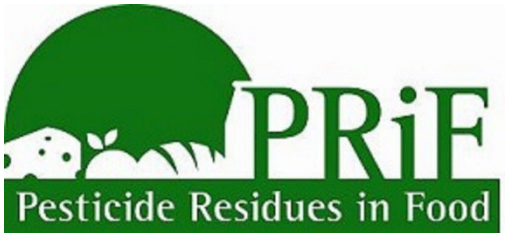
Department for Environment, Food and Rural Affairs

The Expert Committee on Pesticide Residues in Food (PRiF)

Report on the pesticide residues monitoring programme: Results of Quarter 1 2022



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

For further details on information contained in this report, previous surveys or information concerning pesticide residues in food, please contact:

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Summary: Quarter 1 2022 findings

Chair's comments

During this year's surveillance programme, we are measuring up to 398 different pesticides in each of the foods we survey. The Quarter 1 programme surveyed 499 samples of 16 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 2022.

Of 499 samples, we found residues in 272 of them and of these 24 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. In all, but one case, we concluded that effects on health were either unlikely or not expected. Full details are presented in section 3. All other residues found did not cause any concern for health.

We also needed to consider the potential genotoxic health effects of some of the residues of pesticides not authorised in the UK but 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.

These detailed considerations as well as links to underlying information are covered in our reports for avocado, beans with pods, grapes, peaches/nectarines and spinach.

None of the 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.

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 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 Northern Ireland Protocol. In the detailed data files HSE is, for 2022 results, still separating out EU from non-EU origin foods in the results.

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

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

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: Headlines with links to detailed information

Survey title (where samples collected)	Number of pesticides sought	Samples tested	Detailed risk assessment presented?	MRL exceedances (samples)
All Foods tested				
Apples (eating) (GB)	392	24	No	1
Apples (eating) (NI)	396	6	No	0
Avocado (GB)	388	24	Yes	0
Beans with pods (GB)	389	25	Yes	9
Beans with pods (NI)	390	6	No	0
Cabbage (GB)	380	25	No	3
Cabbage (NI)	381	6	No	0
Cucumber (GB)	376	24	No	0
Fish (sea) (NI)	38	11	No	0
Game (NI)	38	19	No	0
Grapes (GB)	390	36	Yes	1
Grapes (NI)	391	6	No	0
Lettuce (GB)	393	24	No	0
Lettuce (NI)	395	6	No	0
Milk (GB)	112	72	No	0
Peaches/Nectarines (GB)	394	24	Yes	3
Peaches/Nectarines (NI)	396	6	No	0
Pork (GB)	115	24	No	0
Potatoes (GB)	390	23	No	1
Potatoes (NI)	391	6	No	0
Spinach (GB)	381	24	Yes	6

Survey title (where samples collected)	Number of pesticides sought	Samples tested	Detailed risk assessment presented?	MRL exceedances (samples)
Spinach (NI)	382	6	No	0
Strawberry (GB)	382	36	No	0
Strawberry (NI)	384	6	No	0
Tomatoes (GB)	396	24	No	0
Tomatoes (NI)	398	6	No	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 Northern Ireland Protocol, 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.

- 1 GB Cabbage with fluazifop-p. Following investigation, which included submission of spray records. HSE enforcement concluded that there was no misuse
- 1 GB Potato with imazalil. Imazalil is authorised for use on seed potatoes. HSE enforcement concluded the likeliest source of the residue was due to contamination from crates or equipment at the grading site. The suppliers have been reminded of cleaning measures that should be taken to prevent contamination.
- 1 GB apple that contained prosulfocarb. HSE enforcement investigation concluded that the residue may have been as a result of volatilisation and not indicative of misuse.

Organic samples with residues

HSE writes to the suppliers of samples of organic produce if they contain a pesticide residue. Defra's Organic Farming branch and the organic certification organisation are also informed.

- 3 GB samples of spinach

Further information

Further information on the individual sample details is in an accessible format at 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 two public interest experts.

