSE's website.

Acute assessments
HSE use short-term estimation values that use the highest residue found in a commodity and short-term consumption values for calculating short-term dietary intakes. These are then compared to the ARfD, a suitable health based reference value for effects that could be caused by a single day or one-off consumption of a higher than usual residue. For acute assessment we consider the variation in residues that could occur within a residue sample, and a variability (multiplication) factor is included for that purpose, in order to address exposure to a higher than usual residue in a single item, such as a single apple or potato.

Chronic assessments
HSE use long-term estimation values (based on median residues and long-term consumption values for calculating long-term dietary intakes) for each commodity survey and compare to the ADI, a suitable health based reference value for lifetime. The issue is more fully considered in regulatory contexts pre-authorisation and at the time of MRL review. Then the issue is considered across all commodities (so more precautionary) by pesticide levels determined in GAP compliant trials, intended to address highest likely residues that might arise following pesticide use according to label recommendations.

Fruit and vegetables with peel
For fruit and vegetables that have peel or skin that might not be consumed HSE present alternative risk assessments for 'without peel -flesh only' where peel versus pulp residue distribution data is available. As standard, we present a 'worst case' assessment for when all of the peel is consumed with the fruit.

Consideration of consumer groups
HSE calculate dietary intakes for different consumer groups, from infants, toddlers and children of varying age to adults, elderly, and vegetarians, to take account of people with

low bodyweights and varying dietary habits. As such the assessments we perform are protective for all consumers.

Multiple residues

For multiple residues, HSE consider the possible implications to health of more than one pesticide being found in samples (sometimes called the ‘cocktail effect’). We currently focus in detail on selected groups that we think are a priority to consider based on toxicity considerations and prevalence.

Table 2: 2023 Survey design

Fruit and vegetables

Some commodities are a requirement of the GB Control Plan Multi-annual Great Britain control plan for pesticide residues and EU Coordinated Programme Commission Implementing Regulation (EU) 2021/601.

Food	Sampling points	Sampled during	Reporting
Beans with pods (GB)	Retail outlets and Supply chain	Quarterly	Rolling and quarterly
Beans with pods (NI)	Retail outlets	Quarterly	Quarterly
Brussel sprouts (NI)	Retail outlets	Quarter 3 and 4	Quarter 3 and 4
Carrot (GB)	Retail outlets and Supply chain	Quarterly	Quarterly
Carrot (NI)	Retail outlets	Quarterly	Quarterly
Cauliflower (GB)	Retail outlets	Quarterly	Quarterly
Cauliflower (NI)	Retail outlets	Quarterly	Quarterly
Grapes (GB)	Retail outlets and Supply chain	Quarterly	Rolling and quarterly
Grapes (NI)	Retail outlets	Quarterly	Quarterly
Kiwi fruit (GB)	Retail outlets and Supply chain	Quarterly	Quarterly
Kiwi fruit (NI)	Retail outlets	Quarterly	Quarterly
Lemons (GB)	Retail outlets and Supply chain	Quarterly	Quarterly
Lemons (NI)	Retail outlets	Quarterly	Quarterly
Onions (GB)	Retail outlets	Quarterly	Quarterly
Onions (NI)	Retail outlets	Quarterly	Quarterly
Oranges (GB)	Retail outlets and Supply chain	Quarterly	Quarterly
Oranges (NI)	Retail outlets	Quarterly	Quarterly
Pears (GB)	Retail outlets and Supply chain	Quarterly	Quarterly
Pears (NI)	Retail outlets	Quarterly	Quarterly
Peas edible pods (GB)	Retail outlets	Quarter 1 and 3	Quarter 1 and 3
Peas edible pods (NI)	Retail outlets	Quarter 1 and 3	Quarter 1 and 3
Peas without pods (GB)	Retail outlets	Quarter 2 and 4	Quarter 2 and 4
Peas without pods (NI)	Retail outlets	Quarter 2 and 4	Quarter 2 and 4
Pineapples (GB)	Retail outlets	Quarterly	Quarterly
Pineapples (NI)	Retail outlets	Quarterly	Quarterly
Potato (GB)	Retail outlets and Supply chain	Quarterly	Rolling and quarterly
Potato (NI)	Retail outlets	Quarterly	Quarterly
Soft citrus (GB)	Retail outlets and Supply chain	Quarterly	Quarterly
Soft citrus (NI)	Retail outlets	Quarterly	Quarterly
Spring onions (GB)	Retail outlets	Quarter 3	Quarter 3
Spring onions (NI)	Retail outlets	Quarter 2 and 3	Quarter 2 and 3

Animal products

Food	Sampling points	Sampled during	Reporting
Fish (oily) (GB)	Retail outlets	Quarters 2, 3 and 4	Quarters 2, 3 and 4
Fish (oily) (NI)	Retail outlets	Quarterly	Quarterly
Liver (bovine) (GB)	Retail outlets	Quarters 1, 2 and 4	Quarters 1, 2 and 4
Liver (bovine) (NI)	Retail outlets	Quarterly	Quarters 2, 3 and 4
Milk (GB)	Retail outlets	Quarterly	Quarterly
Milk (NI)	Retail outlets	Quarterly	Quarterly
Poultry meat (GB)	Retail outlets	Quarterly	Quarterly
Poultry meat (NI)	Retail outlets	Quarterly	Quarterly

Cereal products

Food	Sampling points	Sampled during	Reporting
Bread (GB)	Retail outlets	Quarters 2, 3 and 4	Quarter 3 and 4
Bread (NI)	Retail outlets	Quarters 2, 3 and 4	Quarter 3 and 4
Rice (GB)	Retail outlets	Quarterly	Quarterly
Rice (NI)	Retail outlets	Quarterly	Quarterly
Rye flour (GB)	Retail outlets	Quarter 2 and 4	Quarter 2 and 4
Rye flour (NI)	Retail outlets	Quarterly	Quarterly

Miscellaneous products

Food	Sampling points	Sampled during	Reporting
Beans (dried) (GB)	Retail outlets	Quarterly	Quarterly
Beans (dried) (NI)	Retail outlets	Quarterly	Quarterly
Crisps (potato based) (GB)	Retail outlets	Quarter 4	Quarter 4
Infant formula (GB)	Retail outlets	Quarter 3	Quarter 3
Infant formula (NI)	Retail outlets	Quarter 3	Quarter 3
Orange juice (GB)	Retail outlets	Quarter 3 and 4	Quarter 3 and 4
Pulses (dahls/lentils) (GB)	Retail outlets	Quarter 3	Quarter 3
Snacks (cereal based) (GB)	Retail outlets	Quarter 3	Quarter 3
Snacks (speciality) (GB)	Retail outlets	Quarter 4	Quarter 4

Sampling points

The sampling points are:

- retail outlets: samples bought by market research contractor shoppers
- supply chain: samples taken by inspectors from the Animal and Plant Health Agency (APHA) from a range of points in the supply chain (wholesalers, retail depots, ports and import points)

Reporting

Data is reported in the following ways:

- results for certain higher-priority foods are produced, followed up and published more frequently at Data.gov.uk
- all results are published in the quarterly report. Some surveys are included in every quarter, some are every other quarter and some in just one quarter

Table 3: Summary of results

Food	Analysed	With residues at or below the MRL	With residues above the MRL	With residues of non-approved pesticides (UK only)	With multiple residues	Organic samples tested	Organic samples with residues
Beans (dried) (GB)	12	6	2	0	3	0	0
Beans with pods (GB)	25	9	6	0	9	0	0
Carrot (GB)	30	17	1	1	14	7	0
Cauliflower (GB)	30	8	0	0	1	3	0
Fish (oily) (NI)	12	7	0	0	0	0	0
Grapes (GB)	30	29	0	0	23	0	0
Kiwi fruit (GB)	24	11	0	0	4	1	0
Lemons (GB)	24	20	0	0	20	3	0
Liver (GB)	33	2	1	0	0	0	0
Milk (GB)	66	0	0	0	0	9	0
Milk (NI)	19	0	0	0	0	4	0
Onions (GB)	18	9	0	0	3	7	0

Food	Analysed	With residues at or below the MRL	With residues above the MRL	With residues of non-approved pesticides (UK only)	With multiple residues	Organic samples tested	Organic samples with residues
Oranges (GB)	30	28	1	0	28	1	0
Pears (GB)	30	25	1	1	26	3	0
Peas edible pods (GB)	30	20	0	0	16	0	0
Pineapples (GB)	24	14	0	0	7	0	0
Potato (GB)	37	21	1	0	12	0	0
Poultry meat (GB)	24	1	0	0	0	1	0
Poultry meat (NI)	13	0	0	0	0	1	0
Rice (GB)	18	5	0	0	4	0	0
Soft citrus (GB)	24	23	0	0	22	1	0

Table 4: Summary of MRL Exceedances

Some shorthand has been used in this table. The symbol * means maximum residue levels set at the limit of determination (LOD MRL). These MRLs are set at a default level, for example, at the limit of determination (LOD) where analytical methods can reasonably detect the presence of the pesticide. Either insufficient trials data are available on which to set a maximum residue level, or there may be no use of the pesticide on that crop permitted. However, they may be permitted elsewhere.

Table 4a: Beans (dried) (GB)

Sample ID	Food	Country of origin	Pesticide detected	Residue detected (mg per kg)	MRL (mg per kg)	MRL exceedance after allowing for measurement uncertainty	Sent to FSA for consideration
1215/2023	Black eye beans	UK	fosetyl-Al (sum)	3.4	2*	No	No
1194/2023	Haricot beans	Canada	fosetyl-Al (sum)	3.5	2*	No	No

Table 4b: Beans with pods (GB)

Sample ID	Food	Country of origin	Pesticide detected	Residue detected (mg per kg)	MRL (mg per kg)	MRL exceedance after allowing for measurement uncertainty	Sent to FSA for consideration
0001/2023	Valore beans	India	acetamiprid	0.8	0.6	No	No
0001/2023	Valore beans	India	dimethoate	0.9	0.01*	Yes	Yes
0001/2023	Valore beans	India	dithiocarbamates	2.5	1	Yes	No
0001/2023	Valore beans	India	omethoate	0.2	0.01*	Yes	Yes
0073/2023	Gawar beans with pods	India	diafenthiuron	0.08	0.01*	Yes	No

Sample ID	Food	Country of origin	Pesticide detected	Residue detected (mg per kg)	MRL (mg per kg)	MRL exceedance after allowing for measurement uncertainty	Sent to FSA for consideration
0073/2023	Gawar beans with pods	India	omethoate	0.05	0.01*	Yes	Yes
0077/2023	Papdi valor beans	India	dimethoate	0.5	0.01*	Yes	Yes
0077/2023	Papdi valor beans	India	omethoate	0.2	0.01*	Yes	Yes
0078/2023	Speciality gawar beans	India	omethoate	0.02	0.01*	Yes	No
0210/2023	Gwar beans	India	profenofos	0.04	0.01*	Yes	No
0342/2023	Yard long beans	India	flusilazole	0.05	0.01*	Yes	No
0342/2023	Yard long beans	India	omethoate	0.03	0.01*	Yes	Yes

Table 4c: Carrot (GB)

Sample ID	Food	Country of origin	Pesticide detected	Residue detected (mg per kg)	MRL (mg per kg)	MRL exceedance after allowing for measurement uncertainty	Sent to FSA for consideration
0006/2023	Carrots	UK	linuron	0.05	0.01*	Yes	No

Table 4d: Liver (GB)

Sample ID	Food	Country of origin	Pesticide detected	Residue detected (mg per kg)	MRL (mg per kg)	MRL exceedance after allowing for measurement uncertainty	Sent to FSA for consideration
1233/2023	Ox liver	UK	BAC (sum)	0.2	0.1	Yes	No

Table 4e: Oranges (GB)

Sample ID	Food	Country of origin	Pesticide detected	Residue detected (mg per kg)	MRL (mg per kg)	MRL exceedance after allowing for measurement uncertainty	Sent to FSA for consideration
0320/2023	Valencia oranges	Egypt	cyfluthrin (sum)	0.03	0.02*	No	No

Table 4f: Pears (GB)

Sample ID	Food	Country of origin	Pesticide detected	Residue detected (mg per kg)	MRL (mg per kg)	MRL exceedance after allowing for measurement uncertainty	Sent to FSA for consideration
0396/2023	Conference pears	UK	diuron	0.02	0.01*	Yes	No

Table 4g: Potatoes (GB)

Sample ID	Food	Country of origin	Pesticide detected	Residue detected (mg per kg)	MRL (mg per kg)	MRL exceedance after allowing for measurement uncertainty	Sent to FSA for consideration
0016/2023	Maris piper potatoes	UK	flonicamid (sum)	0.1	0.09	No	No

Samples collected in GB must comply with GB set MRLs unless the goods are qualifying Northern Ireland goods and are subject to unfettered access under the terms of the UK Internal Market Act for 2020. For samples collected in NI, under the Windsor Framework, certain aspects of EU food law, including compliance with EU set MRLs, continue to apply.

MRL adjusted to take into account the effect of processing. Further information can be found in section 4.

Section 1: findings by food

Beans (dried) (GB)

Samples tested

12 samples were tested for up to 414 pesticide residues.

Black eye

One sample came from the UK.

Butter

One sample was imported from outside the EU.

Cannellini

2 samples were imported from outside the EU.

Chickpea

3 samples were imported from outside the EU.

Haricot

One sample was imported from outside the EU.

Kidney

One sample came from the UK.

Mung

One sample came from the UK.

Pinto

2 samples were imported from outside the EU.

The country of origin of samples may not be the same as the country where the dried beans were produced. It may be where the dried beans were processed, where they were packed for consumer purchase or the address of the brand owner.

Pesticide residues detected from those sought:

- 4 samples contained no residues from those sought
- 8 samples contained residues above the reporting limit
- 2 samples contained residues above the MRL
- none of the samples were labelled as organic

Risk assessments

One sample of black eye beans contained residues of chlorpyrifos and dimethoate below the level of their MRLs (0.01* mg per kg) where the effect on health needed to be considered in more detail. The risk assessment is outlined below. Refer to Section 3 for the full details of the HSE assessment of the risks. These are both organophosphate

pesticides and HSE has conducted a combined risk assessment see section on combined risk assessments below.

Regarding chlorpyrifos (a residue of 0.007 mg per kg, below the MRL of 0.01* mg per kg):

Based on the HSE assessment for chlorpyrifos (see Section 3), we conclude a short term effect on health is not expected. As outlined in HSE's full risk assessment (see section 3), EFSA issued a 2019 statement on the human health assessment of chlorpyrifos which included a consideration of the potential for genotoxicity (whether damage to genetic material can occur). We conclude that on a precautionary basis any findings of chlorpyrifos are undesirable due to the uncertainty regarding genotoxicity at low doses. Due to the low level of chlorpyrifos (0.007 mg per kg) in the black eye bean sample we consider any risks of adverse health effects are low.

Regarding dimethoate (a residue of 0.008 mg per kg, below the MRL of 0.01* mg per kg):

Based on the HSE assessment for dimethoate (see Section 3), we conclude a short term effect on health is unlikely. As outlined in HSE's full risk assessment (see section 3), in 2018, EFSA reviewed dimethoate and concluded that no toxicological reference values could be determined for dimethoate, due to a lack of a fully supporting toxicological database (EFSA Conclusion for dimethoate, 2018). The EFSA Conclusion (2018) for dimethoate also includes a consideration of the potential for genotoxicity (whether damage to genetic material can occur) for dimethoate. We conclude that on a precautionary basis any findings of dimethoate are undesirable due to the uncertainty regarding genotoxicity at low doses. Due to the low level of dimethoate (0.008 mg per kg) in the black eye bean sample we consider any risks of adverse health effects are low.

Other risk assessment screening work undertaken did not indicate any other expectation of effects on health. Please refer to how HSE perform the risk assessments for further details.

Combined risk assessments

Some samples contained residues of more than one pesticide. One of these samples contained residues from pesticides which belong to similar chemical groups, and may have similar toxicological effects. So the risk assessors needed to consider their possible impacts on human health, both on their own and in combination.

HSE carried out a combined risk assessment of the relevant sample of black eye beans. At the levels found (chlorpyrifos 0.007 mg per kg and dimethoate 0.008 mg per kg), these pesticides together will be unlikely to inhibit acetyl cholinesterase, the known effect from exposure to each of these residues. HSE conclude that a short term effect on health for the combined residues of dimethoate and chlorpyrifos in this sample of dried beans (black eye beans) is unlikely.

Please see above regarding potential for genotoxicity.

Further information of how HSE consider combined risk assessments is in Section 3: HSE assessment of risk.

Additional comments by the PRiF

We needed to consider the potential genotoxic health effects of dimethoate and chlorpyrifos in one sample of black eye beans. These pesticides are not authorised in the UK but can on occasion be found in some imported food. We concluded that at the levels present, a risk of an adverse effect on health due to genotoxicity would be low.

Although these levels are below the MRL we continue to monitor the number of incidences. Further information about these findings can be found in Section 5.

Further information on fosetyl (sum) residues can be found in Section 4.

Residues measured above the MRL

The laboratory detected 2 residues above the MRL in Beans (dried). Details are available in Table 4.

Further information

- Summary table of results
- Survey Design
- Glossary
- HSE Assessment of Risk
- detailed reference information in an accessible format at Pesticide Residues in Food Quarterly Data. This data includes brand name, sampling point and origin information, pesticides sought and residues found

Beans with pods (GB)

Samples tested

25 samples were tested for up to 405 pesticide residues

Fine beans

2 samples were imported from outside the EU

Green beans

9 samples were imported from outside the EU

Runner beans

One sample was imported from outside the EU

Speciality beans

13 samples were imported from outside the EU

Pesticide residues detected from those sought:

- 10 samples contained no residues from those sought
- 15 samples contained residues above the reporting limit
- 6 samples contained residues above the MRL
- none of the samples were labelled as organic

Risk assessments

Several samples contained dimethoate and its metabolite omethoate, either in combination or omethoate on its own. The sample containing the highest residues above the relevant MRLs were levels of 0.9 mg per kg dimethoate and 0.2 mg per kg omethoate. Dimethoate and omethoate are chemically related pesticides and for toxicology purposes are considered together. Omethoate is also the main metabolite of dimethoate.

Please see section 3 for HSE's full assessment of risk.

In 2018, EFSA reviewed dimethoate and concluded that no toxicological reference values could be determined for dimethoate, due to a lack of a fully supporting toxicological database (EFSA Conclusion for dimethoate, 2018[2]). We conclude that, at the anticipated highest exposures following consumption of this beans with pods sample (containing dimethoate at 0.9 mg per kg and omethoate at 0.2 mg per kg), there is unlikely to be a risk of ill health effects based on short term toxicity.

The EFSA Conclusion (2018) for dimethoate also includes a consideration of the potential for genotoxicity (whether damage to genetic material can occur) for dimethoate and omethoate. We conclude that on a precautionary basis any findings of dimethoate are

[2] EFSA Conclusion for dimethoate (2018) EFSA Journal 2018;16(10):5454, 29 pp. https://doi.org/10.2903/j.efsa.2018.5454

undesirable due to the uncertainty regarding genotoxicity. Please see section 3 which provides further details on the topic of genotoxicity including an update on previous positions on dimethoate and omethoate. We consider any risks of adverse health effects arising from the dimethoate and omethoate residues reported here are low.

Other risk assessment screening work undertaken did not indicate any other expectation of effects on health. Please refer to how HSE perform the risk assessments for further details.

Combined risk assessments

Some samples contained residues of more than one pesticide. One of these samples contained residues from pesticides which belong to similar chemical groups, and may have similar toxicological effects. So the risk assessors needed to consider their possible impacts on human health, both on their own and in combination.

HSE carried out a combined risk assessment of the relevant sample. At the levels found (omethoate 0.008 mg per kg and profenofos 0.04 mg per kg), these pesticides together will be unlikely to inhibit acetyl cholinesterase, the known effect from exposure to each of these residues. HSE concludes that a short term effect on health for the combined residues of omethoate and profenofos in this sample of beans with pods is unlikely.

Further information of how HSE consider combined risk assessments is in Section 3: HSE assessment of risk.

Additional comments by the PRiF

We needed to consider the potential genotoxic health effects of dimethoate with its metabolite omethoate in a few samples. Also omethoate was found in a few samples on its own without dimethoate present. HSE has done a risk assessment for the sample containing the highest residues. These pesticides are not authorised in the UK but can on occasion be found in some imported food. We concluded that at the levels present, a risk of an adverse effect on health due to genotoxicity would be low.

Although these levels are below the MRL we continue to monitor the number of incidences. Further information about these findings can be found in Section 5.

Residues measured above the MRL

The laboratory detected 12 residues above the MRL in beans with pods. Details are available in Table 4.

HSE have passed details of the following samples to FSA for further consideration. Further details are in Table 4.

FSA have communicated with INFOSAN about the following samples:

- 1 sample from India containing acetamiprid at 0.8 mg per kg, dimethoate at 0.9 mg per kg, dithiocarbamates at 2.5 mg per kg and omethoate at 0.2 mg per kg
- 1 sample from India containing diafenthiuron at 0.08 mg per kg and omethoate at 0.05 mg per kg
- 1 sample from India containing dimethoate at 0.5 mg per kg and omethoate at 0.2 mg per kg

- 1 sample from India containing flusilazole at 0.05 mg per kg and omethoate at 0.03 mg per kg

Further information

- Summary table of results
- Survey Design
- Glossary
- HSE Assessment of Risk
- detailed reference information in an accessible format at Pesticide Residues in Food Quarterly Data. This data includes brand name, sampling point and origin information, pesticides sought and residues found

Carrot (GB)

Samples tested

30 samples were tested for up to 385 pesticide residues

Fresh

- 28 samples came from the UK
- one sample was imported from outside the EU
- one sample came from the EU

Pesticide residues detected from those sought:

- 12 samples contained no residues from those sought
- 18 samples contained residues above the reporting limit
- one sample contained residues above the MRL
- 7 samples were labelled as organic. None contained residues from those sought

Risk assessments

The residues detected by the laboratory would not be expected to have an effect on health.

Combined risk assessments

Some samples contained residues of more than one pesticide. Some of these residues are from pesticides which belong to similar chemical groups and may have similar toxicological effects. So, the risk assessors needed to consider their possible impacts on human health, both on their own and in combination.

HSE carried out a combined risk assessment of the relevant samples. We would not expect any of these combinations to have an effect on health.

Further information of how HSE consider combined risk assessments is in Section 3: HSE assessment of risk.

Additional comments by the PRiF

Further information on chlorate residues can be found in section 4.

Residues measured above the MRL

The laboratory detected one residue above the MRL in carrots. Details are available in Table 4.

Further information

- Summary table of results
- Survey Design
- Glossary
- HSE Assessment of Risk
- detailed reference information in an accessible format at Pesticide Residues in Food Quarterly Data. This data includes brand name, sampling point and origin information, pesticides sought and residues found

Cauliflower (GB)

Samples tested

30 samples were tested for up to 382 pesticide residues

Fresh

- 17 samples came from the UK
- 9 samples came from the EU

Frozen

- 3 samples came from the UK
- one sample came from the EU

Pesticide residues detected from those sought:

- 22 samples contained no residues from those sought
- 8 samples contained residues above the reporting limit
- none of the samples contained residues above the MRL
- 3 samples were labelled as organic. None contained residues from those sought

Risk assessments

The residues detected by the laboratory would not be expected to have an effect on health.

Combined risk assessments

One sample contained residues of more than one pesticide. We do not expect these residues to have an effect on health, either separately or in combination. The pesticide residues found in each sample do not include more than one of the pesticides from the groups that the Health and Safety Executive (HSE) consider separately.

Further information of how HSE consider combined risk assessments is in Section 3: HSE assessment of risk.

Additional comments by the PRiF

Further information on chlorate residues can be found in section 4.

Further information

- Summary table of results
- Survey Design
- Glossary
- HSE Assessment of Risk
- detailed reference information in an accessible format at Pesticide Residues in Food Quarterly Data. This data includes brand name, sampling point and origin information, pesticides sought and residues found

Fish (oily) (NI)

Samples tested

12 samples were tested for up to 39 pesticide residues

Salmon

- 5 samples came from the UK
- 7 samples were imported from outside the EU

Where no sea area information is available, the country of origin on the packaging does not necessarily indicate where the fish was caught or farmed. It could be where it was landed, processed or where it was packed for retail.

Pesticide residues detected from those sought:

- 5 samples contained no residues from those sought
- 7 samples contained residues above the reporting level
- none of the samples were labelled as organic

Risk assessments

The residues detected by the laboratory would not be expected to have an effect on health.

Combined risk assessments

None of the samples contained more than one residue, so we did not carry out a combined risk assessment.

Additional comments by the PRiF

DDT

Several samples contained a residue of DDT. The use of DDT is banned or heavily restricted in many countries because these residues take a long time to breakdown in the environment and can accumulate in fatty tissue. An interpretation of the analytical results shows that the DDT residue found was in the form of DDE in all of the samples which indicates historical use. More detailed information about DDT residues is in section 4 of this report.

Further information

- Summary table of results
- Survey Design
- Glossary
- HSE Assessment of Risk
- detailed reference information in an accessible format at Pesticide Residues in Food Quarterly Data. This data includes brand name, sampling point and origin information, pesticides sought and residues found

Grapes (GB)

Samples tested

30 samples were tested for up to 406 pesticide residues.

30 samples were imported from outside the EU.

Pesticide residues detected from those sought:

- one sample contained no residues from those sought
- 29 samples contained residues above the reporting limit
- none of the samples contained residues above the MRL
- none of the samples were labelled as organic

Risk assessments

The residues detected by the laboratory would not be expected to have an effect on health.

Combined risk assessments

Some samples contained residues of more than one pesticide. Some of these residues are from pesticides which belong to similar chemical groups and may have similar toxicological effects. So, the risk assessors needed to consider their possible impacts on human health, both on their own and in combination.

HSE carried out a combined risk assessment of the relevant samples. We would not expect any of these combinations to have an effect on health.

Further information of how HSE consider combined risk assessments is in Section 3: HSE assessment of risk.

Additional comments by the PRiF

None.

Further information

- Summary table of results
- Survey Design
- Glossary
- HSE Assessment of Risk
- detailed reference information in an accessible format at Pesticide Residues in Food Quarterly Data. This data includes brand name, sampling point and origin information, pesticides sought and residues found

Kiwi fruit (GB)

Samples tested

24 samples were tested for up to 384 pesticide residues.

24 samples came from the EU.

Pesticide residues detected from those sought:

- 13 samples contained no residues from those sought
- 11 samples contained residues above the reporting limit
- none of the samples contained residues above the MRL
- one sample was labelled as organic. None contained residues from those sought

Risk assessments

The residues detected by the laboratory would not be expected to have an effect on health.

Combined risk assessments

Some samples contained residues of more than one pesticide. We do not expect these residues to have an effect on health, either separately or in combination. The pesticide residues found in each sample do not include more than one of the pesticides from the groups that the Health and Safety Executive (HSE) consider separately.

Further information of how HSE consider combined risk assessments is in Section 3: HSE assessment of risk.

Additional comments by the PRiF

Further information on fosetyl (sum) residues can be found in section 4.

Further information

- Summary table of results
- Survey Design
- Glossary
- HSE Assessment of Risk
- detailed reference information in an accessible format at Pesticide Residues in Food Quarterly Data. This data includes brand name, sampling point and origin information, pesticides sought and residues found

Lemons (GB)

Samples tested

24 samples were tested for up to 377 pesticide residues

- one sample was imported from outside the EU
- 23 samples came from the EU

Pesticide residues detected from those sought:

- 4 samples contained no residues from those sought
- 20 samples contained residues above the reporting limit
- none of the samples contained residues above the MRL
- 3 samples were labelled as organic. None contained residues from those sought

Risk assessments

The residues detected by the laboratory would not be expected to have an effect on health.

Combined risk assessments

Some samples contained residues of more than one pesticide. We do not expect these residues to have an effect on health, either separately or in combination. The pesticide residues found in each sample do not include more than one of the pesticides from the groups that the Health and Safety Executive (HSE) consider separately.

Further information of how HSE consider combined risk assessments is in Section 3: HSE assessment of risk.

Additional comments by the PRiF

None.

Further information

- Summary table of results
- Survey Design
- Glossary
- HSE Assessment of Risk
- detailed reference information in an accessible format at Pesticide Residues in Food Quarterly Data. This data includes brand name, sampling point and origin information, pesticides sought and residues found

Liver (bovine) (GB)

Samples tested

33 samples were tested for up to 114 pesticide residues

Calf

7 samples came from the UK.

Ox

26 samples came from the UK.

The country of origin of samples may not be the same as the country where the liver was produced. It may be where the liver was processed, where it was packed for consumer purchase or the address of the brand owner.

Pesticide residues detected from those sought:

- 30 samples contained no residues from those sought
- 3 samples contained residues above the reporting limit
- one sample contained residues above the MRL
- none of the samples were labelled as organic

Risk assessments

The residues detected by the laboratory would not be expected to have an effect on health.

Combined risk assessments

None of the samples contained more than one residue, so we did not carry out a combined risk assessment.

Additional comments by the PRiF

BAC

Three samples contained a residue of BAC. This substance is widely used as a biocide (disinfectant) during food preparation and processing. This is the most likely source of the residue.

Residues measured above the MRL

The laboratory detected one residue above the MRL in liver (bovine). Details are available in Table 4.

Further information

- Summary table of results
- Survey Design
- Glossary
- HSE Assessment of Risk
- detailed reference information in an accessible format at Pesticide Residues in Food Quarterly Data. This data includes brand name, sampling point and origin information, pesticides sought and residues found

Milk (GB)

Samples tested

66 samples were tested for up to 112 pesticide residues

Cows milk

62 samples came from the UK.

Goats milk

4 samples came from the UK.

Pesticide residues detected from those sought:

- 66 samples contained no residues from those sought
- none of the samples contained residues above the MRL
- 9 samples were labelled as organic. None contained residues from those sought

Risk assessments

The laboratory did not detect any residues, so we did not carry out a risk assessment.

Additional comments by the PRiF

None.

Further information

- Summary table of results
- Survey Design
- Glossary
- HSE Assessment of Risk
- detailed reference information in an accessible format at Pesticide Residues in Food Quarterly Data. This data includes brand name, sampling point and origin information, pesticides sought and residues found

Milk (NI)

Samples tested

19 samples were tested for up to 39 pesticide residues

Cows milk

- 15 samples came from the UK
- one sample came from the EU

Goats milk

3 samples came from the UK.

Pesticide residues detected from those sought:

- 19 samples contained no residues from those sought
- none of the samples contained residues above the MRL
- 4 samples were labelled as organic. None contained residues from those sought

Risk assessments

The laboratory did not detect any residues, so we did not carry out a risk assessment.

Additional comments by the PRiF

None.

Further information

- Summary table of results
- Survey Design
- Glossary
- HSE Assessment of Risk
- detailed reference information in an accessible format at Pesticide Residues in Food Quarterly Data. This data includes brand name, sampling point and origin information, pesticides sought and residues found

Onions (GB)

Samples tested

18 samples were tested for up to 405 pesticide residues

Fresh

- 11 samples came from the UK
- 7 samples came from the EU

Pesticide residues detected from those sought:

- 9 samples contained no residues from those sought
- 9 samples contained residues above the reporting limit
- none of the samples contained residues above the MRL
- 7 samples were labelled as organic. None contained residues from those sought

Risk assessments

The residues detected by the laboratory would not be expected to have an effect on health.

Combined risk assessments

Some samples contained residues of more than one pesticide. We do not expect these residues to have an effect on health, either separately or in combination. The pesticide residues found in each sample do not include more than one of the pesticides from the groups that the Health and Safety Executive (HSE) consider separately.

Further information of how HSE consider combined risk assessments is in Section 3: HSE assessment of risk.

Additional comments by the PRiF

Further information on fosetyl (sum) residues can be found in Section 4.

Further information

- Summary table of results
- Survey Design
- Glossary
- HSE Assessment of Risk
- detailed reference information in an accessible format at Pesticide Residues in Food Quarterly Data. This data includes brand name, sampling point and origin information, pesticides sought and residues found

Oranges (GB)

Samples tested

30 samples were tested for up to 409 pesticide residues

- 16 samples were imported from outside the EU
- 14 samples came from the EU

Pesticide residues detected from those sought:

- one sample contained no residues from those sought
- 29 samples contained residues above the reporting limit
- one sample contained residues above the MRL
- one sample was labelled as organic. None contained residues from those sought

Risk assessments

Following screening assessment there were four pesticides, lambda-cyhalothrin, imazalil, cypermethrin and thiabendazole, where the effect on health needed to be considered in more detail.

HSE always undertakes assessments that consider both when the peel is not eaten, and one where it is assumed that all of the peel is eaten. These assessments are detailed in section 3 and should be consulted for the full assessment of risk.

For all of these pesticides, if the oranges are consumed without the peel an effect on health is not expected. HSE has conducted a worst-case form of the assessment, assuming that all the peel is consumed with the fruit. In this case, an effect on health would be unlikely. Additionally, an effect on health would only be anticipated if a number of factors came together at the same time: the high residue found in the orange sample being consumed by the most critical consumer, a particularly high residue in an individual fruit, peak consumption levels (97.5th percentile), and a large proportion of peel from the fruit being consumed.

Other risk assessment screening work undertaken did not indicate any other expectation of effects on health. Please refer to 'how HSE perform the risk assessments' for further details.

Combined risk assessments

Some samples contained residues of more than one pesticide. We do not expect these residues to have an effect on health, either separately or in combination. The pesticide residues found in each sample do not include more than one of the pesticides from the groups that the Health and Safety Executive (HSE) consider separately.

Further information of how HSE consider combined risk assessments is in Section 3: HSE assessment of risk.

Additional comments by the PRiF

We needed to consider the risk assessment for some samples of orange containing residues of thiabendazole, imazalil, cypermethrin and lambda-cyhalothrin in more detail.

Further information about the risk assessment carried out can be read in section 3.

Further information on fosetyl (sum) residues can be found in Section 4.

Residues measured above the MRL

The laboratory detected 1 residue above the MRL in oranges. Details are available in Table 4.

Further information

- Summary table of results
- Survey Design
- Glossary
- HSE Assessment of Risk
- detailed reference information in an accessible format at Pesticide Residues in Food Quarterly Data. This data includes brand name, sampling point and origin information, pesticides sought and residues found

Pears (GB)

Samples tested

30 samples were tested for up to 413 pesticide residues

- 5 samples came from the UK
- 1 sample was imported from outside the EU
- 24 samples came from the EU

Pesticide residues detected from those sought:

- 4 samples contained no residues from those sought
- 26 samples contained residues above the reporting limit
- 1 sample contained residues above the MRL
- 3 samples were labelled as organic. None contained residues from those sought

Risk assessments

The residues detected by the laboratory would not be expected to have an effect on health.

Combined risk assessments

Some samples contained residues of more than one pesticide. We do not expect these residues to have an effect on health, either separately or in combination. The pesticide residues found in each sample do not include more than one of the pesticides from the groups that the Health and Safety Executive (HSE) consider separately.

Further information of how HSE consider combined risk assessments is in Section 3: HSE assessment of risk.

Additional comments by the PRiF

Further information on fosetyl (sum) residues can be found in Section 4.

Residues measured above the MRL

The laboratory detected 1 residue above the MRL in pears. Details are available in Table 4.

Further information

- Summary table of results
- Survey Design
- Glossary
- HSE Assessment of Risk
- detailed reference information in an accessible format at Pesticide Residues in Food Quarterly Data. This data includes brand name, sampling point and origin information, pesticides sought and residues found

Peas edible pods (GB)

Samples tested

30 samples were tested for up to 380 pesticide residues

Mange tout

12 samples were imported from outside the EU.

Sugar snaps

18 samples were imported from outside the EU.

Pesticide residues detected from those sought:

- 10 samples contained no residues from those sought
- 20 samples contained residues above the reporting limit
- none of the samples contained residues above the MRL
- none of the samples were labelled as organic

Risk assessments

The residues detected by the laboratory would not be expected to have an effect on health.

Combined risk assessments

Some samples contained residues of more than one pesticide. We do not expect these residues to have an effect on health, either separately or in combination. The pesticide residues found in each sample do not include more than one of the pesticides from the groups that the Health and Safety Executive (HSE) consider separately.

Further information of how HSE consider combined risk assessments is in Section 3: HSE assessment of risk.

Additional comments by the PRiF

None.

Further information

- Summary table of results
- Survey Design
- Glossary
- HSE Assessment of Risk
- detailed reference information in an accessible format at Pesticide Residues in Food Quarterly Data. This data includes brand name, sampling point and origin information, pesticides sought and residues found

Pineapple (GB)

Samples tested

24 samples were tested for up to 381 pesticide residues.

Canned

5 samples were imported from outside the EU.

Fresh

12 samples were imported from outside the EU.

Frozen

4 samples came from the UK.

Prepared

3 samples came from the UK.

The country of origin of samples may not be the same as the country where the pineapples were produced. It may be where the pineapples were processed, where they were packed for consumer purchase or the address of the brand owner.

Pesticide residues detected from those sought:

- 10 samples contained no residues from those sought
- 14 samples contained residues above the reporting limit
- none of the samples contained residues above the MRL
- none of the samples were labelled as organic

Risk assessments

Following screening assessment there were two samples containing a residue of ethephon at 0.5 mg per kg in a pineapple sample, where the effect on health needed to be considered in more detail.

HSE always undertakes assessments that consider both when the peel is not eaten, and one where it is assumed that all the peel is eaten. These assessments are detailed in section 3 and should be consulted for the full assessment of risk.

If the pineapple is consumed without the peel an effect on health is not expected. HSE has conducted a worst case form of the assessment, assuming that all the peel is consumed with the fruit. In this case, an effect on health would be unlikely. Additionally, an effect on health would only be anticipated if a number of factors came together at the same time: the high residue found in the pineapple sample being consumed by the most critical consumer 4 to 6 year old child, a particularly high residue in an individual fruit, peak consumption levels (97.5th percentile), and a large proportion of peel from the fruit being consumed.

Other risk assessment screening work undertaken did not indicate any other expectation of effects on health. Please refer to ‘how HSE perform the risk assessments’ for further details.

Combined risk assessments

Some samples contained residues of more than one pesticide. Two of these samples contained residues of ethephon and diazinon which belong to similar chemical groups and may have similar toxicological effects. So, the risk assessors needed to consider their possible impacts on human health, both on their own and in combination.

HSE carried out a combined risk assessment of the relevant samples. In one sample, at the levels found (ethephon 0.20 mg per kg and diazinon 0.03 mg per kg), a detailed risk assessment was not needed following the initial screening of this multiple residue, and an effect on health arising from the combination of these residues in this sample would not be expected. In the other sample, with a higher level of ethephon in the sample, (ethephon 0.50 mg per kg and diazinon 0.01 mg per kg), these pesticides together will be unlikely to inhibit acetyl cholinesterase, the known effect from exposure to each of these residues, even if all the peel is consumed with the fruit. HSE concludes that a short term effect on health for the combined residues of ethephon and diazinon in pineapple is not expected (one sample) or unlikely (another sample with this combination of residues found following a worst case form of assessment which assumes peel is consumed with the fruit).

Further information of how HSE consider combined risk assessments is in Section 3: HSE assessment of risk.

Additional comments by the PRiF

We needed to consider the risk assessment for some samples of pineapple containing residues of ethephon in more detail. Further information about the risk assessment carried out can be read in section 3 of this report.

Further information

- Summary table of results
- Survey Design
- Glossary
- HSE Assessment of Risk
- detailed reference information in an accessible format at Pesticide Residues in Food Quarterly Data. This data includes brand name, sampling point and origin information, pesticides sought and residues found

Potatoes (GB)

Samples tested

37 samples were tested for up to 406 pesticide residues

- 29 samples came from the UK
- 8 samples were imported from outside the EU

Pesticide residues detected from those sought:

- 15 samples contained no residues from those sought
- 22 samples contained residues above the reporting limit
- one sample contained residues above the MRL
- none of the samples were labelled as organic

Risk assessments

The residues detected by the laboratory would not be expected to have an effect on health.

Combined risk assessments

Some samples contained residues of more than one pesticide. We do not expect these residues to have an effect on health, either separately or in combination. The pesticide residues found in each sample do not include more than one of the pesticides from the groups that the Health and Safety Executive (HSE) consider separately.

Further information of how HSE consider combined risk assessments is in Section 3: HSE assessment of risk.

Additional comments by the PRiF

None.

Residues measured above the MRL

The laboratory detected 1 residue above the MRL in potatoes. Details are available in Table 4.

Further information

- Summary table of results
- Survey Design
- Glossary
- HSE Assessment of Risk
- detailed reference information in an accessible format at Pesticide Residues in Food Quarterly Data. This data includes brand name, sampling point and origin information, pesticides sought and residues found

Poultry meat (GB)

Samples tested

24 samples were tested for up to 116 pesticide residues.

Chicken

21 samples came from the UK.

Turkey

3 samples came from the UK.

The country of origin of samples may not be the same as the country where the poultry was produced. It may be where the poultry was processed, where it was packed for consumer purchase or the address of the brand owner.

Pesticide residues detected from those sought:

- 23 samples contained no residues from those sought
- one sample contained a residue above the reporting limit
- none of the samples contained residues above the MRL
- one sample was labelled as organic. None contained residues from those sought

Risk assessments

The residue detected by the laboratory would not be expected to have an effect on health.