Information on the membership of the PRiF is also available on the PRiF's website: Expert Committee on Pesticide Residues in Food

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. It is not an enforcement programme and its design is generally not adjusted during the year. HSE is also 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 bullet points below, and in more detail, with reference to international assessment contexts in section 3 and on HSE's website

- For acute assessment, we 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.

- For chronic assessment, we 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.

  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 a 'worst case' assessment for when all of the peel is consumed with the fruit.

- We 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.

- For multiple residues, we 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: 2022 Survey Design

Fruit and vegetables

Food	Sampling points	Sampled during	Reporting
Apples (GB)[2]	Retail Outlets	Quarterly	Quarterly
Apples (NI)[3]	Retail Outlets	Quarterly	Quarterly
Apricots (GB)	Retail Outlets	Quarter 2 – 4	Quarter 2 – 4
Apricots (NI)	Retail Outlets	Quarter 2 – 4	Quarter 2 – 4
Avocado (GB)	Retail Outlets and Supply chain	Quarterly	Quarterly
Beans with pods (GB)	Retail Outlets and Supply chain	Quarterly	Rolling and Quarterly
Beans with pods (NI)	Retail Outlets	Quarterly	Rolling and Quarterly
Brussel sprouts (GB)	Retail Outlets	Quarter 3 and 4	Quarter 3 and 4
Brussel sprouts (NI)	Retail Outlets	Quarter 3 and 4	Quarter 3 and 4
Cabbage (GB)[2]	Retail Outlets and Supply chain	Quarterly	Quarterly
Cabbage (NI)[3]	Retail Outlets	Quarterly	Quarterly
Cherry (GB)	Retail Outlets and Supply chain	Quarter 2 – 4	Quarter 2 – 4
Cherry (NI)	Retail Outlets	Quarter 2 – 4	Quarter 2 – 4
Cucumber (GB)	Retail Outlets	Quarterly	Quarterly
Cucumber (NI)	Retail Outlets	Quarter 2 – 4	Quarter 2 – 4
Grapes (GB)	Retail Outlets and Supply chain	Quarterly	Rolling and Quarterly
Grapes (NI)	Retail Outlets	Quarterly	Rolling and Quarterly
Lettuce (GB)[2]	Retail Outlets and Supply chain	Quarterly	Quarterly
Lettuce (NI)[3]	Retail Outlets	Quarterly	Quarterly
Peaches & nectarines (GB)[2]	Retail Outlets and Supply chain	Quarterly	Quarterly
Peaches & nectarines (NI)[3]	Retail Outlets	Quarterly	Quarterly
Potatoes (GB)	Supply chain	Quarterly	Rolling and Quarterly
Potatoes (NI)	Retail Outlets	Quarterly	Rolling and Quarterly
Spinach (GB)[2]	Retail Outlets and Supply chain	Quarterly	Quarterly
Spinach (NI)[3]	Retail Outlets	Quarterly	Quarterly
Strawberries (GB)[2]	Retail Outlets and Supply chain	Quarterly	Quarterly
Strawberries (NI)[3]	Retail Outlets	Quarterly	Quarterly
Tomatoes (GB)[2]	Retail Outlets and Supply chain	Quarterly	Quarterly
Tomatoes (NI)[3]	Retail Outlets	Quarterly	Quarterly

[2] Requirement of GB Control Plan Multi-annual Great Britain control plan for pesticide residues - GOV.UK (www.gov.uk)

[3] Requirement of EU Coordinated Programme Commission Implementing Regulation (EU) 2021/601

Animal products

Food	Sampling points	Sampled during	Reporting
Fish (sea) (GB)	Retail Outlets	Quarter 2 – 4	Quarter 2 – 4
Fish (sea) (NI)	Retail Outlets	Quarterly	Quarterly
Game (NI)	Retail Outlets	Quarterly	Quarterly
Milk (GB)[2]	Retail Outlets	Quarterly	Quarterly
Milk (NI)[3]	Retail Outlets	Quarterly	Quarterly
Pork (GB)[2]	Retail Outlets	Quarterly	Quarterly
Pork (NI)[3]	Retail Outlets	Quarter 2 – 4	Quarter 2 – 4

Cereal products

Food	Sampling points	Sampled during	Reporting
Barley (GB)	Retail Outlets	Quarter 2 – 4	Quarter 2 – 4
Barley (NI)	Retail Outlets	Quarter 2 – 4	Quarter 2 – 4
Bread (GB)	Retail Outlets	Quarter 2 – 4	Quarter 3 and 4
Bread (NI)	Retail Outlets	Quarter 2 – 4	Quarter 2 – 4
Oats (GB)	Retail Outlets	Quarter 2 – 4	Quarter 2 – 4
Oats (NI)	Retail Outlets	Quarter 2 – 4	Quarter 2 – 4
Pasta (GB)	Retail Outlets	Quarter 2 and 3	Quarter 2 and 3

Miscellaneous products

Food	Sampling points	Sampled during	Reporting
Infant food (F&V) (GB)	Retail Outlets	Quarter 3	Quarter 3
Infant food (F&V) (NI)	Retail Outlets	Quarter 3	Quarter 3
Sundried tomatoes (GB)	Retail Outlets	Quarter 2	Quarter 2
Wine (GB)	Retail Outlets	Quarter 2 – 4	Quarter 2 – 4
Wine (NI)	Retail Outlets	Quarters 3 and 4	Quarters 3 and 4

Sampling points

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

Reporting

- 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
Apples (eating) (GB)	24	19	1		19	4	0
Apples (eating) (NI)	6	3	0		3	3	0
Avocado (GB)	24	8	0		0	2	0
Bean with pods (GB)	25	12	9		14	0	0
Beans with pods (NI)	6	2	0		1	0	0
Cabbage (GB)	25	18	3		14	4	0
Cabbage (NI)	6	2	0		2	0	0
Cucumber (GB)	24	15	0		13	9	1
Fish (sea) (NI)	11	2	0		1	0	0
Game (NI)	19	1	0		0	0	0
Grapes (GB)	36	34	1		30	1	0
Grapes (NI)	6	6	0		6	0	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
Lettuce (GB)	24	22	0		11	0	0
Lettuce (NI)	6	3	0		3	0	0
Milk (GB)	72	0	0		0	17	0
Peaches/Nectarines (GB)	24	20	3		19	0	0
Peaches/Nectarines (NI)	6	6	0		6	0	0
Pork (GB)	24	1	0		0	0	0
Potatoes (GB)	23	13	1	1	2	0	0
Potatoes (NI)	6	1	0		1	2	0
Spinach (GB)	24	17	6		20	4	3
Spinach (NI)	6	5	0		4	0	0
Strawberry (GB)	36	32	0		25	2	0
Strawberry (NI)	6	6	0		6	0	0
Tomatoes (GB)	24	19	0		19	2	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
Tomatoes (NI)	6	5	0		3	2	1

Table 4: Summary of MRL Exceedances

Apples (GB)

Sample ID	Food Type	Country of Origin	Pesticide Detected	Residue Detected (mg/kg)	MRL (mg/kg)	MRL exceedance after allowing for measurement uncertainty	Sent to FSA for consideration
0321/2022	Braeburn Apples	UK	prosulfocarb	0.02	0.01*	No	

Beans with pods (GB)

Sample ID	Food Type	Country of Origin	Pesticide Detected	Residue Detected (mg/kg)	MRL (mg/kg)	MRL exceedance after allowing for measurement uncertainty	Sent to FSA for consideration
0180/2022	Fine Beans	Kenya	omethoate	0.04	0.01*	Yes	Yes
0516/2022	Speciality Beans	India	thiophanate-methyl	0.3	0.1*	Yes	
0543/2022	Speciality Beans	India	carbendazim (sum)	0.9	0.2	Yes	
0548/2022	Speciality Beans	India	chlorpyrifos	0.04	0.01*	Yes	Yes
			omethoate	0.02	0.01*	No	