Combined risk assessments

Only one residue was found (in a single sample), so we did not carry out a combined risk assessment.

Additional comments by the PRiF

BAC

One sample of Turkey mince contained a residue of BAC, this substance is widely used as a biocide (disinfectant) during food preparation and processing. This is the most likely source of the residues.

Further information

- Summary table of results
- Survey Design
- Glossary
- HSE Assessment of Risk
- detailed reference information in an accessible format at Pesticide Residues in Food Quarterly Data. This data includes brand name, sampling point and origin information, pesticides sought and residues found

Poultry meat (NI)

Samples tested

13 samples were tested for up to 43 pesticide residues

Chicken

- 9 samples came from the UK
- 1 sample was imported from outside the EU

Duck

2 samples came from the EU.

Turkey

1 sample came from the UK.

The country of origin of samples may not be the same as the country where the poultry was produced. It may be where the poultry was processed, where it was packed for consumer purchase or the address of the brand owner.

Pesticide residues detected from those sought:

- 13 samples contained no residues from those sought
- none of the samples contained residues above the MRL
- one sample was labelled as organic. None contained residues from those sought

Risk assessments

The laboratory did not detect any residues, so we did not carry out a risk assessment.

Additional comments by the PRiF

None.

Further information

- Summary table of results
- Survey Design
- Glossary
- HSE Assessment of Risk
- detailed reference information in an accessible format at Pesticide Residues in Food Quarterly Data. This data includes brand name, sampling point and origin information, pesticides sought and residues found

Rice (GB)

Samples tested

18 samples were tested for up to 415 pesticide residues

Basmati

- 5 samples came from the UK
- 2 samples were imported from outside the EU
- 2 samples came from the EU

White

- 2 samples came from the UK
- 2 samples were imported from outside the EU
- 5 samples came from the EU

The country of origin of samples may not be the same as the country where the rice was produced. It may be where the rice was processed, where it was packed for consumer purchase or the address of the brand owner.

Pesticide residues detected from those sought:

- 13 samples contained no residues from those sought
- 5 samples contained residues above the reporting limit
- none of the samples contained residues above the MRL
- none of the samples were labelled as organic

Risk assessments

One sample of risotto rice contained a residue of ethylene oxide where the effect on health needed to be considered in more detail. The amount detected in the sample was 0.01 mg per kg, below the level of the MRL at 0.02* mg per kg.

The residue definition includes both ethylene oxide and its metabolite 2-chloroethanol. The residue determined in the sample of risotto rice was in the form of 2-chloroethanol, which is expected since the conversion to 2-chloroethanol is rapid.

Whilst there are no formal toxicological reference values set for ethylene oxide there are international approaches to consumer risk assessment and management that have been followed previously. HSE has applied such an approach to the detailed assessment. Full details are presented in section 3

HSE has presented the information on possible genotoxicity for 2-chloroethanol. The use of ethylene oxide in food production is not permitted in the UK as the substance can have mutagenic and carcinogenic effects (can cause genetic damage and can potentially lead to cancer). The evidence for 2-chloroethanol being mutagenic and carcinogenic is more uncertain than the data for ethylene oxide. This is because of a less than fully satisfactory data set for 2-chloroethanol which has also not been independently evaluated. HSE's assessment has taken the precautionary approach in assuming that, in the absence of further data, the residues of 2-chloroethanol should be regarded as potentially genotoxic (cause genetic damage) and carcinogenic

As a short term reference value is not available, based on the understanding of the toxicity profile, HSE has presented a long term exposure assessment applying a margin of

exposure (MOE) approach. HSE derived that the highest long term estimate of exposure is 14,800 x lower than the $BMDL_{10}$ for the formation of tumours, so the margin of exposure is more than 10,000. HSE concludes that these findings are unlikely to be of concern

Overall, HSE concludes that the residue finding of ethylene oxide (found in one rice sample only as it's metabolite 2-chloroethanol) is not indicative of an expectation of effects on health, although the risk assessment approach does not exclude the possibility of adverse health effects. On a precautionary basis any findings of 2-chloroethanol in food are undesirable due to concerns regarding genotoxicity. Any risks of adverse health effects are low at the highest levels of exposure after eating large portions (97.5th percentile consumption) of the rice containing 0.01 mg per kg ethylene oxide.

Other risk assessment screening work undertaken did not indicate any other expectation of effects on health. Please refer to 'how HSE perform the risk assessments' for further details.

Combined risk assessments

Some samples contained residues of more than one pesticide. We do not expect these residues to have an effect on health, either separately or in combination. The pesticide residues found in each sample do not include more than one of the pesticides from the groups that the Health and Safety Executive (HSE) consider separately.

Further information of how HSE consider combined risk assessments is in Section 3: HSE assessment of risk.

Additional comments by the PRiF

We needed to consider the risk assessment for one sample of risotto rice containing a residue of ethylene oxide in more detail. Further information about the risk assessment carried out can be read in section 3 of this report and in the genotoxicity section Substances which might be genotoxic.

Further information on fosetyl (sum) residues can be found in Section 4.

Further information

- Summary table of results
- Survey Design
- Glossary
- HSE Assessment of Risk
- detailed reference information in an accessible format at Pesticide Residues in Food Quarterly Data. This data includes brand name, sampling point and origin information, pesticides sought and residues found

Soft citrus (GB)

Samples tested

24 samples were tested for up to 405 pesticide residues

Clementine

one sample came from the EU.

Easy peelers

- 4 samples were imported from outside the EU
- 2 samples came from the EU

Mandarin

- 9 samples were imported from outside the EU
- 3 samples came from the EU

Tangerine

- one sample was imported from outside the EU
- 4 samples came from the EU

Pesticide residues detected from those sought:

- one sample contained no residues from those sought
- 23 samples contained residues above the reporting limit
- none of the samples contained residues above the MRL
- one sample was labelled as organic. None contained residues from those sought

Risk assessments

Following screening assessment there were two pesticides, imazalil and thiabendazole, where the effect on health needed to be considered in more detail.

HSE always undertakes assessments that consider both when the peel is not eaten, and one where it is assumed that all of the peel is eaten. These assessments are detailed in section 3 and should be consulted for the full assessment of risk.

For these pesticides, if the soft citrus are consumed without the peel an effect on health is not expected. HSE has conducted a worst-case form of the assessment, assuming that all the peel is consumed with the fruit. In this case, an effect on health would be unlikely. Additionally, an effect on health would only be anticipated if a number of factors came together at the same time: the high residue found in the soft citrus sample being consumed by the most critical consumer, toddlers, a particularly high residue in an individual fruit, peak consumption levels (97.5th percentile), and a large proportion of peel from the fruit being consumed.

Other risk assessment screening work undertaken did not indicate any other expectation of effects on health. Please refer to ‘how HSE perform the risk assessments’ for further details.

Combined risk assessments

Some samples contained residues of more than one pesticide. We do not expect these residues to have an effect on health, either separately or in combination. The pesticide residues found in each sample do not include more than one of the pesticides from the groups that the Health and Safety Executive (HSE) consider separately.

Further information of how HSE consider combined risk assessments is in Section 3: HSE assessment of risk.

Additional comments by the PRiF

We needed to consider the risk assessment for some samples of soft citrus containing residues of thiabendazole and imazalil in more detail. Further information about the risk assessment carried out can be read in section 3 of this report.

Further information

- Summary table of results
- Survey Design
- Glossary
- HSE Assessment of Risk
- detailed reference information in an accessible format at Pesticide Residues in Food Quarterly Data. This data includes brand name, sampling point and origin information, pesticides sought and residues found

Section 2: Sample details and supplier responses

Sample details

The sample details are published on Pesticide Residues in Food Quarterly Data as a dataset in an open document spreadsheet (ODS) format.

About sample information

The following information is available on each sample collected this quarter:

- date and place of collection
- description (for example, ‘runner bean’, organic milk)
- country of origin or manufacture
- brand name and packer or manufacturer
- residues detected (results shown in green indicate residues above the MRL)
- where the brand name of a sample is given the produce involved may have been on sale in other retail premises at the same time

The description and country of origin are taken from labelling on the food or at the point of sale. The country of origin of processed food may not be the country where the unprocessed produce was produced. This is true even of food that has undergone minimal processing, such as meat that has been butchered or frozen vegetables.

Samples with residues above the MRL are in bold, green text.

Some brand name details have been withheld; these will be published once enquiries are complete.

The government’s ‘brand naming’ policy

The government has decided that brand name information should be published as part of the government food chemical surveillance programme. Brand names have been published for most pesticide residue surveys since 1998. Certain samples are excluded from the release of brand name information. These include samples taken as part of any pesticide residues enforcement programme and those taken as part of surveys to study individual people and farms. This policy was reviewed in between 2000 and 2001, when Ministers agreed to its continuation.

Where we find residues above an MRL or the presence of non-authorised plant protection product, brand owners, retailers and or growers are notified of the result in advance of publication of reports and given 4 weeks to comment.

Interpreting brand name information

There is no ready definition of what constitutes a brand in all cases. For clearly branded produce like breakfast cereals or biscuits the ‘brand owner’ is shown. In the case of ‘own brand’ goods this may be one of the multiple retailers. For fruit and vegetables, the retailer is generally shown. For meat, milk and most other animal products the retailer is also generally shown. Finally, for all commodities the country of origin is shown where this was displayed either on the produce or in the store.

Our programme aims to takes samples of produce in approximate proportion to the market share of the main retailers. This has been done to ensure we obtain an accurate representation of a sector (for example, fruit and vegetables).

Individual programmes are not capable of generating statistically valid information on residues in particular crops from particular retailers. This would require the collection of a much larger number of samples: either substantially increasing costs or greatly reducing the range of different foods sampled in any one year. Therefore, results from an individual survey cannot be taken as a fair representation of the residues status of any particular brand.

However, we do collect samples from a variety of outlets in a range of locations, over a period of years. Successive programmes should therefore help generate information on the typical residues profile of particular types of produce and on major trends in the incidence and levels of pesticides. It should be noted that this quarterly report is not intended to give a comprehensive comparison with previous surveys of the same commodities.

A particular issue arises in relation to the country of origin of fruit and vegetables. The origins included in the reports are those recorded either on the produce or in the store. However, it is not uncommon for mixing to occur on shop shelves. We have responded by increasing the proportion of pre packed goods sampled. However, pre packed samples are not available for some produce in some stores, and it could also introduce bias to surveys if loose produce were not sampled. Loose produce is therefore sampled but the origin of the sample should be interpreted with a degree of caution.

Action taken by HSE

HSE wrote to:

- the suppliers of all samples containing residues above the MRL
- the authorities of the exporting countries of all samples containing residues above the MRL
- the suppliers of GB and NI samples that contained residues of actives which do not have a plant protection product authorised for the crop they were detected in
- the Organics branch of Defra about samples that were labelled as organic and contained any residues of pesticides which is not permitted under retained organic regulation Commission Regulation (EC) No 889/2008
- the suppliers and certification organisation of all organic samples containing any residues of pesticides which is not permitted under retained organic regulation Commission Regulation (EC) No 889/2008

Recipients of the letters are given 4 weeks to provide a statement for inclusion in the report. The Expert Committee on Pesticide Residues in Food reviews any replies received.

Supplier responses

None.

Section 3: HSE assessment of risk

The surveillance programme is designed to enable the regulatory authorities to check that pesticides are being found at levels, as expected, under the MRLs. This confirms that the regulatory processes are working correctly, and as part of this, that pesticides users are complying with any specified conditions that were part of the authorisation. In addition, this work checks that dietary intakes of residues are within acceptable limits. This may be more challenging when pesticide residues are found in food products that have not been grown in the UK or EU, notably when older pesticides have been used. One of the roles of the PRiF, using the work of HSE, is to call out any pesticide residue which is higher than expected and explain more about any risks to consumers from this.

This section details how risks from dietary intakes are assessed.

When assessments are carried out

HSE performs screening assessment for each residue and commodity combination to identify residue levels that would lead to intakes above the relevant health based reference doses (these are also sometimes referred to as toxicological reference values 'TRVs'). Further information on this screening approach is available on request from HSE. We then present detailed assessments for every case where the actual residue level found could lead to an intake by any group above the reference dose.

Assessing dietary intakes

Assessing the acceptability of dietary intakes is complicated. HSE carries out consumer risk assessments for both short term (peak) and long term intakes. These assessments use information on food consumption collected in UK dietary surveys in conjunction with the residue levels we find. Occasionally, HSE uses additional pesticide specific information on the losses of residues that occur during preparation and/or cooking of food.

How the assessment is carried out

Short term risk assessment

HSE calculate short term intakes (also called NESTIs) using consumption data for high level (97.5th percentile) consumers, based on single day consumption values and the highest residue found in a food commodity. The residue found is multiplied by a variability factor to take account of the fact that residues may vary between individual items that make up the sample analysed. This is why in some of our detailed risk assessments we refer to some of the general variability factors (of 5, 7 and 10) that are applied in short term risk assessments. Sometimes, regulatory assessment of data for a pesticide can support an alternative specific value of the variability factor, and where justified, HSE will apply these to the risk assessment and explain this. The estimated intake is compared to the Acute Reference Dose (ARfD). This is done for 10 consumer groups: adults, infants, toddlers, 4 to 6 year olds, 7 to 10 year olds, 11 to 14 year olds, 15 to 18 year olds, vegetarians, elderly living in residential homes and elderly living in their own homes.

Long term risk assessment

HSE also calculate long term intakes (NEDIs) for high level (97.5th percentile) consumers, but in this case the consumption data are high level long-term values rather than peak

single-day events. Similarly, the residue values used reflect long term average levels (we use the median value across each commodity type) rather than occasional high values. Again, these estimates are made for the ten consumer groups. In this case the estimated intake is compared to the Acceptable Daily Intake (ADI).

Where do we get reference doses from?

The reference doses (ADI, ARfD or other suitable health based reference values such as Tolerable Daily Intake (TDI) (sometimes used instead of an ADI)) are set following regulatory assessment. In the UK, these values will be reviewed prior to establishment by the Expert Committee on Pesticides (ECP). We currently use reference values from a range of respected sources, including the EU and values set by EFSA. Up to 2019, the UK was part of a harmonised approach to the assessment of pesticide substances in the EU, and we have taken part in the peer review of previously established values. PRiF will also use values from other respected international sources, such as those established by the joint FAO and WHO Meeting on Pesticide Residues (JMPR, which evaluates and publishes residues and toxicological evaluations of pesticides) and levels set by regulatory authorities in other countries. For a small number of pesticides, the reference doses used have been determined by HSE (for example, prothiofos, tecnazene). These have not been independently peer reviewed and should therefore be regarded as provisional.

Further explanation of the models we use and application to the PRiF work

We use deterministic models

The assessments we use are 'deterministic' which means we use a defined level of input (such as a median or highest residue and 97.5th percentile dietary consumption values). More information on the deterministic intake assessments is available on HSE's website: The HSE Pesticide Website then search for Consumer Exposure. Here you will find information and further links. See below for an explanation of probabilistic models, where the inputs into the assessments can be varied and more realistic assessments reflecting a range of possible scenarios can be modelled.

Detailed risk assessment work is carried out before pesticides are authorised

The fundamental full complement of risk assessment work for pesticides is done at the pre authorisation stage considering the residues data packages when trials reflecting the label uses of the pesticides are assessed. These trials profile the highest likely residues that might arise when the pesticides are used as intended (crops and permitted doses of use). MRLs are set on the basis of these data sets, and the post approval monitoring work then serves as a check for whether residues found are in line with this prior expectation. The risk assessments supporting the MRLs assess the highest residue observed in each crop (or animal product) for short term assessment. For the long term MRL assessments, the median residues, across all crops and animal products are taken together to assess combined intakes over the long term as 'total dietary intakes', taking account of all possible food exposures. Authorisation for pesticide products can only be granted where these assessments of dietary intake do not exceed the health based reference values.

MRL considerations

Although MRLs are not safety levels, an MRL would not be established if the residue concentrations measured in the supervised trials used to support the MRL would give rise to health concerns. In most cases residues present at the MRL result in intakes below the

ARfD and the ADI. So even if the MRL is exceeded this does not always lead to an intake above the ARfD or ADI.

What happens if we find a pesticide intake above an ADI or an ARfD?

In addition, an estimated intake in the monitoring work that exceeds the ADI or ARfD does not automatically result in concerns for consumer health, because a protective approach is used in setting the ADI and ARfD. In the unusual circumstance of an intake exceeding the ADI or ARfD, HSE undertake an evaluation of the toxicological data, and we present details of this assessment.

When we present the outcomes of risk assessments, we provide a conclusion on the possible impact on human health based on the degree of concern following the HSE assessment of risk. These conclusions keep to the following order severity, from lowest to highest risk: “Effects on health are not expected” (toxicological reference values not exceeded), “unlikely risk” (of effects on health), “low risk”, “higher risk” (exposures are undesirable[3]). Most detailed consumer intake assessments that we present with the PRiF reports are for short term exposure rather than chronic exposure. This is because in most cases the monitoring data show the majority of samples tested contain residues below the reporting limit and so chronic exposure would not present a concern. The reporting limits are set at suitable low levels based on analytical laboratory procedures so that dietary intakes are typically far below the health based reference values.

Monitoring data presented in the PRiF quarterly reports provides a ‘snapshot view’ of the residues found in specific foods in a survey usually conducted over a 12 week period and limited to around 30 samples for most commodities. It is important not to use isolated findings of higher than expected residues in small surveys to make judgements on long term effects over a lifetime exposure.

For PRiF work, long term exposure assessments use median residue levels, rather than the highest residues found. For quarterly assessment (data obtained over 3 months only) we currently only assess long term dietary assessment commodity by commodity and not as total dietary intakes across commodities. Even where a number of samples in a PRiF commodity survey do contain the same pesticide, it is very rare that the ‘screening assessment’ we undertake leads to the need for a more detailed assessment to be presented (only where the dietary intakes exceed the ADI or TDI).

We do not see a high number of PRiF samples for any pesticide that exceed an MRL. This means that, over time, median residue levels found in PRiF monitoring do not often exceed the median residues used in the trials assessed at the time of MRL setting and so do not often require consideration of long term effects. When HSE does need to assess long term effects, it is likely to overestimate exposure to an assessed pesticide residue in a single food item. For a single commodity risk assessment, we assume high level (97.5th percentile) consumption at the median residue level in that food for each day of lifetime. Although the HSE long term assessments by their quarterly nature are indicative only, the assessment we perform is conservative. Furthermore, alternative published assessments (for example, those considering trends and large bodies of data) are available which

[3] Furthermore, PRiF will always conclude that on a precautionary basis any findings of genotoxic substances in food are undesirable (please see the explanation regarding genotoxicity in the below section on ‘Implications for health’).

further consider the long term exposure to pesticides[4]. Some pesticides contribute more significantly to long term dietary intakes across commodities based on their toxicology and prevalence (such as chlorpyrifos, cyfluthrin, deltamethrin, diazinon, dieldrin, dimethoate, dithiocarbamates, fenamiphos, fipronil, imazalil, lambda-cyhalothrin, omethoate and pirimiphos-methyl), based on the chronic exposure assessments presented in EFSA, 2020[5]).

We will continue to have focus on residues of consumer relevance, when they are found, in both UK and NI produced and imported produce. As pesticide use changes, including when there are impacts of regulatory action on pesticides, the profiles of residues in the monitoring can change over time. For example, chlorpropham, which was previously found at levels well above the reporting limits in potatoes, is no longer permitted for use in the UK and EU, and this pesticide will no longer have dietary intakes which take up a substantial portion of its health based reference values.

Implications for health

Where intakes exceed a reference dose, it is necessary for the underlying toxicological studies (animal studies) to be considered to enable the significance for the consumer of such an exceedance to be understood. Toxicological studies supplied by the registrants in the regulatory data packages are conducted using different doses to determine the nature of any ill health effects as well as the levels at which such effects can be expected to occur.

Toxicological studies that we refer to and use in the HSE risk assessments are conducted using test animals to identify the highest experimental dose that causes no detectable adverse effects (the NOAEL). Where there is more than one relevant toxicological study, the lowest appropriate NOAEL for the most sensitive adverse effect is typically used. There is some uncertainty in extrapolating between animals and people and it is therefore important to use a 'safety factor' to account for sources of variation. This safety factor is incorporated (by dividing the NOAEL by the safety factor) in deriving a reference dose, either an ADI or an ARfD, to which consumer intakes are compared. A safety factor therefore extrapolates from the animal testing to the general population. Factors in the order of x100 are commonly used, x10 for animal to man, and x10 for within human population differences in sensitivity. However, toxicologists may propose different values (for example, from 5 to 1,000) based on scientific reasoning in accordance with study designs and the quality of the data that has been generated from the studies.