0562/2022	Speciality Beans	Dominican Republic	fipronil (sum)	0.05	0.005*	Yes	
0615/2022	Speciality Beans	India	dimethoate	0.04	0.01*	Yes	Yes
			hexaconazole	0.04	0.01*	Yes	
			omethoate	0.05	0.01*	Yes	
0712/2022	Speciality Beans	India	omethoate	0.05	0.01*	Yes	Yes
0734/2022	Speciality Beans	India	omethoate	0.02	0.01*	Yes	Yes
			quinalphos	0.5	0.01*	Yes	
0906/2022	Speciality Beans	India	dimethoate	0.03	0.01*	Yes	Yes
			omethoate	0.08	0.01*	Yes	

Cabbage (GB)

Sample ID	Food Type	Country of Origin	Pesticide Detected	Residue Detected (mg/kg)	MRL (mg/kg)	MRL exceedance after allowing for measurement uncertainty	Sent to FSA for consideration
0513/2022	Savoy Cabbage	UK	fluazifop-p (sum)	0.03	0.01*	Yes	
0517/2022	Pointed Cabbage	Portugal	chlorate	0.2	0.07	Yes	

0541/2022	Primo Cabbage	UK	prothioconazole	0.1	0.09	No	

Grapes (GB)

Sample ID	Food Type	Country of Origin	Pesticide Detected	Residue Detected (mg/kg)	MRL (mg/kg)	MRL exceedance after allowing for measurement uncertainty	Sent to FSA for consideration
0545/2022	Red Seedless Grapes	Lebanon	ethephon	1.6	1	No	Yes
			thiophanate-methyl	0.7	0.1*	Yes	

Peaches and nectarines (GB)

Sample ID	Food Type	Country of Origin	Pesticide Detected	Residue Detected (mg/kg)	MRL (mg/kg)	MRL exceedance after allowing for measurement uncertainty	Sent to FSA for consideration
0041/2022	Nectarines	South Africa	glufosinate (sum)	0.2	0.15	No	
0506/2022	Nectarines	South Africa	chlorpyrifos	0.04	0.01*	Yes	Yes
0564/2022	Nectarines	South Africa	glufosinate (sum)	0.2	0.15	No	

Potatoes (GB)

Sample ID	Food Type	Country of Origin	Pesticide Detected	Residue Detected (mg/kg)	MRL (mg/kg)	MRL exceedance after allowing for measurement uncertainty	Sent to FSA for consideration
0867/2022	Wilja	UK	imazalil	0.1	0.01*	Yes	

Spinach (GB)

Sample ID	Food Type	Country of Origin	Pesticide Detected	Residue Detected (mg/kg)	MRL (mg/kg)	MRL exceedance after allowing for measurement uncertainty	Sent to FSA for consideration
0502/2022	Spinach - Fresh	Spain	deltamethrin	0.03	0.01*	Yes	
0505/2022	Spinach - Fresh	Italy	acetamiprid	1.2	0.6	No	
0519/2022	Spinach - Fresh	Spain	pyraclostrobin	1.1	0.6	No	
0561/2022	Spinach - Fresh	Spain	deltamethrin	0.04	0.01*	Yes	
0611/2022	Spinach - Fresh	Spain	dithiocarbamates	0.07	0.05*	No	
0613/2022	Spinach - Fresh	Spain	cypermethrin (sum)	0.8	0.7	No	

*** Maximum Residue Levels set at the LOD (LOD MRL):** These MRLs are set at a default level, i.e. 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.

+ 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 Northern Ireland Protocol., certain aspects of EU food law, including compliance with EU set MRLs, continue to apply.

Section 1: findings by food

Apples (GB)

Samples tested

24 samples were tested for up to 392 pesticide residues

Eating

- 9 samples came from the UK
- 15 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
- 1 sample contained residues above the MRL
- 4 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.

Residues measured above the MRL

The laboratory detected 1 residue above the MRL in eating apples. 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, including
    - Brand name, sampling point and origin information
    - Pesticides sought and residues found

Apples (NI)

Samples tested

6 samples were tested for up to 396 pesticide residues

Eating

- 6 samples came from the EU

Pesticide residues detected from those sought

- 3 samples contained no residues from those sought
- 3 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, including
    - Brand name, sampling point and origin information
    - Pesticides sought and residues found

Avocado (GB)

Samples tested

24 samples were tested for up to 388 pesticide residues

Fresh

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

Pesticide residues detected from those sought

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

Risk assessments

Following screening assessment, there were some samples of avocado that contained a residue of prochloraz at levels where the effect on health needed to be considered in more detail. The highest level detected was 1.5 mg/kg.

HSE always undertake 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.

If the avocado 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 avocado, and we conclude that 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 avocado sample being consumed by the critical consumer groups (infants are the most critical consumer of avocado), high residue in a single avocado item, peak consumption levels (97.5th percentile), and a large proportion of peel being consumed.

Assuming the avocado is eaten whole, including all of the peel, we consider an effect on health to be unlikely. However, if the peel is not consumed, because it is reported that only 8% of the residue remains (JMPR, 2004), based on the lower intake a short-term effect on health is not expected.

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

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

Additional Comments by the PRiF

Several samples of avocado contained a residue of prochloraz at levels where the effect on health needed to be considered in more detail. The highest level detected was 1.5 mg/kg. Although this level is below the MRL, many fruits with removable inedible peel have had the MRLs set taking account the removal of the peel. We present different options, as explained in our explanation to the risk assessments in section 3. We take a worst case assumption that all the peel might be eaten, and a least worst case approach where the peel is entirely removed. We would not expect an effect on health if the peel was not eaten and even if all of the peel was eaten an effect is unlikely.

Further Information

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- Detailed reference information in an accessible format at Pesticide Residues in Food Quarterly Data, including
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Beans with Pods (GB)

Samples tested

25 samples were tested for up to 389 pesticide residues

Dwarf Beans

- 2 samples were imported from outside the EU

Fine Beans

- 5 samples were imported from outside the EU

Green Beans

- 2 samples were imported from outside the EU

Speciality Beans

- 16 samples were imported from outside the EU

Pesticide residues detected from those sought

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

Risk assessments

Following screening assessment, we found three pesticide residues in beans with pods, chlorpyrifos, quinalphos and dimethoate and its metabolite omethoate, where the effect on health needed to be considered in more detail. Please refer to section 3 for full details of risk assessment.

Chlorpyrifos:

Chlorpyrifos was found in a sample of Guar beans at a level of 0.04 mg/kg, above the MRL of 0.01* mg/kg. Based on the HSE assessment of short-term risk for chlorpyrifos (see section 3), we conclude an effect on health is not expected.

As outlined in HSE's full risk assessment (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. Due to the low level of chlorpyrifos (0.04 mg/kg) in the Guar beans we consider any risks of adverse health effects are low.

Quinalphos:

Quinalphos was found in a sample of yard long beans at a level of 0.5 mg/kg, above the MRL of 0.01* mg/kg. Based on the HSE assessment of short-term risk for quinalphos (see section 3), we conclude an effect on health would be unlikely.

Dimethoate:

Dimethoate and omethoate are chemically related pesticides and for toxicology purposes are considered together. Omethoate is also the main metabolite of dimethoate. Dimethoate and/or omethoate were found in several samples of beans with pods. The highest levels observed were in two samples (Guar beans and yard long beans) containing 0.04 mg/kg dimethoate and 0.05 mg/kg omethoate in one sample and 0.03 mg/kg dimethoate and 0.08 mg/kg omethoate in the other. These levels are above the respective MRLs of 0.01* mg/kg. For each of these samples, full risk assessments have been provided, giving similar results (see section 3).

The EFSA Conclusion (2018) for dimethoate has indicated that no toxicological reference values could be determined for dimethoate and omethoate, due to a lack of a fully supporting toxicological database. We think that at the anticipated highest exposures following consumption of beans with pods containing these residues of dimethoate and omethoate, 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). We conclude that on a precautionary basis any findings of dimethoate and omethoate are undesirable due to the uncertainty regarding genotoxicity at low doses. Due to the low levels of dimethoate and omethoate (up to 0.04 mg/kg dimethoate and 0.08 mg/kg omethoate) in the beans with pods 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. 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, as these contained different pesticides which might have similar effects; these pesticides are known to inhibit the enzyme acetylcholinesterase (please see the glossary on page 117).