In order to ensure exposures to pesticides do not pose unacceptable risk to humans a wide range of investigations are performed. Most of these are performed on experimental animals because the only endpoints that can be examined in human volunteers are those involving observation or blood and urine sampling. Human volunteer studies involving

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[4] Total diet studies (for example, those performed by US FDA US FDA total diet study program, various Nougadère A et al., publications in Environment International journal on TDS in France); see also EFSA evaluations of chronic exposures to pesticides (2020 and 2021 examples included in the list of EFSA publications on cumulative exposure to pesticides outlined in this section (under Multiple residues)). annual EU monitoring data published on the EFSA website: 2018 report (published in 2020) noted below at The 2018 European Union report on pesticide residues in food).

[5] EFSA (European Food Safety Authority), Medina-Pastor P and Triacchini G, 2020. The 2018 European Union report on pesticide residues in food. EFSA Journal 2020;18(4):6057, 103 pp.
The 2018 European Union report on pesticide residues in food

pesticides are not generated in current regulatory work. There is debate at the international level as to whether human studies that have been generated should be used for risk assessment purposes. The UK policy is not to use these data in pre authorisation assessments which support the registration of a pesticide; the JMPR chose to apply judgement in the appropriate use of these data if available. The HSE risk assessments will usually refer to test animal species, such as dog, rat, and rabbit. All toxicological work is undertaken based on principles of minimising animal distress. Where scientifically valid human data are available the risk assessments will refer to these as they reduce the uncertainty in the assessment. Therefore, human data is only referred to in more limited circumstances.

Acute (short term) toxicology is not a concern for all pesticides, as some are not acutely toxic. In terms of the pesticides that have been found in fruit and vegetables through the surveillance programme an acute risk assessment would not be necessary on the following examples: maleic hydrazide, diphenylamine, kresoxim-methyl, and quintozene.

During regulatory assessment, careful consideration is given to any pesticides that may exhibit any potential to be genotoxic (able to damage genetic material) in live animals. In the PRiF programme we note residue types that have been shown in the toxicological data sets to have genotoxic potential or those where data are suggestive of genotoxicity but not certain. There is a small number of cases of older pesticides, likely found only in imported foods, that might be genotoxic. These are examples where modern data to investigate the true genotoxic potential are not expected to be made available. In such situations, we might conclude on a precautionary basis that any findings of these pesticides are undesirable due to the uncertainty regarding genotoxicity, and at low residue levels any risks of adverse health effects are low due to the limited levels of exposure anticipated. PRiF uses low reporting limits for these pesticides to detect these residues even at very low levels, as we know they are of particular interest to consumers.

Consumption data and refining the risk assessment

Consumption values

As the surveillance programme monitors residues in all types of food, from raw commodities (for example, potatoes) to processed (for example, wine), dried (for example, dried fruit) and composite foods (for example, fruit bread), consumer risk assessments are specifically tailored to address processed and mixed food products. Sometimes this can be affected by availability of consumption data. For example, for pâté, we assess this using consumption data for liver (all types of liver), and for fish pâté we use consumption data for fish (all sources and types of fish). However, we use specific consumption data where FSA have provided data to us (for example, data on orange juice, dried grapes, and bread). Consumption data are available for most raw commodities, but where data are limited then we will suggest using alternative data. This may involve considering other commodities (for example, using potato data as ‘surrogate’ for sweet potato), or alternative sources of consumption data such as EU PRIMo or JMPR consumption and dietary assessment models, to consider items that do not currently feature in UK data sets. Where alternative data are used in our screening and written assessments we explain this in our presentation of the risk assessment work for each quarterly report (for examples, please see the bullet points before the table of detailed risk assessments in section 3).

Fruit and vegetables with removable peel

For fruit and vegetables that have peel or skin that might not be consumed we present alternative risk assessments for ‘without peel, flesh only’ where peel versus pulp residue distribution data is available. As standard, we present an assessment for ‘all of the peel’ consumed. It is not expected that consumers will always eat peel, so these standard assessments are considered to be highly cautious and not necessarily realistic. Further data are being generated to better understand whether some people do eat the peel of these, and if so how much of the peel they tend to eat.

At the time of MRL assessment, the agreed international approach applied to the risk assessment is to assume that the peel is removed for certain types of commodity that are designated as having ‘inedible peel’. In this way when the MRLs are agreed, if there are suitable data on distribution of residues between peel and pulp (flesh), the risk assessment supporting the MRL can use a peeling factor which removes the higher residue associated with the peel. The MRLs are set for the whole fruit (with peel on), and as such in the PRiF work there can be examples of residues found well below the MRL that lead to dietary intakes that exceed the ARfD, if it is assumed that a consumer will eat all the peel.

For transparency, in the PRiF work, we present the alternative assessments: ‘all of the peel consumed’ and ‘without peel, flesh only’.

Dithiocarbamate residues

Dithiocarbamate residues are determined as carbon disulphide which is a common product from different dithiocarbamate pesticides. For the risk assessment we take a precautionary approach. For short term assessment, the worst case dithiocarbamate residue is calculated by assuming the residue is derived from thiram (a molecular weight conversion is applied to estimate the level of residue based on thiram) and this is compared to the ARfD for thiram. If the ARfD for thiram is exceeded, it might be possible for additional laboratory analysis to determine if the residue could have resulted from either thiram, propineb or ziram. Where it can be confirmed that a specific dithiocarbamate was applied the equivalent residue of the specific active substance is estimated and the intake compared to the appropriate reference dose, we select an alternative worst case dithiocarbamate if the laboratory analyses indicate absence of specific types. We only present a detailed risk assessment when dietary intake exceeds either the thiram or other suitable reference dose.

The analysis of dithiocarbamates is further complicated by an expectation that some types of crops, such as members of Brassicaceae (for example, watercress) and Caricaceae (for example, papaya) might contain natural sources of sulphur compounds that could be also determined as carbon disulphide during analysis in the laboratory. The PRiF will consider and explain in the report whether residues reported as dithiocarbamates could be from natural sources or whether they have arisen as a result of fungicide treatment.

Residues that are isomers

The routine methods used for pesticide residues analyses are not always able to distinguish between different isomers of pyrethroid pesticides because these isomers are very similar in their physical and chemical properties. Isomers share the same molecular formula and differ only in the spatial arrangement of the molecular structure. Pyrethroid pesticides can have many isomers and are marketed either as pure individual isomers or as a mixture of them. It is possible for isomers to have different toxicological properties.

For such residues, during the risk assessment work undertaken, HSE will use available information on the toxicology, an understanding of the pesticide marketed in the country in which the pesticide was used for the sample in question and whether the analysis can distinguish between different isomers. For example, residues of lambda and gamma-cyhalothrin are not distinguishable analytically. Gamma-cyhalothrin is the more toxic form (than lambda-cyhalothrin), but we might have information on whether gamma-cyhalothrin or lambda-cyhalothrin has been sprayed on the crop. In terms of cypermethrin, alpha-cypermethrin is more toxic than other isomers of cypermethrin. The analytical data can sometimes be used to determine whether the residue may have arisen from use of alpha-cypermethrin. In addition, we might have information on whether alpha-cypermethrin has been used on the crop.

In considering these refinements to the risk assessment, if case by case it is not possible to determine which isomer may have been used, we will assume that the most toxic form was used. As explained above, we only present a detailed risk assessment when dietary intake exceeds the relevant reference dose.

Probabilistic modelling

The standard ‘deterministic’ calculations of consumer exposure used in regulatory assessment and the HSE risk assessments for PRiF work use realistic consumption data and residue levels. However, they tend to overestimate intakes in most circumstances. This is due to the assumptions used, fruit and vegetables would contain high levels of residue in an individual unit and that these would be consumed by high level consumers. They do not take into account the possible range of residue levels and consumption distributions that may occur in reality. These possible combinations of residues and consumption levels can be taken into account using modelling or simulation techniques to produce probability distributions of residue intake levels to indicate the range of consumer intakes, presented as a probabilistic assessment of consumer exposure. These techniques are not yet routinely used to estimate dietary intakes of pesticide residues.

Multiple residues and other developments in risk assessment for pesticides

The risk assessment process is not standing still. We are aware that some consumers are concerned by the possible implications of residues of more than one chemical occurring in, say, a single portion of fruit or vegetables or the interaction between mixtures of pesticides and veterinary medicines. The possible implications to health of multiple residues is sometimes called the ‘cocktail effect’. Where more than one pesticide residue is found in a sample, we consider the need for further assessment. The question of which pesticides should be assessed together remains a challenge due to the complexity of the mixtures. In the PRiF work currently, we consider some combinations that we think are a priority (based on toxicological profile or prevalence of the co-occurring residues that are related to one another chemically). If more than one of the following combinations are found together, in the same sample, we will undertake an additional risk assessment:

- triazoles
- organophosphates and, or carbamates
- captan and folpet
- BAC and DDAC
- chlormequat and mepiquat

In a ‘first step’ screening assessment approach we will consider whether the sum of the dietary intakes of each pesticide taken together in that commodity (when expressed as a percentage of its own reference value) exceeds a total of 100. If this value is not exceeded, then we do not anticipate that there would be an effect on human health and the assessment is not considered further. If this value (of 100) is exceeded (in the initial screen) then we would present a more detailed risk assessment, including a table to show the dietary intakes of each of the pesticides within the group, in the report. Further information is available on: The HSE Pesticide Website. Search for the Data Requirements Introduction and Index and follow the ‘consumer exposure’ links.

International research is aimed at improving the regulatory assessment of mixtures of residues to help understand whether there are any health implications from any observed combinations of pesticide residues in food. In our work, PRiF aims to keep our assessments at a high regulatory standard taking account of current knowledge in the field. We will look to adapt as new risk assessment approaches develop. We are keen to ensure our reports reflect consumer concerns.

The Food Standards Agency (FSA) asked the Committee on Toxicity of Chemicals in Food, Consumer Products and the Environment (COT) to assess these concerns. Their report Risk Assessment of Mixtures of Pesticides’ was published in 2002.

The Committee concluded that the probability of any health hazard from exposures to mixtures is likely to be small. Nonetheless, it identified areas of uncertainty in the risk assessment process and made recommendations for further work. These fell under the broad headings of regulatory, surveillance, research and public information issues. An action plan to take forward the recommendations was published by the FSA. A number of research projects were commissioned by the FSA to help progress the action plan.

Further to the work done by COT in 2002, combined assessment methodology has been taken forward at the international level, especially the European Food Safety Authority (EFSA) to develop methodology.

Much of the existing recent work on cumulative exposures to pesticides uses probabilistic models and large EU wide monitoring data sets. Notable work includes the EFSA publications on cumulative exposure cited below. On the basis of the work to date, including consumer assessment case studies, EFSA concludes, with varying degrees of certainty for all the population groups assessed, that consumer risk from dietary cumulative exposure is below the thresholds established by EU risk managers. Further information can be obtained from EFSA’s publications, news updates, and frequently asked questions:

- EFSA Feb 2021 (Statement): Comparison of cumulative dietary exposure to pesticide residues for the reference periods 2014–2016 and 2016–2018
- EFSA Feb 2021 (Scientific Report) Cumulative dietary risk assessment of chronic acetylcholinesterase inhibition by residues of pesticides
- EFSA April 2020: News Pesticides: first cumulative risk reports published This work is centred on two case studies (outlined below)
- EFSA April 2020: Cumulative risk assessment of pesticides: FAQ
- EFSA April 2020: Cumulative dietary risk characterisation of pesticides that have acute effects on the nervous system

- EFSA April 2020: Cumulative dietary risk characterisation of pesticides that have chronic effects on the thyroid
- EFSA news update (Jan 2016) Pesticides: breakthrough on cumulative risk assessment
- EFSA Sept 2019: Establishment of (CAGs) cumulative assessment groups (effects on thyroid)
- EFSA Sept 2019: Establishment of (CAGs) cumulative assessment groups (effects on the nervous system)
- EFSA Jan 2014: Outcome of the public consultation on the Scientific Opinion on the identification of pesticides to be included in cumulative assessment groups (CAGs) on the basis of their toxicological profile
- EFSA Dec 2013: Scientific Opinion on the relevance of dissimilar mode of action and its appropriate application for cumulative risk assessment of pesticides residues in food
- EFSA Sept 2009: Scientific Opinion on Risk Assessment for a Selected Group of Pesticides from the Triazole Group to Test Possible Methodologies to Assess Cumulative Effects from Exposure through Food from these Pesticides on Human Health
- EFSA May 2008: Opinion of the Scientific Panel on Plant Protection products and their Residues to evaluate the suitability of existing methodologies and, if appropriate, the identification of new approaches to assess cumulative and synergistic risks from pesticides to human health with a view to set MRLs for those pesticides in the frame of Regulation (EC) 396/2005

Further publications on topics related to consumer risk assessment that are under development are as follows:

- UK Committee on Carcinogenicity (2019) guidance note (COC Guidance Statement G09) on LTL exposure assessment. COC 2019 LTL Guidance
- EFSA: Update: use of the benchmark dose approach in risk assessment (2016) BMDL
- WHO guidance on genotoxicity (2020). EHC 240 (updated 2nd Ed) genotoxicity

HSE (UK) is participating in a number of international initiatives related to residues and risk assessment (OECD Working group on residue definitions, and the ongoing JMPR programme of evaluation work/attendance at CCPR (CODEX) and participating in JMPR and CCPR discussions of a technical nature on general considerations for risk assessment.

Further advances in risk assessment methodology will be taken into account in developing the approach to risk assessments in the future.

Risk assessment - dietary intake assessments

The screening assessment uses the internationally agreed approach to long term (chronic) and short term (acute) consumer exposure assessment with UK food consumption data as detailed within the UK NEDI and NESTI models which are available on the HSE website.

Screening assessments have been done for all pesticides to check that predicted intakes are within the relevant health based reference values. A short term (acute) exposure assessment is not done for pesticides which are not acutely toxic where it has been established that an ARfD is not required. EU toxicological endpoints can be found in the EU Pesticides database.

Toxicological reference values set by the JMPR (The Joint FAO and WHO Meeting on Pesticide Residues) can be found in individual pesticide evaluations at JMPR Evaluations (an up to date index to pesticide evaluations is available in the latest report).

The screening assessment uses the internationally agreed approach to long term (chronic) and short term (acute) consumer exposure assessment with UK food consumption data as detailed within the UK NEDI and NESTI models which are available on the HSE website.

For the Q1 2023 assessments, the following approaches have been taken to refine these assessments according to case by case issues and to ensure that appropriate consumption values are used for less frequently consumed commodities where available food consumption data may be limited:

- data on dried beans (pulses) were used for all types of dried beans, including speciality dried beans
- data on beans with pods were used for all forms of green beans, including speciality beans
- data on fish were used for all forms of oily fish
- data on liver were used for samples of bovine liver
- data on peas with pods were used despite a low number of consumers in several of the sub groups. However, use of these consumption data was considered reasonable after comparison with alternative data
- data on mandarin were used for all forms of soft citrus

Short term dietary risk assessment – single substance assessments where exceedance of the ARfD has been identified during screening

Beans (dried)

Crop	Pesticide	Highest residue (mg per kg)	Adult intake (mg per kg bw per day)	Critical group intake (mg per kg bw per day)	ARfD (mg per kg bw)	Source
Black eye beans	Chlorpyrifos	0.007	0.000039	• 0.00013 infants • 0.000087 toddlers • 0.000081 4 to 6 year olds • 0.000058 7 to10 year olds • 0.000052 11 to 14 year olds • 0.000046 15 to 18 year olds • 0.000044 vegetarians • 0.000039 adults • 0.000023 elderly (own home) • 0.000021 elderly (residential)	No toxicological reference values established	EU, 2019

Comment on risk assessment

EFSA (2019)[6] has indicated that no toxicological reference values could be determined for chlorpyrifos, due to concerns over genotoxicity. Additionally, EFSA raised concerns over neurological effects in the developing foetus and young child. Chlorpyrifos is not approved in the EU and UK, and pesticide products containing chlorpyrifos were withdrawn in 2020.

HSE considers that for short term risk assessment, an indicative toxicological reference value of 0.0003 mg per kg bw can be used based on the LOAEL set by EFSA for a developmental neurotoxicity study and applying a safety factor of 1,000 to account for the severe nature of the findings (effects on brain measurements in a developmental neurotoxicity study). Toxicologists usually

[6] Chlorpyrifos: assessment identifies human health effects | EFSA (europa.eu)

use safety factors of between 100 and a 1,000 when a NOAEL cannot be determined within a study. The HSE proposed indicative toxicological reference value is conservative as it uses the highest uncertainty factor applied by toxicologists and is based on a LOAEL from a study with repeated dosing. Overall, the HSE approach is considered precautionary in protecting the nervous system in the developing foetus and child.

None of the intakes exceeded the HSE proposed indicative toxicological reference value for short term assessment. Based on the low intakes, HSE concludes that a short term effect on health is not expected.

Please refer to the section below on 'Substances that might be genotoxic' for HSE's conclusions regarding potential genotoxicity.

Beans (dried)

Crop	Pesticide	Highest residue (mg per kg)	Adult intake (mg per kg bw per day)	Critical group intake (mg per kg bw per day)	ARfD (mg per kg bw)	Source
Black eye beans	Dimethoate	0.008	0.000044	• 0.00015 infants • 0.000099 toddlers • 0.000093 4 to 6 year olds • 0.000066 7 to 10 year olds • 0.000060 11 to 14 year olds • 0.000053 15 to 18 year olds • 0.000050 vegetarians • 0.000044 adults • 0.000026 elderly (own home) • 0.000024 elderly (residential)	Not established	EU, 2019

Comment on risk assessment

The EFSA Conclusion (2018) for dimethoate has indicated that no toxicological reference values could be determined for dimethoate, due to a lack of a fully supporting toxicological database. Dimethoate is not approved in the UK and pesticide products containing dimethoate were withdrawn in the EU and UK in 2020.

For dimethoate, EFSA (2018) stated an indicative value for a hypothetical toxicological reference value for short term exposure of 0.0001 mg per kg bw per day. Using this indicative value, the estimated dietary intake of dimethoate for the critical consumer group infants exceed this reference value.

If infants ate large portions of black eye beans (dried beans) containing dimethoate at 0.008 mg per kg their intake could be 146% of the above mentioned hypothetical toxicological reference value for short term exposure. This indicative toxicological reference value is a precautionary value intended to protect the nervous system in the developing foetus and child, which has been set well below intakes which caused no observed effects in animal studies.

The JMPR established an ARfD for dimethoate of 0.02 mg per kg bw per day in 2019; this supports the view that the proposed hypothetical reference value from the EFSA Conclusion is precautionary.

The estimated exposures are low and not expected to inhibit acetylcholinesterase[7], the basis of previous evaluations of the safety of dimethoate. Based on this assessment, HSE concludes that a short term effect on health is unlikely after eating large portions (97.5th percentile consumption) of black eye beans (dried beans) containing the levels found in this report.

Please refer to the section below on 'Substances that might be genotoxic' for HSE's conclusions regarding potential genotoxicity.

Beans with pods GB

Crop	Pesticide	Highest residue (mg per kg)	Adult intake (mg per kg bw per day)	Critical group intake (mg per kg bw per day)	ARfD (mg per kg bw)	Source
Beans with pods (Valore beans)	Dimethoate and Omethoate	0.9 (D: dimethoate) and 0.2 (O: omethoate)	D: 0.0021	D: • 0.0045 (infant) • 0.0045 (toddler) • 0.0034 (4 to 6 year old child) • 0.0025 (vegetarian)	Not established	EU, 2019

[7] this enzyme, acetylcholinesterase, is included in the Glossary on page 104

Crop	Pesticide	Highest residue (mg per kg)	Adult intake (mg per kg bw per day)	Critical group intake (mg per kg bw per day)	ARfD (mg per kg bw)	Source
				• 0.0025 (15 to 18 year old child) • 0.0021 (adult) • 0.0020 (elderly own home) • 0.0018 (7 to 10 year old child) • 0.0018 (11 to 14 year old child) • 0.00098 (elderly residential home)		
			O: 0.00046	O: • 0.0010 (infant) • 0.0010 (toddler) • 0.00075 (4 to 6 year old child) • 0.00056 (vegetarian) • 0.00055 (15 to 18 year old child) • 0.00046 (adult) • 0.00043 (elderly own home) • 0.00043 (7 to 10 year old child) • 0.00039 (11 to 14 year old child) • 0.00022 (elderly residential home)	Not established	EFSA, 2018 and EU, 2019 (dimethoate)

Comment on risk assessment

The EFSA Conclusion (2018) for dimethoate has indicated that no toxicological reference values could be determined for dimethoate and its metabolite omethoate, due to a lack of a fully supporting toxicological database. Both dimethoate and omethoate are not approved in the UK and pesticide products containing dimethoate were withdrawn in the EU and UK in 2020.

For dimethoate, EFSA (2018) stated an indicative value for a hypothetical toxicological reference value for short term exposure of 0.0001 mg per kg bw per day. Using this indicative value, all the estimated dietary intakes for the consumer subgroups exceed this reference value. The highest intake was for infants and toddlers.

If infants and toddlers ate large portions of beans with pods containing dimethoate at 0.9 mg per kg their intake could be 4,000% of the above mentioned hypothetical toxicological reference value for short term exposure. If infants and toddlers ate large portions of beans with pods containing omethoate at 0.2 mg per kg their intake could be 1,000% of this hypothetical toxicological reference value for dimethoate. This indicative toxicological reference value is a precautionary value intended to protect the nervous system in the developing foetus and child, which has been set well below intakes which caused no observed effects in animal studies.

The JMPR established an ARfD for dimethoate of 0.02 mg per kg bw per day in 2019 and established an ARfD for omethoate of 0.002 mg per kg bw per day in 2022; this supports the view that the proposed hypothetical reference value from the EFSA Conclusion is precautionary.

These exposures are undesirable but it is not clear if they may cause any adverse effect. Both the JMPR, EFSA (2018) and the previous EU evaluations observe that omethoate is more potent than dimethoate. Despite this, the estimated exposures are unlikely to inhibit acetylcholinesterase, the basis of previous evaluations of the safety of dimethoate and omethoate.

Based on this assessment, HSE concludes that a short term effect on health is unlikely after eating large portions (97.5th percentile consumption) of beans with pods containing the levels found in this report.

Please refer to the section below on ‘Substances that might be genotoxic’ for HSE’s conclusions regarding potential genotoxicity.

Oranges GB

In this table, ‘critical group intake’ means the highest intake of all 10 consumer groups, or intakes for all consumer groups that exceed the ARfD.

Crop	Pesticide	Highest residue (mg per kg)	Adult intake (mg per kg bw per day)	Critical group intake (mg per kg bw per day)	ARfD (mg per kg bw)	Source
Oranges	lambda-cyhalothrin	0.1	0.0023	• 0.013 infants • 0.0099 toddlers • 0.0072 4 to 6 year olds	0.005	EU, 2016

Comment on risk assessment

Residues of lambda-cyhalothrin are indistinguishable analytically from gamma-cyhalothrin. Based on the pesticide uses on citrus, we expect that the residues in these Egyptian oranges comes from use of lambda-cyhalothrin (the least toxic form), so the risk assessment has been undertaken using the ARfD for lambda-cyhalothrin (which is two-fold higher than the ARfD for gamma-cyhalothrin).

Oranges flesh after peeling

The dietary intakes calculated based on the peel being removed before consumption indicate that there are no exceedances of the ARfD. In this case, an effect on health is not expected. This is in line with the risk assessment performed when the MRL was established.

The risk assessment only applies if all of the peel is consumed. This is because it has been reported that only 25% of the residue of cyhalothrin remains (EFSA, 2015) in the flesh when the fruit is peeled.

Whole orange, including all the peel

We consider that an effect on health would be unlikely. Any effect on health would depend on a number of factors which would need to come together at the same time (the high residue found in the sample being consumed by the most critical consumer, a particularly high residue in an individual fruit, peak consumption levels (97.5th percentile), and a large proportion of peel from the fruit being consumed).

The intakes for infants, toddlers and 4 to 6 year olds exceeded the ARfD. The highest intake was for infants (0.013 mg per kg bw per day). These initial assessments are based on consumption data which include all forms of the commodity being considered. Orange juice is a significant portion of the total amount of orange consumed. In this case, lambda-cyhalothrin residues are mainly on the peel, peel is not included in juice, and residues of lambda-cyhalothrin have not been found in orange juice from 320 samples (2006, 2009, 2012, 2015 and 2020 surveys). Therefore, the intakes shown here will overestimate representative exposures.

When excluding the dietary contribution of orange juice, toddlers become the critical group and their intake could be 0.0077 mg per kg bw per day, 154% of the ARfD. This intake is 65 times lower than a dose which caused no observed adverse effect in a 1 year oral toxicity study in dogs with lambda-cyhalothrin. The European Food Safety Authority used this study as the basis of the ARfD. Toxicologists usually apply a factor of 100 to this dose to take into account uncertainties caused by using animal data and possible differences in susceptibility between people. We consider the reduced factor of 65 still sufficient to make an effect on health unlikely.

However, if the peel is not consumed then the risk assessment on which the MRL is based applies (see the assessment above under ‘orange flesh after peeling’). Then intakes in all groups are within the ARfD and an effect on health is not expected.

Oranges GB

In this table, ‘critical group intake’ means the highest intake of all 10 consumer groups, or intakes for all consumer groups that exceed the ARfD

Crop	Pesticide	Highest residue (mg per kg)	Adult intake (mg per kg bw per day)	Critical group intake (mg per kg bw per day)	ARfD (mg per kg bw)	Source
Oranges	Cypermethrin (alpha-cypermethrin)	0.03	0.00068	• 0.0040 infants • 0.0030 toddlers • 0.0022 4 to 6 year olds • 0.0015 7 to 10 year olds	0.00125	EU, 2019

Comment on risk assessment

Cypermethrin is an insecticide which is available in different isomeric forms. The analytical data (chromatograms) supports the understanding that the residue found most likely comes from use of a specific isomer of cypermethrin rather than cypermethrin (mix of isomers). We understand that alpha-cypermethrin is used on citrus crops in Egypt where the oranges were grown, so we have conducted the assessment based on alpha-cypermethrin, which is the more toxic form.

Oranges flesh after peeling

The dietary intakes calculated based on the peel being removed before consumption indicate that there are no exceedances of the ARfD. In this case, an effect on health is not expected. This is in line with the risk assessment performed when the MRL was established.

The below risk assessment only applies if all of the peel is consumed. This is because it has been reported that only up to 12.5% of the residue of cypermethrin remains (EFSA, 2023) in the flesh when the fruit is peeled.

Whole orange, including all the peel

We consider that an effect on health would be unlikely. Any effect on health would depend on a number of factors which would need to come together at the same time (the residue found in the sample being consumed by the most critical consumer, a particularly high residue in an individual fruit, peak consumption levels (97.5th percentile), and a large proportion of peel from the fruit being consumed).

The intakes for infants, toddlers, 4 to 6 year old children and 7 to 10 year old children exceeded the ARfD. The highest intake was for infants (0.0040 mg per kg bw per day). These initial assessments are based on consumption data which include all forms of the commodity being considered. Orange juice is a significant portion of the total amount of orange consumed. In this case, cypermethrin residues are mainly on the peel, peel is not included in juice, and residues of cypermethrin have not been found in orange juice from 320 samples (2006, 2009, 2012, 2015 and 2020 surveys). Therefore, the intakes shown here will overestimate representative exposures.

When excluding the dietary contribution of orange juice, toddlers become the critical group and their intake could be 0.0023 mg per kg bw per day, 184% of the ARfD. This intake is 109 times lower than a dose which caused minor adverse effects in a developmental neurotoxicity study in rats. The European Food Safety Authority used this study as the basis of the ARfD. Toxicologists usually apply a factor of 100 to this dose to take into account uncertainties caused by using animal data and possible differences in susceptibility between people. The factor used for alpha-cypermethrin was two fold greater (200) to account for the absence of a dose level in the study where no adverse effects were seen. Based on this assessment, we consider the reduced factor of 109 still sufficient to make an effect on health unlikely.

This estimate assumes that peel of oranges is consumed. However, if the peel is not consumed then the risk assessment on which the MRL is based applies. Then intakes in all groups are within the ARfD and an effect on health is not expected.

Oranges GB

In this table, ‘critical group intake’ means the highest intake of all 10 consumer groups, or intakes for all consumer groups that exceed the ARfD

Crop	Pesticide	Highest residue (mg per kg)	Adult intake (mg per kg bw per day)	Critical group intake (mg per kg bw per day)	ARfD (mg per kg bw)	Source
Oranges	Imazalil	3	0.068	0.40 (infants) 0.30 (toddlers) 0.22 (4 to 6 year olds) 0.15 (7 to 10 year olds) 0.11 (11 to 14 year olds) 0.092 (15 to 18 year olds) 0.077 (vegetarians) 0.068 (adults)	0.1 (General population) 0.05 (Pregnant and nursing female)	EFSA, 2007

Comment on risk assessment

Oranges flesh after peeling

The dietary intakes calculated based on the peel being removed before consumption indicate that there are no exceedances of the ARfD. In this case, an effect on health is not expected. This is in line with the risk assessment performed when the MRL was established.

The below risk assessment only applies if all of the peel is consumed. This is because it has been reported that only 7% of the residue of imazalil remains (EFSA, 2017) in the flesh when the fruit is peeled.

Whole orange, including all the peel

We consider that an effect on health would be unlikely. Any effect on health would depend on a number of factors which would need to come together at the same time (the high residue found in the sample being consumed by the most critical consumer, a particularly high residue in an individual fruit, peak consumption levels (97.5th percentile), and a large proportion of peel from the fruit being consumed).We are presenting the following risk assessment which assumes all of the peel is consumed. However, the PRiF considers this to be a ‘worst case’ form of assessment for the reasons explained above.

Pregnant and nursing women

The intakes for 11 to 14 year old children, 15 to 18 year old children, vegetarians and adults exceed the acute reference dose of 0.05 mg per kg bw per day (for pregnant and nursing females). The highest intake was for 11 to 14 year old children.

If 11 to 14 year old children ate large portions of oranges containing imazalil at 3.0 mg per kg their intake could be 218% of the Acute Reference Dose of 0.05 mg per kg bw per day. This intake is 46 times lower than a dose which caused no observed

adverse effects in a 13 day repeat dose rabbit developmental study (the ARfD is based on a NOAEL of 5 mg per kg bw per day for fetal toxicity (increased resorptions). The European Food Safety Authority used this study as the basis of the ARfD.

Toxicologists usually apply a factor of 100 to this dose to take into account the uncertainties caused by using animal data and possible differences in susceptibility between people. The remaining margin of 46 is considered to still be sufficient to account for the uncertainties associated with the use of animal data and possible differences in susceptibility between people. It is not possible because of the way data were reported, to attribute effects at higher doses to single or multiple treatments. Therefore, the ARfD is suitably protective when considering single day exposures and might be overprotective. Based on this assessment an effect on health is unlikely.

General population

The intakes for infants, toddlers, 4 to 6 year old children, 7 to 10 year old children and 11 to 14 year old children exceed the acute reference dose of 0.1 mg per kg bw per day (for the general population excluding pregnant and nursing females). The highest intake was for infants.

If infants ate large portions of oranges containing imazalil at 3.0 mg per kg their intake could be 398% of the Acute Reference Dose of 0.1 mg per kg bw per day. This intake is 25 times lower than a dose which caused no observed adverse effects in a rabbit developmental study, used as the basis of the ARfD (the ARfD is based on a NOAEL of 10 mg per kg bw per day for reduced bodyweight gain and food consumption in dams). The European Food Safety Authority used this study as the basis of the ARfD.

Toxicologists usually apply a factor of 100 to this dose to take into account uncertainties caused by using animal data and possible differences in susceptibility between people. We consider this significant reduction in the factor of 100 to a level of 25 undesirable. However, the remaining margin is considered to still be sufficient to allow for the uncertainties associated with the use of animal data and possible differences in susceptibility between people. Also, it is noted that an ARfD based on maternal toxicity in a developmental study with repeated dosing (13 days) might be over-protective for the general population. Based on this assessment, we consider the reduced factor of 25 still sufficient to make an effect on health unlikely.

This risk assessment assumes that peel of oranges is consumed. However, if the peel is not consumed then the risk assessment on which the MRL is based applies. Then intakes in all groups are within the ARfD and an effect on health is not expected.

Oranges GB

In this table, ‘critical group intake’ means the highest intake of all 10 consumer groups, or intakes for all consumer groups that exceed the ARfD

Crop	Pesticide	Highest residue (mg per kg)	Adult intake (mg per kg bw per day)	Critical group intake (mg per kg bw per day)	ARfD (mg per kg bw)	Source
Oranges	Thiabendazole	1.4	0.032	• 0.19 infants • 0.14 toddlers	0.1	EU, 2017

Comment on risk assessment

Oranges flesh after peeling

The dietary intakes calculated based on the peel being removed before consumption indicate that there are no exceedances of the ARfD. In this case, an effect on health is not expected. This is in line with the risk assessment performed when the MRL was established.

The below risk assessment only applies if all of the peel is consumed. This is because it has been reported that only 4.7% of the residue of thiabendazole remains (EFSA, 2021) in the flesh when the fruit is peeled.

Whole orange, including all the peel

We consider that an effect on health would be unlikely. Any effect on health would depend on a number of factors which would need to come together at the same time (the high residue found in the sample being consumed by the most critical consumer, a particularly high residue in an individual fruit, peak consumption levels (97.5th percentile), and a large proportion of peel from the fruit being consumed).

We are presenting the following risk assessment which assumes all of the peel is consumed. However, the PRiF considers this to be a ‘worst case’ form of assessment for the reasons explained above.

The intakes for infants and toddlers exceeded the ARfD. The highest intake was for infants.

If infants ate large portions of oranges containing thiabendazole at 1.4 mg per kg, their intake of thiabendazole could be 186% of the Acute Reference Dose. This intake is 53 times lower than a dose which caused no observed adverse effect in a developmental study in rats over 11 days. The European Food Safety Authority used this study as the basis of the ARfD.

Toxicologists usually apply a factor of 100 to this dose to take into account uncertainties caused by using animal data and possible differences in susceptibility between people. We consider the reduced factor of 53 still sufficient to make an effect on health unlikely.

This estimate assumes that peel of oranges is consumed. However, if the peel is not consumed then the risk assessment on which the MRL is based applies. Then intakes in all groups are within the ARfD and an effect on health is not expected.

Pineapple GB

In this table, 'critical group intake' means the highest intake of all 10 consumer groups, or intakes for all consumer groups that exceed the ARfD.

Crop	Pesticide	Highest residue (mg per kg)	Adult intake (mg per kg bw per day)	Critical group intake (mg per kg bw per day)	ARfD (mg per kg bw)	Source
Pineapple	Ethephon	0.5	0.011	0.051 4 to 6 year olds	0.05	EU, 2008

Comment on risk assessment

Pineapple flesh after peeling

The dietary intakes calculated based on the peel being removed before consumption indicate that there are no exceedances of the ARfD. In this case, an effect on health is not expected. This is in line with the risk assessment performed when the MRL was established.

The below risk assessment only applies if all of the peel is consumed. This is because it has been reported that only 29% of the residue of ethephon remains (JMPR, 2015) in the flesh when the fruit is peeled.

Whole pineapple, including all the peel

We consider that an effect on health would be unlikely. Any effect on health would depend on a number of factors which would need to come together at the same time (the high residue found in the sample being consumed by the most critical consumer, a particularly high residue in an individual fruit, peak consumption levels (97.5th percentile), and a large proportion of peel from the fruit being consumed).

We are presenting the following risk assessment which assumes all of the peel is consumed. However, the PRiF considers this to be a 'worst case' form of assessment for the reasons explained above.

The intakes for 4 to 6 year old children exceeded the ARfD. If 4 to 6 year old children ate or drank large portions of pineapple containing ethephon at 0.5 mg per kg, their intake of ethephon could be 101% of the Acute Reference Dose. This intake is 118 times lower than a dose which caused no observed adverse effect in a 28 day oral dog study. The European Food Safety Authority used this study as the basis of the ARfD.

Toxicologists usually apply a factor of 100 to this dose to take into account uncertainties caused by using animal data and possible differences in susceptibility between people. However, in this case the factor was larger (120) to ensure consistency with the findings of human volunteer studies. We consider the reduced factor of 118 (from 120) still sufficient to make an effect on health unlikely. More detail on the factors applied can be found in Implications for health.

This estimate assumes that peel of pineapple is consumed. However, if the peel is not consumed then the risk assessment on which the MRL is based applies. Then intakes in all groups are within the ARfD and an effect on health is not expected.

Rice GB

Crop	Pesticide	Highest residue (mg per kg)	Adult intake (mg per kg bw per day)	Critical group intake (mg per kg bw per day)	ARfD (mg per kg bw)	Source
Rice	Ethylene oxide (2-chloroethanol, expressed as ethylene oxide)	0.01	0.000061	• 0.00013 toddlers • 0.00011 7 to 10 year olds • 0.00011 4 to 6 year olds • 0.000085 15 to 18 year olds • 0.000082 11 to 14 year olds • 0.000075 vegetarians • 0.000061 adults • 0.00005 infants • 0.000039 elderly (own home) • 0.000018 elderly (residential)	No toxicological reference values established	

Comment on risk assessment

The residue definition includes both ethylene oxide and its metabolite 2-chloroethanol. The definition for MRLs and monitoring comprises: sum of ethylene oxide and 2-chloroethanol, expressed as ethylene oxide. The residue determined in the rice samples was in the form of 2-chloroethanol, which is expected since the conversion of ethylene oxide to 2-chloroethanol is rapid. The residue found is at a level of 0.0264 mg per kg 2-chloroethanol, which is equivalent to 0.01 mg per kg ethylene oxide (expression of the residue in terms of ethylene oxide following molecular weight adjustment). The level of 0.01 mg per kg ethylene oxide is below the level of the MRL (0.02* mg per kg).

The use of ethylene oxide in food production is not permitted in the UK as the substance can have mutagenic and carcinogenic effects (can cause genetic damage and can potentially lead to cancer). The evidence for 2-chloroethanol being mutagenic and carcinogenic is more uncertain than the data for ethylene oxide; however HSE's assessment has taken the precautionary approach in assuming that, in the absence of further data, the residues of 2-chloroethanol should be regarded as potentially genotoxic (cause genetic damage) and carcinogenic.

There are no formal toxicological reference values (TRVs) set for ethylene oxide or 2-chloroethanol, no ARfD, and no relevant data on which to propose TRVs. Therefore, an acute exposure risk assessment cannot be performed. Concern following exposure to ethylene oxide and its metabolite 2-chloroethanol, even on a single day exposure, is due to its potential for genotoxicity and carcinogenicity. This is further discussed below in the sections on 'Long-term dietary risk assessments needed following screening assessment of samples' and 'Substances that might be genotoxic'.

Soft citrus GB

In this table, 'critical group intake' means the highest intake of all 10 consumer groups, or intakes for all consumer groups that exceed the ARfD

Crop	Pesticide	Highest residue (mg per kg)	Adult intake (mg per kg bw per day)	Critical group intake (mg per kg bw per day)	ARfD (mg per kg bw)	Source
Soft citrus	Imazalil	2	0.022	0.11 toddlers	0.1 (General population) 0.05 (Pregnant and nursing female)	EFSA, 2007

Comment on risk assessment

Soft citrus flesh after peeling

The dietary intakes calculated based on the peel being removed before consumption indicate that there are no exceedances of the ARfD. In this case, an effect on health is not expected. This is in line with the risk assessment performed when the MRL was established.

The below risk assessment only applies if all of the peel is consumed. This is because it has been reported that only 7% of the residue of imazalil remains (EFSA, 2017) in the flesh when the fruit is peeled.

Whole soft citrus, including all the peel

We consider that an effect on health would be unlikely. Any effect on health would depend on a number of factors which would need to come together at the same time (the high residue found in the sample being consumed by the most critical consumer, a

particularly high residue in an individual fruit, peak consumption levels (97.5th percentile), and a large proportion of peel from the fruit being consumed).

We are presenting the following risk assessment which assumes all of the peel is consumed. However, the PRiF considers this to be a ‘worst case’ form of assessment for the reasons explained above.

Pregnant and nursing women

The intakes for 11 to 14 year old children, 15 to 18 year old children, adults and vegetarians are all below the ARfD of 0.05 mg per kg bw per day for pregnant and nursing females, and an effect on health is not expected.

General population

The intakes for toddlers exceeded the acute reference dose of 0.1 mg per kg bw per day (for the general population excluding pregnant and nursing females).

If toddlers ate or drank large portions of soft citrus containing imazalil at 2 mg per kg, their intake of imazalil could be 111% of the Acute Reference Dose of 0.1 mg per kg bw per day (for the general population excluding pregnant and nursing women). This intake is 91 times lower than a dose which caused no observed adverse effects in a rabbit developmental study. The European Food Safety Authority used this study as the basis of the ARfD.

Toxicologists usually apply a factor of 100 to this dose to take into account uncertainties caused by using animal data and possible differences in susceptibility between people. Also, it is noted that an ARfD based on maternal toxicity in a developmental study with repeated dosing (13 days) might be over-protective for the general population. Based on this assessment, we consider the reduced factor of 91 still sufficient to make an effect on health unlikely.

This risk assessment assumes that peel of soft citrus is consumed. However, if the peel is not consumed then the risk assessment on which the MRL is based applies. Then intakes in all groups are within the ARfD and an effect on health is not expected.