One sample of Guar beans contained chlorpyrifos and dimethoate and its metabolite omethoate. HSE's assessment of this combination concluded that 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 is unlikely.

One sample of yard long beans contained omethoate and quinalphos. CRD's combined risk assessment on this sample concluded that 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 is unlikely.

It is noted that each of chlorpyrifos and dimethoate and its metabolite omethoate, have shown some potential to be genotoxic (cause genetic damage). Please refer to the above comments (under risk assessment) and details in section 3 on 'Substances that might be genotoxic' for HSE's conclusions regarding potential genotoxicity.

These combined assessments are detailed in section 3 and should be consulted for the full assessment of risk.

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 several samples of beans with pods containing either chlorpyriphos, dimethoate and its metabolite omethoate and/or quinalphos in both individual and detailed multiple assessments.

We concluded any risk of adverse health effect from chlorpyriphos, dimethoate, and its metabolite omethoate, due to genotoxicity to be low. We note that market approval for these pesticides has been withdrawn in many jurisdictions. This is consistent with our view that any residue of dimethoate, its metabolite omethoate, or chlorpyrifos is undesirable, due to uncertainty in the genotoxicity safety assessment.

We also considered a sample containing quinalphos at 0.5 mg/kg (MRL = 0.01* mg/kg). At the levels found in this survey, HSE still consider any effect on health to be unlikely.

Five samples of beans with pods, all containing residues of omethoate above the MRL of 0.01* mg/kg, were referred by HSE to FSA for further consideration. A specific toxicological reference value or a hypothetical reference value for omethoate is not available, due to toxicity concerns including its potential for genotoxicity.

Residues measured above the MRL

The laboratory detected 14 residues above the MRL in beans with pods. Details are available in Table 4

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

- 1 sample from India containing omethoate at 0.08 mg/kg and dimethoate at 0.03 mg/kg
- 1 sample from India containing omethoate at 0.05 mg/kg and dimethoate 0.04 mg/kg
- 1 sample from India containing omethoate at 0.04 mg/kg
- 1 sample form India containing omethoate at 0.05 mg/kg
- 1 sample from India containing quinalphos 0.05 mg/kg
- 1 sample from India containing chlorpyrifos at 0.04 mg/kg, dimethoate at 0.01 mg/kg and omethoate at 0.02 mg/kg

Further Information

- Summary table of results
- Survey Design
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- Detailed reference information in an accessible format at Pesticide Residues in Food Quarterly Data, including
    - Brand name, sampling point and origin information
    - Pesticides sought and residues found

Beans with Pods (NI)

Samples tested

6 samples were tested for up to 390 pesticide residues

Fine Beans

- 3 samples were imported from outside the EU

Green Beans

- 2 samples were imported from outside the EU

Speciality Beans

- 1 sample was imported from outside the EU

Pesticide residues detected from those sought

- 4 samples contained no residues from those sought
- 2 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

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 this 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, including
    - Brand name, sampling point and origin information
    - Pesticides sought and residues found

Cabbage (GB)

Samples tested

25 samples were tested for up to 380 pesticide residues

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

Pesticide residues detected from those sought

- 4 samples contained no residues from those sought
- 21 sample contained residues above the reporting limit
- 3 samples contained residues above the MRL
- 4 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. Two of these residues (in one sample) 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 sample. 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.

Residues measured above the MRL

The laboratory detected 3 residues above the MRL in cabbage. 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, including
    - Brand name, sampling point and origin information
    - Pesticides sought and residues found

Cabbage (NI)

Samples tested

6 samples were tested for up to 381 pesticide residues

- 6 samples came from the UK

Pesticide residues detected from those sought

- 4 samples contained no residues from those sought
- 2 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, including
    - Brand name, sampling point and origin information
    - Pesticides sought and residues found

Cucumber (GB)

Samples tested

24 samples were tested for up to 376 pesticide residues

- 1 sample came from the UK
- 2 samples were imported from outside the EU
- 21 sample came from the EU