Soft citrus GB

In this table, ‘critical group intake’ means the highest intake of all 10 consumer groups, or intakes for all consumer groups that exceed the ARfD.

Crop	Pesticide	Highest residue (mg per kg)	Adult intake (mg per kg bw per day)	Critical group intake (mg per kg bw per day)	ARfD (mg per kg bw)	Source
Soft citrus	Thiabendazole	2.5	0.028	0.14 toddlers	0.1	EU, 2017

Comment on risk assessment

Soft citrus flesh after peeling

The dietary intakes calculated based on the peel being removed before consumption indicate that there are no exceedances of the ARfD. In this case, an effect on health is not expected. This is in line with the risk assessment performed when the MRL was established.

The below risk assessment only applies if all of the peel is consumed. This is because it has been reported that only 4.7% of the residue of thiabendazole remains (EFSA, 2021) in the flesh when the fruit is peeled.

Whole soft citrus, including all the peel

We consider that an effect on health would be unlikely. Any effect on health would depend on a number of factors which would need to come together at the same time (the high residue found in the sample being consumed by the most critical consumer, a particularly high residue in an individual fruit, peak consumption levels (97.5th percentile), and a large proportion of peel from the fruit being consumed).

We are presenting the following risk assessment which assumes all of the peel is consumed. However, the PRiF considers this to be a ‘worst case’ form of assessment for the reasons explained above.

The intakes for toddlers exceeded the ARfD. If toddlers ate large portions of soft citrus containing thiabendazole at 2.5 mg per kg, their intake of thiabendazole could be 139% of the Acute Reference Dose. This intake is 71 times lower than a dose which caused no observed adverse effect in a developmental study in rats over 11 days. The European Food Safety Authority used this study as the basis of the ARfD.

Toxicologists usually apply a factor of 100 to this dose to take into account uncertainties caused by using animal data and possible differences in susceptibility between people. We consider the reduced factor of 71 still sufficient to make an effect on health unlikely.

This estimate assumes that peel of soft citrus is consumed. However, if the peel is not consumed then the risk assessment on which the MRL is based applies. Then intakes in all groups are within the ARfD and an effect on health is not expected.

Short-term dietary risk assessment – multiple assessments needed following screening assessment of samples

Samples which contain more than one pesticide from the groups we consider, and where a more detailed assessment was needed following screening:

- triazoles
- organophosphates and, or carbamates
- captan and folpet
- BAC and DDAC
- chlormequat and mepiquat

Beans (dried) – values represent the critical consumer group of infants for a sample containing this combination of active ingredients.

Pesticide	Residue (mg per kg)	Intake (mg per kg bw)	Intake (%ARfD)	ARfD	Source
Chlorpyrifos	0.007	0.00013	Not applicable	Not established	EU, 2019
Dimethoate	0.008	0.00015	Not applicable	Not established	EU, 2019

The total (sum of the dietary intakes of each pesticide taken together in that commodity (when expressed as a percentage of its own reference value)) could not be calculated in this screening assessment.

Comment on combined risk assessment:

The estimated highest intake of dimethoate represents around 146% of the hypothetical toxicological reference value for short term exposure of 0.0001 mg per kg bw per day proposed by EFSA (see explanation above of this indicative value in the single substance assessment for beans with pods - dimethoate and omethoate above). This indicative toxicological reference value is a precautionary value intended to protect the nervous system in the developing foetus and child, which has been set well below intakes which caused no observed effects, including the inhibition of acetyl cholinesterase (AChE), in animal studies.

Chlorpyrifos can also affect AChE and this was the basis for the previous ARfD of 0.005 mg per kg bw (EU, 2015). The proposed indicative TRV for short term assessment was based on reported changes in brain measurements in a developmental neurotoxicity study which were not seen in an equivalent study with dimethoate. The relationship between the reported changes in brain morphometry and AChE inhibition is unclear. Whilst we know that the known effect from exposure to each of dimethoate and chlorpyrifos is inhibition of AChE, the reported change in brain morphometry appears only to have been an effect relating to chlorpyrifos for this group of combined residues. We expect this to be the case for the dietary intake arising from the residue levels in this sample. The estimated highest intake of chlorpyrifos represents around 3% of the previous ARfD based on AChE inhibition (EU, 2015). Overall HSE considers the presence of chlorpyrifos in the sample does not significantly contribute to the

combined risk of an effect on acetyl cholinesterase when compared to that identified for dimethoate in the above single substance risk assessment.

At the levels found, these pesticides together will be unlikely to inhibit acetyl cholinesterase, the known effect from exposure to each of these residues.

HSE concludes that a short term effect on health for the combined residues of dimethoate and chlorpyrifos in this sample of dried beans (black eye beans) is unlikely.

Please refer to the section 'Substances that might be genotoxic' for HSE's conclusions regarding potential genotoxicity.

Beans with pods – values represent the critical consumer group of infants for a sample containing this combination of active ingredients.

Pesticide	Residue (mg per kg)	Intake (mg per kg bw)	Intake (%ARfD)	ARfD	Source
Omethoate	0.008	0.000040	Not applicable	Not established	EU, 2019 (dimethoate)
Profenofos	0.04	0.00020	0.020	1	JMPR, 2007

The total (sum of the dietary intakes of each pesticide taken together in that commodity (when expressed as a percentage of its own reference value)) could not be calculated in this screening assessment.

Comment on combined risk assessment:

These highest calculated dietary intakes are low. The estimated highest intake of profenofos represents less than 1% of the above noted ARfD (JMPR, 2007). The estimated highest intake of omethoate represents around 40% of the hypothetical toxicological reference value for short term exposure of 0.0001 mg per kg bw per day for dimethoate (see explanation above of this indicative value in the single substance assessment for beans with pods - dimethoate and omethoate above). At these low levels, these pesticides together will be unlikely to inhibit acetyl cholinesterase, the known effect from exposure to each of these residues. Overall, HSE concludes that, when taking into account the known effect that each of omethoate and profenofos can have on acetyl cholinesterase, the presence of these pesticides in the same sample is unlikely to inhibit acetyl cholinesterase. HSE concludes that a short term effect on health for the combined residues of omethoate and profenofos in this sample of beans with pods (Guar beans) is unlikely.

Please refer to the section 'Substances that might be genotoxic' for HSE's conclusions regarding potential genotoxicity.

Pineapple – values represent the critical consumer group of 4 to 6 year olds for a sample containing this combination of active ingredients.

Pesticide	Residue (mg per kg)	Intake (mg per kg bw)	Intake (%ARfD)	ARfD	Source
Diazinon	0.01	0.0010	4.0	0.025	EFSA, 2006
Ethephon	0.5	0.051	101.2	0.05	EU, 2008

The total of 105.2% (sum of the dietary intakes of each pesticide taken together in that commodity (when expressed as a percentage of its own reference value)) exceeds 100 in this screening assessment.

Comment on combined risk assessment:

The presence of diazinon in the sample does not significantly contribute to the overall combined intake when compared to ethephon alone. The overall risk is not expected to be different to the individual risk assessment presented for ethephon in pineapple in the table above. HSE concludes that a short term effect on health for the combined residues of diazinon and ethephon in this sample of pineapples is not expected (if the peel is removed prior to consuming the fruit) or unlikely (if the peel is consumed with the fruit).

Long-term dietary risk assessments needed following screening assessment of samples

As noted in section 3 total long term dietary assessments across all commodities are not performed for these quarterly assessments. The issue is more fully considered in regulatory contexts pre-authorisation and at the time of MRL review. Then the issue is considered across all commodities (so more precautionary) by pesticide levels determined in GAP compliant trials, intended to address highest likely residues that might arise following pesticide use according to label recommendations.

However, for the PRiF quarterly assessments, HSE do perform a screening exercise for all of the residues found for an individual commodity to see if the long term intakes (commodity by commodity) show any indication of exceedance of the ADI. If an exceedance was observed then HSE would consider further and we would present a more detailed risk assessment.

In HSE's long-term exposure screening assessment for this report NI and GB samples were combined, where possible.

Aside from ethylene oxide (see below for the long term assessment for ethylene oxide), none of these individual commodity long term exposure screening assessments performed in this quarter (for each of the pesticides found in this report) indicated potential for adverse long term health effects. HSE assessed the dietary intakes to be below the ADI or other established long term health based reference value.

Ethylene oxide:

Typically long term dietary intake assessments only need to be performed (following the screening assessments) when a number of samples contain the pesticide to address the potential for exposure to these residues in the long-term.

In rice, there is only one sample containing a residue of ethylene oxide, at a low level of 0.01 mg per kg below the MRL of 0.02* mg per kg.

There are no formal toxicological reference values (TRVs) set for ethylene oxide or 2-chloroethanol, no ARfD, and no relevant data on which to propose TRVs. Therefore, an acute exposure risk assessment cannot be performed. Concern following exposure to ethylene oxide and its metabolite 2-chloroethanol, even on a single day exposure, is due to its potential for genotoxicity and carcinogenicity.

Therefore the below long term assessment has been performed based on the toxicity profile of ethylene oxide and considers the long term dietary intakes since it is not possible to present an acute dietary intake assessment.

The residue definition includes both ethylene oxide and its metabolite 2-chloroethanol. The definition for MRLs and monitoring comprises: sum of ethylene oxide and 2-chloroethanol, expressed as ethylene oxide. The residue determined in the rice sample was in the form of 2-chloroethanol, which is expected since the conversion of ethylene oxide to 2-chloroethanol is rapid. The residue found is at a level of 0.0264 mg per kg 2-chloroethanol, which is equivalent to 0.01 mg per kg ethylene oxide (expression of the residue in terms of ethylene oxide following molecular weight adjustment).

Long term dietary assessment usually considers a median residue level to seek to address residues that are more representative of long term exposures. Given the finding of 0.01 mg per kg ethylene oxide is in only one sample, HSE has taken an approach to conduct the long term dietary intake assessment using an estimated median residue level of 0.01 mg per kg of 2-chloroethanol (which is equivalent to 0.005 mg per kg ethylene oxide). This estimated median level is assumed to be at a level of half the reporting limit (RL) for analytical determination of 2-chloroethanol.

Rice GB

Crop	Pesticide	Estimated median residue (mg per kg)	Adult intake (mg per kg bw per day)	Critical group intake (mg per kg bw per day)	ARfD (mg per kg bw)	Source
Rice	Ethylene oxide (2-chloroethanol, expressed as ethylene oxide)	0.005	0.000011	• 0.000025 7 to 10 year olds • 0.000024 toddlers • 0.000020 11 to 14 year olds • 0.000019 4 to 6 year olds • 0.000014 infants • 0.000013 15 to 18 year olds • 0.000011 adults • 0.000010 vegetarians • 0.000006 elderly (own home) • 0.000002 elderly (residential)	No toxicological reference values established	Not applicable

For ethylene oxide, no formal long term toxicological reference values, such as an ADI or TDI have been established.

The use of ethylene oxide in food production is not permitted in the UK as the substance can have mutagenic and carcinogenic effects (can cause genetic damage and can potentially lead to cancer). The evidence for 2-chloroethanol being mutagenic and carcinogenic is more uncertain than the data for ethylene oxide; however HSE's assessment has taken the precautionary approach in assuming that, in the absence of further data, the residues of 2-chloroethanol should be regarded as potentially genotoxic (cause genetic damage) and carcinogenic.

Whilst there are no formal toxicological reference values set for ethylene oxide there are international approaches to consumer risk assessment and management that have been followed previously.

The BfR (German Regulatory Authority) in 2021 used a margin of exposure approach in proposing a preliminary risk assessment. The approach considers that where exposures are at least 10,000 x lower than a dose predicted to cause a 10% increase in tumour formation in experimental animals (the $BMDL_{10}$) they are unlikely to be of concern. This approach is endorsed by both the UK Committee on Carcinogenicity (2019[8]) and by EFSA (2005[3]). For ethylene oxide, BfR derived a $BMDL_{10}$ value of 0.37 mg per kg bw/d, and they applied this to risk assessments of both ethylene oxide and 2-chloroethanol as the genotoxic and carcinogenic potency of 2-chloroethanol was not expected to exceed that of ethylene oxide. Therefore, exposures of less than 0.037 µg per kg bw are not expected to raise concerns for carcinogenicity. The level is not a safety threshold, as the approach does not establish a level at which health effects would not be expected. In regard of long-term assessment, HSE derived that the highest intake (that for 7 to 10 year old children presented in the above table) is 14,800 x lower than the $BMDL_{10}$ for the formation of tumours, so the margin of exposure is more than 10,000. Therefore, HSE conclude on this basis that the residue finding is unlikely to be of concern. On a precautionary basis any findings of 2-chloroethanol in food are undesirable due to concerns regarding genotoxicity. Please refer to the section below on 'Substances that might be genotoxic' for HSE's conclusions regarding potential genotoxicity.

[8] Committee on Carcinogenicity - COC set of principles for consideration of risk due to less than lifetime exposure (2019) G09_Less_than_lifetime_exposure_Final.pdf (publishing.service.gov.uk) . The UK COC advised that for genotoxic substances that a BMDL (the benchmark dose- 95% lower bound confidence level) is the preferred point of departure (position on the dose-response curve) for risk assessment purposes. The $BMDL_{10}$ is defined as the dose that corresponds to a 10% change response compared to the (modelled) response in control animals.

[3] EFSA (2005): Opinion of the Scientific Committee on a request from EFSA related to A Harmonised Approach for Risk Assessment of Substances Which are both Genotoxic and Carcinogenic. The EFSA Journal (2005) 282, 1-31.

Substances that might be genotoxic (see explanation in the section on HSE's assessment of risk)

During regulatory assessment, careful consideration is given to any pesticides that may exhibit any potential to be genotoxic (able to damage genetic material) in live animals, so we need to consider the significance to the consumer when these residues are found. There are small number of examples of older pesticides that might be genotoxic, where modern data to investigate the true genotoxic potential is not expected to be made available. It is likely that these will only be found in imported foods. For many of these old pesticides, the toxicological reference doses are low and PRiF uses low reporting limits to ensure that these residues are found even at very low levels, as we know they are of particular interest to consumers. The evaluation of possible health implications for PRiF findings is complex as tests for genotoxicity are commonly performed at higher doses (orders of magnitude higher) than the dietary exposure levels that are assessed in PRiF reports. As such it is difficult to conclude specifically, and to extrapolate the findings in the laboratory to the context of findings in the PRiF monitoring and the presence of residues at low levels in foods. Where relevant some reassurance that any risks are likely to be small can be gained if increased cancer incidence, which may be due to gene mutations, does not occur in long-term animal feeding studies, designed to detect such observations. Where relevant we will indicate this. Due to the uncertainty about the potential for genetic damage (genotoxicity) at low doses, PRiF will always conclude that on a precautionary basis any findings of genotoxic substances in food are undesirable.

Assessment of genotoxicity (Q1 2023) and conclusions

Residues found in this report that have genotoxic potential (concluded from laboratory studies on animals): None

Residues found in this report where toxicological data are suggestive of genotoxicity but not certain: dimethoate, omethoate, 2-chloroethanol, and chlorpyrifos (please see below a recently updated position on the residues of dimethoate and its metabolite omethoate).

It is unclear whether these pesticides can damage genetic material (are genotoxic).

Regarding dimethoate, omethoate and chlorpyrifos, there is some evidence from studies performed in vitro and or in vivo[9] that they may be genotoxic. Whilst there are negative results in the available *in vivo* studies, the currently recommended follow up studies, that may clarify the genotoxic potential of these pesticides, have not been performed. There is some reassurance that risks of developing ill health effects following single or repeat exposures are likely to be low, since they did not cause cancer in cancer or other long-term studies with repeat daily doses in animals over their life-span. The doses used in these studies were orders of magnitude higher than the exposures estimated in this assessment. It is not known if lower doses which are not toxic also have this effect.

[9] in vivo, in vitro: see glossary

Regarding 2-chloroethanol, the ethylene oxide residue in this report (one sample of rice) was found as 2-chloroethanol. This is expected as conversion of ethylene oxide to 2-chloroethanol is rapid. As stated on page 85, the use of ethylene oxide in food production is not permitted in the UK as it is known to be mutagenic and carcinogenic. Although genotoxicity tests were conducted using 2-chloroethanol, the evidence of genotoxicity is more uncertain than the data for ethylene oxide. This is because of a less than fully satisfactory data set for 2-chloroethanol which has not been independently evaluated. HSE's assessment has taken the precautionary approach in assuming that, in the absence of further reliable data, the residue of 2-chloroethanol should be regarded as potentially genotoxic (cause genetic damage).

Update on previous positions on dimethoate and omethoate regarding genotoxicity:

It is unclear whether dimethoate can damage genetic material (is genotoxic) (EFSA, 2018). There is some evidence from studies performed *in vitro* that dimethoate may be genotoxic. The currently recommended *in vivo* follow up studies, that may clarify the genotoxic potential have not been performed. JMPR (2019) concluded on the basis of the available data that dimethoate was unlikely to be genotoxic.

Based on assessment by EFSA (2018), there is some evidence (in vitro and or in vivo[10]) that omethoate is genotoxic.

JMPR (2022) assessed newer more modern genotoxicity *in vitro* and *in vivo* test data for omethoate and reported that these new test results were negative for genotoxicity. JMPR noted that the previous positive results for genotoxicity were only seen at either high or severely cytotoxic concentrations and with no dose response. Based on all the available data, JMPR (2022) concluded that omethoate is unlikely to be genotoxic *in vivo* and unlikely to pose a carcinogenic risk to humans at levels occurring in the diet.

HSE's conclusions regarding the new information on dimethoate/omethoate: HSE notes the difference in approach taken by EFSA and JMPR to the assessment of the genotoxic potential of dimethoate and omethoate and the remaining uncertainties about these. HSE has not had the opportunity to evaluate the new genotoxicity data on omethoate and therefore considers it appropriate to conclude, taking a precautionary approach, that there is still a suggestion of possible genotoxicity associated with residues of dimethoate and its metabolite omethoate.

Conclusions: Overall, we conclude that on a precautionary basis any residue finding of these pesticides is undesirable due to the uncertainty regarding genotoxicity at low doses; however, we consider any risks of adverse health effects are low at the highest levels of exposure after eating large portions (97.5th percentile consumption) of the foods containing the levels of these pesticides found in this report.

[10] in vivo, in vitro: see glossary

Section 4: issues arising in this report and updates on previous reports

Issues arising in this report

Chlorate

We have been testing a limited number of foods for chlorate since 2016. The pesticide sodium chlorate is a residual broad action weed killer that is not authorised for use in the EU or UK. However, we are confident that the residues we are detecting come from use of chlorine-based disinfectants used to maintain microbiological safety (control microorganisms that cause food poisoning). Because these residues are unavoidable, and important for the maintaining of microbiological control vital for food safety, we are not treating these results as breaches of the MRL. **We are not advising that food companies change their existing practices as a result of our findings, but they should be aware about the ongoing discussion in this area**.

We are only part of the work going on across government and beyond to consider what to do about chlorate residues in food and water.

How chlorate MRLs take account of use of biocides

The footnote included in the chlorate MRLs takes into account chlorate residues incurred during the processing of food (from treated water or processing aids, such as biocides). The footnote exceptionally specifies that for considering compliance with chlorate MRLs, simple types of processing, such as packing, washing, chopping and freezing can be taken into account. Chlorate in irrigation water is taken into account in the MRLs as set and no further adjustment can be considered.

The responsibility for providing evidence showing that residues from processing can be taken into account, lies with the food business operator, and so we will be interested to see such evidence where appropriate. HSE will decide whether the footnote can be applied and if so this will be reflected in our reports.

The Food and Biocides Industry Group have produced more detailed information and guidance on this topic which is available on the Chilled Food Association's website.

Infant food

Infant food MRLs are set under separate legislation managed by UK health departments. The footnote that applies to other foods cannot be used for infant foods, although residues occur for the same reasons. UK health departments are working with HSE and FSA to resolve this.

Sanitisers

The presence of low-level residues of chlorate in food results from measures taken by the food and water industries to protect food safety by reducing microbiological contamination of food and drink (including drinking water, which is a significant source of chlorate in food). Chlorate itself is not used as a disinfectant, but chlorine-based sanitisers contain small amounts of chlorate. The Food Standards Agency has worked with industry who promote best practice and guidance for use of sanitisers.

Drinking water

In national legislation throughout the UK it is already a requirement to keep disinfection by-products as low as possible. This is usually achieved through management of disinfectant dosing and storage.

Advisory Committee on the Microbiological Safety of Food

Microbiological safety of food

The HSE is working with the Advisory Committee on the Microbiological Safety of Food to understand how changes to pesticide MRLs affect biocide use, microbiological food safety, and any change to the overall risk to consumers taking into account both chemical and microbiological safety.

Dietary intakes

Since 2018 the Committee on Toxicity of Chemicals in Food, Consumer Products and the Environment (COT) has been considering chlorate as part of its on-going work looking at the chemicals in the diet of infants and young children (up to 5 years). The European Food Safety Authority's 2015 opinion on chlorate[11] establishes appropriate health-based guidance values for chlorate exposure to protect against acute and chronic risks to health.

Fosetyl-Al (sum)

The full residue definition is "fosetyl-Al (sum of fosetyl, phosphonic acid and their salts, expressed as fosetyl)". Throughout this report that definition is reflected as fosetyl (sum) All the residues reported as fosetyl (sum) in this report were detected as phosphonic acid.

Fosetyl-Al breaks down to phosphonic acid, but phosphoric acid can also be a residue left by use of pesticides containing disodium phosphonate or potassium phosphonates. Additionally, products sold as fertilizers also can contain or break down to phosphonic acid. And finally, phosphonic acid also occurs naturally in the environment. The presence of phosphonic acid does not necessarily mean that a pesticide was used. Those producing food need to be aware that the use of products that contain phosphonic acid or break down to phosphonic acid may lead to produce which breaches the MRL.

DDT

The use of DDT is banned of heavily restricted in many countries. It is not allowed for use on food crops anymore, but it is still used in some countries outside the EU as a public health insecticide. Residues of DDT take a long time to break down in the environment and can accumulate in fatty tissue which is a major reason that it has been banned in the EU and many other countries.

Due to the bans and restrictions on use the levels in food have decreased substantially since the 1960s and 1970s. Even so, because it takes a long time to break down we do expect, and do see, occasional DDT residues in our monitoring results. Overall, the incidence and the size of residues have fallen steadily over time, which is what we would expect. In recent years none of our findings were unusual, unexpected or of concern. We can tell from the chemical form that we detect whether the residues we have found are from historic use

[11] EFSA Journal 2015;13(6):4135 [103 pp.]

(which is what we usually find). Historic use is indicated by the detection of DDE which is a break down product of DDT. We explain this every time we publish DDT results to try to make it as clear as we can that the results show food producers are not using DDT today. However, there are occasional media stories about DDT and various links and associations, which do not make this distinction.

The residues we find nowadays are at levels that would not be expected to have any effect on health, either in the short term or in the long term, when checked against today's understanding of the effect of DDT on health. As a committee, we take care to ensure we look thoroughly at this, and the Food Standards Agency is also actively involved in our considerations.

Follow-up from previous reports

Quarter 4 2021

Mushrooms (NI) deltamethrin

Sample: 0667/2021

This case has been referred to HSE Northern Ireland to Investigate. Once that investigation is concluded the details of that sample will be included here.

Quarter 4 2022

Apples (NI) pirimicarb

Sample: 5212/2022

This case has been referred to HSE Enforcement to investigate. Once that investigation is concluded the details of that sample will be included here.

The details of closed samples from previous quarterly reports will be included in the Quarter 1 2023 ODS.

In our next report:

In Quarter 2 of 2023 we will look at results for:

Samples collected

Great Britain

- Beans with pods
- Beans (dried)
- Bread (morning bakery)
- Bread (ordinary)
- Carrot
- Cauliflower
- Fish (oily)
- Grapes
- Kiwi fruit
- Lemons
- Liver (bovine)
- Milk
- Onions
- Oranges
- Pears
- Peas without pods
- Pineapples
- Potatoes
- Poultry meat
- Rice
- Rye flour
- Soft citrus

Northern Ireland

- Beans (dried)
- Beans with pods
- Carrot
- Cauliflower
- Fish (oily)
- Grapes
- Kiwi fruit
- Lemons
- Liver (bovine)
- Milk
- Onions
- Oranges
- Pears
- Peas without pods
- Pineapples
- Potatoes
- Poultry meat
- Rice
- Rye flour
- Soft citrus
- Spring onions

Sampling list for 2024

In 2024 we will look at results for:

Samples collected

Great Britain

- Aubergine
- Banana
- Beans (dried)
- Beans with pods
- Beef
- Beetroot
- Bread (ordinary)
- Bread (savoury)
- Broccoli
- Chilli peppers
- Eggs
- Fish (white)
- Garlic
- Ginger
- Grapefruit
- Grapes
- Honey
- Infant food (cereal based)
- Limes
- Melon
- Milk
- Mushrooms
- Olive oil
- Peppers (sweet)
- Potatoes
- Potatoes (processed)
- Speciality vegetables (root)
- Tomatoes (processed)
- Wheat flour

Northern Ireland

- Aubergine
- Banana
- Beans with pods
- Beef
- Beetroot
- Bread (ordinary)
- Bread (savoury)
- Broccoli
- Chilli peppers
- Eggs
- Fish (white)

- Garlic
- Grapefruit
- Grapes
- Infant food (cereal based)
- Limes
- Melon
- Milk
- Mushrooms
- Olive oil
- Peppers (sweet)
- Potatoes
- Sweet potatoes
- Wheat flour

Section 5: background and reference

Reasons for pesticide residue testing

Food safety is important. Modern food production processes have given us plentiful supplies of a wide range of good quality affordable produce.

In the food industry of today the production environment can be managed from the preparation of seeds used for crops, through to growth, harvesting and storage of the produce.

One of the ways the food industry controls the environment in which foodstuffs are produced is by applying pesticides. They help farmers and growers maximise the production of food stuffs by, for example, preventing weeds inhibiting the growth of the crop, or insects destroying or infesting them. Pesticides can also be used to help protect seeds or prolong the life of crops after they have been harvested. Biological and physical (cultural) controls are also used to protect crops or as part of an integrated system.

As pesticides are used to control unwanted pests, weeds and diseases, they can potentially also harm people, wildlife and the environment. This is why the UK, in common with most other countries, imposes legally enforceable conditions as to how and when pesticides can be used. No pesticide can be supplied or used on a food or ornamental crops in the UK without government authorisation. To obtain this authorisation the manufacturer of the pesticide must show that it does not present a concern for people's health or the environment. Naturally derived and synthetic pesticides are subject to the same regulation.

Once the authorisation has been granted government authorities carry out follow up checks to ensure that the authorisation is providing the necessary degree of protection to users, consumers and the environment and that those who use pesticides are complying with conditions specified within it.

The government authority responsible for checking pesticide residues in foodstuffs is the Health and Safety Executive. Defra's Expert Committee on Pesticide Residues in Food (PRiF) oversees and provides an independent check on this work. We know that the use of pesticides on crops may lead to traces (residues) of these chemicals in food and we expect to find these in our monitoring programme.

Detail of reporting practice

Results by food commodity

The following is reported about the food commodity:

- we include information about the survey (for instance where samples came from) for each commodity
- detailed tabulated results are available for download from our website
- we summarise our findings and any follow-up action taken

Risk assessments – single residues

The following is carried out in HSE risk assessments with simple residues:

- all results are screened by HSE to check for intakes above the toxicological reference values, the Acute Reference Dose (ARfD) or the Acceptable Daily Intake (ADI). HSE assumes a relatively high level of intake and also assumes that most produce is eaten whole including peel/skin even when these are rarely consumed

- where intakes above the toxicological reference values are identified, we consider a detailed risk assessment prepared by HSE (at section II of this report)
- our observations and the follow-up action taken are summarised in the section for that food

Risk assessments – multiple combined residues

The following is carried out in HSE risk assessments with combined residues:

- residues of more than one pesticide from the same category/class of particular categories of pesticides, which have a similar toxicological mode of action, are initially screened by HSE to check for intakes that might need further combined assessment
- where combined intakes exceed the initial screen 'trigger', we consider a detailed combined risk assessment prepared by HSE (at section 3 of this report). Further details on the approach are explained in section 3
- our observations and any follow-up action taken are summarised in the section for that food commodity

Risk assessment – conclusions

The following is carried out to conclude HSE risk assessments:

- where, in the light of current knowledge and considering the usual level of scientific uncertainty the intake will not cause ill health the conclusion will say no effect on health is expected
- where, in the light of current knowledge the intake is not likely to cause ill health, the conclusion will be less definite and state that an effect on health is unlikely
- where scientific uncertainty is greater or if risk of adverse health effects could be higher more information is provided

Residues in GB and NI produce of pesticides which do not have a PPP authorised for use on that crop in GB and NI

The following steps are taken to consider unauthorised uses:

- all residues found in foods produced in GB or NI are checked by HSE to make sure there is a PPP containing that pesticide authorised for use on that crop
- where there is no GB or NI authorisation is identified, details of the sample are referred to the Enforcement Section for follow up
- our observations and any follow-up action taken to date are summarised in the section for that food commodity. We may have to withhold details of samples while investigations are underway, in which case the details will be published in a later report

Residues above the MRL, after taking into account measurement uncertainty

The following approach is taken in consideration of measurement uncertainty:

- samples containing residues above the MRL are listed at Appendix B, and those which are clearly above the MRL after taking into account measurement uncertainty of plus or minus 50% are highlighted
- our observations and any follow-up action taken are summarised in the section for that food commodity
- the results in our reports are rounded for publication but not adjusted for measurement uncertainty
- we apply measurement uncertainty only to decide whether to highlight a result as over the MRL in the brand name annex. To do this we use the actual value reported by the laboratory before rounding. If after taking measurement uncertainty into account that value is found to be over the MRL the result will be highlighted in the brand name annex

For example:

- the lab reports the results of duplicate analysis of a residue above an MRL at 0.023 mg per kg and 0.025 mg per kg giving an average value of 0.024 mg per kg. For reporting purpose this value would be 0.02 mg per kg
- if measurement uncertainty is then applied to the reported value of 0.02 mg per kg it could take the value to between 0.01 and 0.03 mg per kg. If the MRL is 0.01 mg per kg the lower value would be at the MRL and there is no exceedance
- however, if measurement uncertainty is applied to the measured result, for example, 0.024 mg per kg the value could then be in the range of 0.012 to 0.036 mg per kg. In this case the lower value is above the MRL and so will be treated as an exceedance

Residues in organic food

The following steps are taken to consider organic food:

- we monitor pesticide residues in all the GB and NI food supply, including organic food.
- we are not responsible for checking compliance with the rules associated with organic production. However, when we do detect residues in an organic food we explain whether or not those residues indicate a breach of the rules and inform Defra's Organic Farming Branch

Residues where further risk management is needed

The following steps are taken to consider risk management:

- where residues are above the MRL and there may be a risk to health, then HSE refer the sample to the FSA who undertake a risk assessment and when there is an appreciable risk to health from the residue in the food including genotoxicity can take appropriate action
- if food is still available from the same source then Local Authority contacts can follow up to withdraw or recall of the food from the market
- where necessary notify the International Network Food Safety Authorities (INFOSAN) Emergency Contacts Points in the exporting country of the non-compliance and safety risk

Results from the PRiF programme are also used by the FSA as intelligence to inform advice to Port Health Authorities on import checks.

Brand name annex

The following brand name information is published:

- full brand name details for samples included in this report are published in a brand name annex. Within this annex, samples with results of interest are highlighted
- brand name details are only published when enough follow-up work is completed for us to be reasonably sure whether a breach of the law or good practice has occurred
- therefore, sometimes brand name details are withheld pending completion of this work but are published in a later report

Pesticides analysed as multi-component analytes and their reporting limits

Why some results cover more than one substance

Both the legal controls and our analytical tests are aimed at checking food for the presence of residues of specific pesticides. Residues are the chemical traces left behind after pesticides are used. In most cases the residue of a pesticide is measured by first identifying the pesticide and then measuring the quantity of that pesticide in the food itself. But for some pesticides the residue remaining in the food is known to be chemically different from the original pesticide and

so the laboratory needs to look for more than one component. There are various reasons why this happens, for example:

- the animal or plant can change the pesticide into related chemicals
- the pesticide can change in the environment into related chemicals
- some pesticides are mixtures of chemicals, so the relevant components of the mixture need to be checked for
- in the laboratory sample preparation and or analysis may change pesticides into related chemicals
- related chemicals may be pesticides in their own right

The MRL setting process takes account of all these issues. The EU may set a complex residue definition to ensure that the identity and quantity of the residue found is representative of the pesticide present. A complex residue definition may be set where it is necessary for safety reasons or to be able to accurately identify the pesticide residue present in the food. This definition usually includes the actual pesticide, plus other related chemicals. These residues are usually reported together as a "sum". Sometimes different foods need different definitions because different pesticide residues are known to occur in that food. For instance, plants and animals may metabolise a pesticide differently, which forms different residues.

The full definitions of pesticides that we have found in our surveys are described in the table describing 'Complex residue definitions used in our reports' below. If you would like more detail about a particular residue definition, please get in touch. You can email us at prif@hse.gov.uk and other contact details are on the back cover.

Where the detailed individual analysis results tell us something useful, we mention that in our conclusions.

How we calculate sums

Unless the definition says otherwise, the summed result is a simple addition. For individual components that are not detected that result is treated as a zero.

Where a residue definition says, "expressed as", that means that the individual component results are adjusted by molecular weight before being added together. The residue definition is set this way so that the final calculated result for the whole definition is an expression of the level of the most toxic component, and so that value can be used directly in consumer risk assessment without further adjustment.

Complex residue definitions used in our reports

There are a large number of pesticides used and types of food in the world. So other complex residue definitions may apply to food/pesticide combinations not yet considered by PRiF. You can look up all the MRL definitions for pesticide residues on the HSE site for GB MRL's GB MRL Register or the European Commission's pesticide database for NI MRLs at EU-Pesticide Database.

Short name we use in our reports	Legal residue definition – These definitions apply to all foods unless otherwise stated
2,4-D (sum)	2,4-D (sum of 2,4-D and its esters expressed as 2,4-D)
Abamectin (sum)	Abamectin (sum of Avermectin B1a, AvermectinB1b and delta-8,9 isomer of Avermectin B1a)
Aldicarb (sum)	Aldicarb (sum of aldicarb, its sulfoxide and its sulfone, expressed as aldicarb)
Aldrin and dieldrin	Aldrin and dieldrin (aldrin and dieldrin combined expressed as dieldrin), aka dieldrin (sum)
Amitraz	Amitraz (amitraz including the metabolites containing the 2,4 - dimethylaniline moiety expressed as amitraz)
BAC (sum)	Benzalkonium chloride (mixture of alkylbenzyldimethylammonium chlorides with alkyl chain lengths of C_8, C_{10}, C_{12}, C_{14}, C_{16} and C_{18})
Benthiavalicarb (sum)	Benthiavalicarb (benthiavalicarb-isopropyl (KIF-230 R-L) and its enantiomer (KIF-230 S-D) and diastereomers (KIF-230 R-L and KIF-230 S-D)
Bixan (animal products)	Sum of bixafen and desmethyl bixafen expressed as bixafen This definition applies to animal products only
Captan and folpet	Sum of captan and folpet aka captan/folpet This definition applies only to pome fruit (fruits such as apples and pears), strawberries, raspberries, currants, tomatoes and beans. For all other foods there are separate MRLs for captan only and for folpet only.
Carbendazim (animal products)	Carbendazim and thiophanate-methyl, expressed as carbendazim
Carbendazim (sum)	Carbendazim and benomyl (sum of benomyl and carbendazim expressed as carbendazim)
Carbofuran (sum)	Carbofuran (sum of carbofuran and 3-hydroxy-carbofuran expressed as carbofuran)
Chlordane (animal products)	Chlordane (sum of cis- and trans-isomers and oxychlordane expressed as chlordane) This definition applies to animal products only

Short name we use in our reports	Legal residue definition – These definitions apply to all foods unless otherwise stated
Chlordane (sum)	Chlordane (sum of cis- and trans- isomers) This definition applies to all foods except animal products
Chlorpropham (potatoes)	Chlorpropham only This definition applies only to potatoes
Chlorpropham (sum for animal products)	Chlorpropham and 4-hydroxychlorpropham-O-sulphonic acid (4-HSA), expressed as chlorpropham This definition applies only to animal products
Chlorpropham (sum)	Chlorpropham (chlorpropham and 3-chloroaniline, expressed as chlorpropham) This definition applies to all foods except potatoes and animal products
DDAC (sum)	Didecyldimethylammonium chloride (mixture of alkyl-quaternary ammonium salts with alkyl chain lengths of C_8, C_{10} and C_{12})
DDT (sum)	DDT (sum of p,p'-DDT, o,p'-DDT, p-p'-DDE and p,p'-TDE (DDD) expressed as DDT)
Dichlorprop	Sum of dichlorprop, including dichlorprop-p and its conjugates, expressed as dichlorprop
Dicofol (sum)	Dicofol (sum of p, p' and o,p' isomers)
Dimethenamid	Dimethenamid–p (dimethenamid-p including other mixtures of constituent isomers (sum of isomers))
Dimethoate (sum)	Dimethoate (sum of dimethoate and omethoate expressed as dimethoate)
Disulfoton (sum)	Disulfoton (sum of disulfoton, disulfoton sulfoxide and disulfoton sulfone expressed as disulfoton)
Dithiocarbamates	Dithiocarbamates are a group of pesticides that are chemically similar. Testing for them individually in routine analysis is not possible, so MRLs are set for a test for the group.
Endosulfan (sum)	Endosulfan (sum of alpha- and beta-isomers and endosulfan-sulphate expresses as endosulfan)
Ethylene oxide	Ethylene oxide (sum of ethylene oxide and 2-chloro-ethanol expressed as ethylene oxide)
Fenamiphos (sum)	Fenamiphos (sum of fenamiphos and its sulphoxide and sulphone expressed as fenamiphos)
Fenchlorphos (sum)	Fenchlorphos (sum of fenchlorphos and fenchlorphos oxon expressed as fenchlorphos)

Short name we use in our reports	Legal residue definition – These definitions apply to all foods unless otherwise stated
Fensulfothion (sum)	Fensulfothion (sum of fensulfothion, its oxygen analogue and their sulfones, expressed as fensulfothion).
Fenthion (sum)	Fenthion (fenthion and its oxygen analogue, their sulfoxides and sulfone expressed as parent)
Fenvalerate and esfenvalerate (all isomers)	Fenvalerate (any ratio of constituent isomers (RR, SS, RS & SR) including esfenvalerate)
Fipronil (infant food)	Sum of fipronil and fipronil-desulfinyl, expressed as fipronil This definition applies to foods for babies only
Fipronil (sum)	Fipronil (sum Fipronil and sulfone metabolite (MB46136) expressed as Fipronil) This definition applies to all foods except foods for babies
Flonicamid (sum)	Flonicamid (sum of flonicamid, TNFG and TNFA) This definition applies to all food except animal products. The full definition must be sought. Residues found are usually of the metabolites.
Fluazifop-p-butyl (sum)	Fluazifop-P-butyl (fluazifop acid (free and conjugate))
Fosetyl -Al (sum)	In the body of the report, fosetyl (sum) is referred to and this equates to fosetyl-Al (sum of fosetyl, phosphonic acid and their salts, expressed as fosetyl)
Haloxyfop (sum)	Haloxyfop including haloxyfop-R (haloxyfop-R methyl ester, haloxyfop-R and conjugates of haloxyfop-R expressed as haloxyfop-R)
Heptachlor (infant food)	Sum of heptachlor and trans heptachlor epoxide This definition applies to foods for babies only
Heptachlor (sum)	Heptachlor (sum of heptachlor and heptachlor epoxide expressed as heptachlor) This definition applies to all foods except infant foods
Hexachlorocyclohexane (sum)	Hexachlorocyclohexane (HCH), sum of isomers, except the gamma isomer This definition applies to all foods except animal products (For animal products the alpha and beta isomers have separate MRLs)
Malathion	Malathion (sum of malathion and malaoxon expressed as malathion)

Short name we use in our reports	Legal residue definition – These definitions apply to all foods unless otherwise stated
MCPA (animal products)	[Residue definition, animal products] MCPA, MCPB and MCPA thioethyl expressed as MCPA This definition applies to animal products only
MCPA (sum)	MCPA and MCPB (MCPA, MCPB including their salts, esters and conjugates expressed as MCPA) This definition applies to all foods except animal products
Mepanipyrim (sum)	Mepanipyrim and its metabolite (2-anilino-4-(2-hydroxypropyl)-6-methylpyrimidine) expressed as mepanipyrim
Methiocarb (sum)	Methiocarb (sum of methiocarb and methiocarb sulfoxide and sulfone, expressed as methiocarb)
Methomyl (sum)	Sum of methomyl and thiodicarb expressed as methomyl
Oxydemeton-methyl (sum)	Oxydemeton-methyl (sum of oxydemeton-methyl and demeton-S-methylsulfone expressed as oxydemeton-methyl)
Parathion-methyl (sum)	Parathion-methyl (sum of Parathion-methyl and paraoxon-methyl expressed as Parathion-methyl)
Permethrin	Permethrin (sum of isomers)
Phorate (sum)	Phorate (sum of phorate, its oxygen analogue and their sulfones expressed as phorate)
Phosmet (sum)	Phosmet (phosmet and phosmet oxon expressed as phosmet) This definition applies to all foods except animal products
Pirimicarb (sum)	Pirimicarb (sum of pirimicarb and desmethyl pirimicarb expressed as pirimicarb) for certain animal products. Pirimicarb only for fruit and vegetables and some animal products.
Prochloraz (sum)	Prochloraz (sum of prochloraz and its metabolites containing the 2,4,6-Trichlorophenol moiety expressed as prochloraz)
Prothioconazole (sum)	Prothioconazole (sum of prothioconazole-desthio and its glucuronide conjugate, expressed as prothioconazoledesthio) This definition applies to animal products only
PTU and propineb	Sum of PTU and propineb This definition applies to food for babies only
Quintozene (sum)	Quintozene (sum of quintozene and pentachloro-aniline expressed as quintozene)
Terbufos (sum)	Terbufos (sum of terbufos, its sulfoxide and sulfone This definition applies only to foods for babies

Short name we use in our reports	Legal residue definition – These definitions apply to all foods unless otherwise stated
Thiamethoxam (sum)	Thiamethoxam (sum of thiamethoxam and clothianidin expressed as thiamethoxam) There are also separate clothianidin MRLs
Tolylfluanid (sum)	Tolylfluanid (Sum of tolylfluanid and dimethylaminosulfotoluidide expressed as tolylfluanid)
Triadimefon and Triadimenol	Triadimefon and triademenol
Vinclozolin (animal products)	Vinclozolin, iprodione, procymidone, sum of compounds and all metabolites containing the 3,5-dichloroaniline moiety expressed as 3,5-dichloroaniline This definition applies to animal products only
Vinclozolin (sum)	Vinclozolin (sum of vinclozolin and all metabolites containing the 3,5-dichloraniniline moiety, expressed as vinclozolin) This definition applies to all foods except animal products

Glossary

This is a ‘standard’ glossary which defines the key terms used in the PRiF reports. Not all the terms listed here are used in this particular report.

97.5th percentile consumer:

Please refer to glossary entry for ‘High level consumer’.

Acceptable daily intake (ADI):

This is the amount of a chemical which can be consumed every day for a lifetime in the practical certainty, on the basis of all known facts, that no harm will result. It is expressed in milligrams of the chemical per kilogram of body weight of the consumer. The starting point for the derivation of the ADI is usually the ‘no observed adverse effect level’ (NOAEL) that has been observed in animal studies for toxicity. This is then divided by an uncertainty factor (most often 100) to allow for the possibility that animals may be less sensitive than humans and also to account for possible variation in sensitivity between individuals. The studies from which NOAELs and hence ADIs are derived take into account any impurities in the pesticide active substance as manufactured, and also any toxic breakdown products of the pesticide.

Acetylcholine:

Acetylcholine is a neurotransmitter, a chemical that carries signals through the nervous system. *See* cholinergic.

Acetylcholinesterase:

This is an enzyme which degrades acetylcholine and is involved in the regulation of nerve impulses. Inhibition of this enzyme can interfere with this nerve transmission function. This is a short-term effect of concern with organophosphate and carbamate pesticides at levels above the ARfD.

Acute Reference Dose (ARfD):

The definition of the ARfD is similar to that of the ADI, but it relates to the amount of a chemical that can be taken in at one meal or on one day without appreciable health risk to the consumer. It is normally derived by applying an appropriate uncertainty factor to the lowest NOAEL in studies that assess acute toxicity or developmental toxicity.

As a matter of policy, the EU does not use NOAELs from tests that involve deliberate administration of pesticides to humans to determine ADIs and ARfDs. However, where such data have been ethically and scientifically derived some authorities, for example, the World Health Organization, do consider such data. Where human data are used there is usually less uncertainty in the resulting reference value compared to extrapolating from animal tests to humans, and a lower uncertainty factor (most often 10) is used to account for the variation in sensitivity between individuals.

The initial risk assessments in PRiF reports use the agreed EU reference values. However, where intakes are above the EU value and a reference value based on acceptable human data is available a refined assessment, which is a more appropriate indicator of the risk, is also reported.

Analyte:

This is the name for the substance that the PRiF surveys look for and measure if present; it could be a pesticide itself or a product from a pesticide when it is degraded, or metabolised.

Cocktail effect:

See **“multiple residues”**.

Codex:

The Codex Committee on Pesticide Residues (CCPR) is responsible for establishing Codex MRLs for pesticide residues in specific food items or in groups of food. These Codex maximum residue levels (CXLs) are internationally agreed food standards.

COLEACP (Europe-Africa-Caribbean-Pacific Liaison Committee):

It aims to promote the competitive export of fresh fruit, vegetables, flowers and ornamental plants from the ACP. Its specialised information and advisory services are open to all ACP companies in the horticultural export sector and are financed by the European Commission. It has two overriding objectives to enable ACP companies to comply with European food safety and traceability requirements and to consolidate the position of small-scale producers in the ACP horticultural export sector.

Cholinergic:

In relation to the animal nervous system, processes and structures are cholinergic if they release or use acetylcholine.

Cryogenic milling:

Processing of commodities at very low temperatures can be achieved by milling/grinding pre-frozen samples in the presence of dry ice, a procedure known as ‘cryogenic milling’.

Extensions of Authorisations for Minor Use (EAMUs):

Users and authorisation holders of agricultural Plant Protection Products (PPP) may apply to have the authorisation of specific PPP’s extended to cover uses additional to those authorised and shown on the manufacturer’s product label. For many reasons, label recommendations of authorised pesticides do not cover the control of every problem which may arise. This is particularly true for crops that are grown on a comparatively small scale in the UK as well as for pests and diseases that occur less often or which are new to the UK. As part of the process evidence on residues that would arise from the use is required, and consumer safety is evaluated and if necessary a specific MRL set. EAMU is pronounced “emu” these types of authorisations are also informally called “off labels”.

Genotoxicity:

Genotoxicity is the effect of substances (called genotoxins) which can alter or damage the genetic material (DNA, RNA, or chromosomes) within a cell. Cells have the capacity to protect themselves from genotoxic effects by many repair processes and therefore many genotoxic events do not become evident as mutations. Where mutations occur, this can lead to cancer or effects that can be passed to unborn children (for example, birth defects, inherited diseases).

Good Agricultural Practice in the Use of Pesticides (GAP):

The nationally authorised safe uses of pesticides under conditions necessary for effective and reliable pest control (the way products should be used according to the statutory conditions of authorisation which are stated on the label). GAP encompasses a range of pesticide applications up to the highest authorised rates of use, applied in a manner which leaves a residue which is the smallest practicable. Authorised safe uses are determined at the national level and include nationally registered recommended uses, which take into account public and occupational health and environmental safety considerations. Actual conditions include any stage in the production, storage, transport, distribution and processing of food commodities and animal feed.

High-level Consumer:

A term used in UK risk assessment calculations to describe the amount of food consumed by a person. In line with internationally agreed approaches, the PRiF uses the 97.5th percentile value, which is generally about three times the average amount consumed. This takes account of different eating patterns that may occur throughout the population.

Human Data:

See "**Acute Reference Dose"**.

In vitro:

A test performed in vitro "in the glass" means that it is performed outside of a living organism and usually involves isolated tissues, organs or cells.

In vivo:

Live animal studies.

Import Tolerance:

An MRL set for imported products where the use of the active substance in a plant protection product on a commodity is not authorised in the European Community (EC) or an existing EC MRL is not sufficient to meet the needs of international trade. All import tolerances are assessed for consumer safety.

Imported:

The tables in the reports record whether the sample was of UK origin, or imported. This can mean different things depending on the commodity. See also 'Origin'. The PRiF report the country from where the produce has been imported only if this is clear from the packaging or labelling.

INFOSAN (International Food Safety Authority network):

Since the end of the EU transition period, in GB, notifications are submitted via FAO and WHO's International Food Safety Authority network (INFOSAN) of which UK is a member. Non compliances that do not present a food safety risk are not communicated by GB to other countries and there is an expectation that non-compliance notifications will be communicated by the importer/exporter in liaison with the LA.

Northern Ireland continues to be part of the EU Rapid Alert for Food and Feed (RASFF -see glossary) network under the terms of the Windsor Framework so where appropriate will email notifications via the RASFF network, including for non-compliances under AAC procedures.

JMPR:

Joint FAO and WHO Meeting on Pesticide Residues, which conducts scientific evaluations of pesticide residues in food.

LOD (Limit of Determination) and LOD MRLs:

The Limit of Determination (LOD) is the lowest concentration of a pesticide residue or contaminant that can be routinely identified and quantitively measured in a specified food, agricultural commodity or animal feed with an acceptable degree of certainty by the method of analysis. Note, exceptionally we test at levels lower than the LOD MRL to determine incidence of certain pesticides of specific interest.

LOD MRL (Maximum Residue Levels set at the LOD):

These are marked by a '*'. For some pesticides and commodities insufficient trials data are available on which to set a maximum residue level or there may be no use of the pesticide on

that crop. In these cases, the MRL may be set at a default level for example, at the limit of determination (LOD) where analytical methods can reasonably detect the presence of the pesticide. **These MRLs are not based on Good Agricultural Practice (GAP).** Also, see under Reporting limit.

Lowest Observed Adverse Effect Level (LOAEL):

The lowest concentration or amount of a substance, found by experiment or observation, which causes detectable adverse alteration of morphology, functional capacity, growth, development or life span of the target organism under defined conditions of exposure.

Off Label:

See **"Extensions of Authorisations for Minor Use (EAMUs)"**.

Maximum Residue Level (MRL):

The maximum concentration of a pesticide residue (expressed as mg per kg) legally permitted in or on food commodities and animal feeds. MRLs are based on good agricultural practice data and residues in foods derived from commodities that comply with the respective MRLs are intended to be toxicologically acceptable.

MRLs are intended primarily as a check that GAP is being followed and to assist international trade in produce treated with pesticides. **MRLs are not in themselves 'safety limits'**, and exposure to residues in excess of an MRL does not automatically imply a hazard to health.

The MRLs applicable in the UK are now largely set under EC legislation.

Maximum Residue Levels (MRLs) reflect levels of pesticides that could occur in produce, which has been treated in accordance with good agricultural practice. Where pesticides do not give rise to readily detectable residues, or are not authorised for use on particular commodities, MRLs are set at the lowest level which can be identified in routine laboratory analysis. Thus, they provide a mechanism for statutory controls on pesticides in produce which is put into circulation and for monitoring correct use of these chemicals.

If no use of a pesticide on a crop is identified when MRLs are set the tolerance for that pesticide/crop combination is set at the limit of determination (effectively zero). Limit of determination MRL are marked by a '*'.

MRLs are established under the Pesticides (Maximum Residue Levels in Crops, Food and Feeding Stuffs) (England and Wales) Regulations 1999 (as amended), the Pesticides (Maximum Residue Levels in Crops, Food and Feeding Stuffs) (Scotland) Regulations 2000 and the Pesticides (Maximum Residue Levels in Crops, Food and Feeding Stuffs) Regulations (Northern Ireland) 2002. These Regulations list all statutory MRLs established under UK national or EC procedures. Today, virtually all these MRLs are set under an ongoing EC programme and the Regulations are amended periodically as levels are set for increasing numbers of pesticides.

There are a number of pesticides which do not yet have statutory MRLs. In the absence of such MRLs we advise suppliers to adhere to any appropriate levels established by the Codex Alimentarius Commission (CAC) a United Nations body established to promote global trading standards. Codex MRLs are not statutory but have been risk-assessed when set and provide a suitable standard in the absence of a statutory MRL.

MRLs may be extended to composite and processed products but levels are not specifically laid down in legislation. They are derived by calculation on an individual basis.

Maximum Residue Levels set at the LOD (LOD MRL):

See LOD MRL. For some pesticides and commodities, insufficient trials data are available on which to set a maximum residue level or there may be no use of the pesticide on that crop. In these cases, the MRL may be set at a default level, for example, at the limit of determination (LOD) where analytical methods can reasonably detect the presence of the pesticide. **These MRLs are not based on Good Agricultural Practice (GAP).**

MRL exceedances:

When a residue is found at a level higher than that set for the MRL.

MRL Exceedances and Relationship with the Acceptable Daily Intake (ADI):

Before permitting any use of a pesticide, a detailed assessment is made to ensure that residues in foods derived from commodities comply with MRLs and will not give rise to unacceptable risks to consumers. MRLs do take account of consumer safety aspects and, in effect, are set at levels below safety limits. However, MRLs must not be confused with safety limits, which are expressed in terms of the acceptable daily intake (ADI) of a particular pesticide residue from all sources. The ADI (expressed as mg per kg bw per day) is the amount of chemical that can be consumed every day of an individual's entire lifetime in the practical certainty, on the basis of all known facts, that no harm will result. See ADI for further information.

Whenever unexpectedly high or unusual residues occur during monitoring, the risk to consumers, from exposure to residues at the highest levels found, is assessed by comparison of predicted intakes with the ADI or ARfD as appropriate.

No MRL:

For certain pesticides an MRL may not have been set.

Metabolite:

A degradation or conversion product from a pesticide when it is metabolised.

Multiple Residues:

In this report this term is used to describe when more than one pesticide is found in an individual food sample. It may have arisen because the crop was treated at different times with pesticides applied singularly, or when pesticides are applied as mixtures (several pesticides mixed in the spray tank at the same time) or the marketed pesticide product contains more than one pesticide or any combination of these three situations. Mixtures may be used in response to specific pest pressures and also as part of strategies to minimise pesticide resistance building up on pest populations. We consider the possible implications to health of more than one pesticide being found in samples (sometimes called the 'cocktail effect'). Please refer to section 3 for further details.

NEDI:

National Estimate of Daily Intake. An estimate of intake of pesticide in the diet over the long-term to compare to the ADI. The NEDI is based on median or mean residue levels and a high level consumption (97.5th percentile value) for the daily amounts of the food item consumed over the long-term. For further details on the calculation of NEDIs please refer to section 3 of the data requirements handbook using the following link: The HSE Pesticide Website then search for Consumer Exposure. Here you will find information and further links.

NESTI:

National Estimate of Short-Term Intake. An estimate of peak intake of pesticide in the diet to compare to the ARfD. The NESTI is based on the highest residue found multiplied by a variability factor (see glossary description) and a high level consumption (97.5th percentile value)

for the amount of the food item consumed over a single day. For further details on the calculation of NESTIs please refer to section 3 of the data requirements handbook using the following link: The HSE Pesticide Website then search for Consumer Exposure. Here you will find information and further links.

Neurotoxicity:

Neurotoxicity is the effect of substances (called neurotoxins) which alter the normal working of an animal's nervous systems and/or damage the nervous tissue.

No Observed Adverse Effect Level (NOAEL):

The greatest concentration or amount of a substance, found by experiment or observation, which causes no detectable adverse alteration of morphology, functional capacity, growth, development or life span of the target organism under defined conditions of exposure.

Off Label:

See **"EAMUs"**.

Origin:

The brand name annex reports the origins of the samples tested. This can mean different things depending on the commodity. For example, butter is often labelled as 'UK origin'; however, the majority of it comes in bulk from New Zealand and is split into smaller blocks and packaged in the UK. Lettuce is a fresh produce and 'UK origin' usually means that it has been grown and packaged in the UK. Processed commodities such as cereal bars often contain multiple raw ingredients, each of which may come from a different source/origin. Therefore, the origin of the produce usually reflects the place where it was manufactured. The PRiF report the origin as stated on the packaging or labelling of the commodity concerned, unless other more accurate information is available to indicate that the origin is from elsewhere. Some products are listed as 'unknown origin' because the labelling does not give this information.

Parent:

The chemical form of a pesticide as applied to plants, as opposed to metabolites and breakdown products.

Percentile:

A percentile is a value that divides a sample of measurements at a specific point when they are listed in ascending order of magnitude. For example, the 97.5th percentile from a food consumption survey is a value that is equal to or more than 97.5% of the measurements and equal to or less than 2.5% of the measurements. So, in a sample of 40 daily food consumption values, the 97.5th percentile is equal to or more than 39 of the measurements. Such high percentile estimates of food consumption are used in risk assessments as they are more protective than using average consumption levels.

Permitted Level (PL):

The permitted levels (expressed as mg per kg), in specific commodities, of some substances which can be classified as pesticides but are controlled under the Miscellaneous Food Additives Regulations 1995 (S.I. 1995 No. 3187).

Pesticide:

A pesticide is any substance, preparation or organism prepared or used for destroying any pest. The majority of pesticides sought by the PRiF in its monitoring are those used to control pests in agricultural crops, although non-agricultural products may be included where there is a specific

reason for doing so, for example, where there are implications in terms of possible intakes of residues.

Probabilistic Modelling:

The usual estimates of consumer exposure use single high values for both consumption amounts and residue levels. Whilst these are based on realistic UK dietary survey data and residue levels, they tend to overestimate most representative intakes. This is because they do not take into account actual variations in both amounts consumed and residue levels. Probabilistic modelling is a technique that considers all the possible different combinations of consumption and residue levels. This provides information on the probability of particular intakes occurring.

Rapid Alert System for Food and Feed (RASFF):

The European Commission's Rapid Alert System for Food and Feed (RASFF) allows member authorities (EU and EFTA member States) to quickly exchange information about measures taken when responding to risks detected in food or feed. This exchange of information helps authorities in countries inside the European single market to act more rapidly and in a coordinated way in response to a possible health threats caused by food or feed.

RASFFs notifications about pesticide residues are sent when a residue is over the MRL taking into account measurement uncertainty and a potential consumer risk has been identified. For pesticide residues in food traded in the single market this means when a risk assessment has identified that risk to people eating the food cannot be ruled out.

More information is available on the European Commission website at RASFF - Food and Feed Safety Alerts.

Relationship between GAP and MRLs:

The MRL can be defined as the maximum concentration of a pesticide residue (expressed as mg per kg) likely to **occur** in or on food commodities and animal feeds, after the use of the pesticide according to the GAP.

Reporting Limit:

The reporting limit is the lowest level at which residues will be reported by a laboratory for a survey, as agreed in advance with the laboratory. It can be equal to or higher than the limit of quantification (sometimes also referred to as the limit of determination). The limit of quantification is the lowest concentration that has been validated to meet strict acceptance criteria and may vary slightly from laboratory to laboratory depending on the equipment available and operating procedures used. The reporting limit should be at or below the MRL. For a small number of pesticides for example, monocrotophos, we are looking for the pesticide below the LOD MRL because we are specifically interested in prevalence in food due to the nature of the pesticide. In such cases, tests are performed in the laboratory to support the lower reporting limits by validating the method at lower limits. **'None were detected above the set RL':** This term is used in the Brand Name Annex, where no residues were found above their reporting limit.

Residue:

Residues may be present in vegetable and animal products following the application(s) of a pesticide(s). They may not only include the pesticide that was applied but other degradation or reaction products and metabolites that may be of toxicological significance. The levels or amounts of residues present are expressed in milligrams of the chemical in a kilogram of crop or food or commodity (mg per kg), or parts per million.

Risk Assessment:

A risk assessment is carried out when residues are found in foods to determine whether, at the levels found, they present a concern for consumer health or not. Consumer risk assessments are routinely conducted as part of the approval process for pesticides and are based on residue trials. Approval of a pesticide is only recommended when the consumer risk is acceptable.

Safety Factor:

Values used in extrapolation from experimental studies in animals (usually 100) or humans (usually 10) to the population: for PRiF assessments this represents a value by which the NOAEL is divided to derive an ADI or ARfD. The value depends on the nature of the effect, the dose-response relationship, and the quality of the toxicological information available. The use of such a factor accounts for possible differences in susceptibility between the animal species tested and humans, and for variation between different individuals in the population. The terms ‘uncertainty factor’ and ‘assessment factor’ are also sometimes used for this factor; the PRiF will use ‘safety factor’.

Sample:

The nature of all samples is as designated in the EC’s ‘sampling’ Directive 2002/63/EC. Examples are: apple at least 10 apples weighing at least 1 kg; grapes at least 5 bunches, weighing at least 2 kg.

Technical Exceedances:

When an MRL has been set at the LOD because there have been no data to support a higher level. In the context of this report, ‘technical exceedances’ always relate to produce from third countries.

Variability Factor:

A value that describes the variation in residue levels between the highest unit level and the average level in samples made up of many units. Internationally this is agreed to be the 97.5th percentile unit residue level divided by the average of the sum. The variability factor multiplied by the measured residue level from a composite sample (for example, a sample made up by mixing several units before analysis) gives an estimate of the likely higher residue levels that may have occurred in individual units. These estimated higher levels are used in short-term risk assessments involving fruit and vegetables where consumers eat only a portion of a single item, for example, melon, or a small number of units for example, apples and potatoes.