Pesticide residues detected from those sought

- 9 samples contained no residues from those sought
- 15 samples contained residues above the reporting limit
- None of the samples contained residues above the MRL
- 9 samples were labelled as organic. 1 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, including
    - Brand name, sampling point and origin information
    - Pesticides sought and residues found

Fish (Sea) (NI)

Samples tested

11 sample were tested for up to 38 pesticide residues

Basa

- 1 sample was imported from outside the EU

Cod

- 6 samples were imported from outside the EU

Haddock

- 1 sample was imported from outside the EU

Hake

- 1 sample was imported from outside the EU

Sea bass

- 1 sample was imported from outside the EU

Sea bream

- 1 sample was 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 or processed or where it was packed for retail sale.

Pesticide residues detected from those sought

- 9 samples contained no residues from those sought
- 2 samples contained residues above the reporting limit
- 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

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 this 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

BAC

1 sample of sea bass 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.

DDT

1 sample of sea bass contained a residue of DDT. The use of DDT is banned or heavily restricted in many countries because the 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 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, including
    - Brand name, sampling point and origin information
    - Pesticides sought and residues found

Game (NI)

Samples tested

19 samples were tested for up to 38 pesticide residues

Duck

- 5 samples came from the UK
- 11 sample came from the EU

Venison

- 3 samples came from the UK

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

Pesticide residues detected from those sought

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

Risk assessments

The residue 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

1 sample of venison 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.

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, including
    - Brand name, sampling point and origin information
    - Pesticides sought and residues found

Grapes (GB)

Samples tested

36 samples were tested for up to 390 pesticide residues

- 36 samples were imported from outside the EU

Pesticide residues detected from those sought

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

Risk assessments

Following screening assessment, we found two pesticide residues in grapes (lambda-cyhalothrin at 0.07 mg/kg (below the MRL of 0.08 mg/kg) and ethephon at 1.6 mg/kg (above the MRL of 1 mg/kg)) where the effect on health needed to be considered in more detail.

Based on the HSE assessment of short-term risk for ethephon (see section 3), we conclude an effect on health would be unlikely.

Residues of lambda-cyhalothrin are indistinguishable analytically from gamma-cyhalothrin, and the residue could have arisen from application of either gamma-cyhalothrin or lambda-cyhalothrin. As a worst case, it is assumed that the residues in the sample are possibly derived from application of gamma-cyhalothrin to the crop, and therefore this assessment has used the specific ARfD for gamma-cyhalothrin (which is two-fold lower than that for lambda-cyhalothrin). Based on the HSE assessment of short-term risk, we conclude that an effect on health would be unlikely. However, it is recognised that the residue could have arisen from the different isomeric form (lambda-cyhalothrin) which is less toxic than gamma-cyhalothrin; in this case the ARfD for lambda-cyhalothrin is not exceeded and an effect on health is not expected.

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. 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

Following the HSE risk assessment, we needed to consider one sample in more detail, with residues of ethephon at 1.6 mg/kg and lambda-cyhalothrin at 0.07 mg/kg. We consider that an effect on health would be unlikely.

Grapes are available throughout the year, imported from all around the world and so they have been surveyed as part of our rolling reporting programme for a number of years; Rolling Reporting Data

Residues measured above the MRL

The laboratory detected 2 residues above the MRL in one sample of grapes. Details are available in Table 4

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

- 1 sample from Lebanon containing ethephon at 1.6 mg/kg

Further Information

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- Detailed reference information in an accessible format at Pesticide Residues in Food Quarterly Data, including
    - Brand name, sampling point and origin information
    - Pesticides sought and residues found

Grapes (NI)

Samples tested

6 samples were tested for up to 391 pesticide residues

- 6 samples were imported from outside the EU

Pesticide residues detected from those sought

- All samples contained residues
- 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

All 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

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- Detailed reference information in an accessible format at Pesticide Residues in Food Quarterly Data, including
    - Brand name, sampling point and origin information
    - Pesticides sought and residues found

Lettuce (GB)

Samples tested

24 samples were tested for up to 393 pesticide residues

Cos

- 1 sample came from the EU

Iceberg

- 19 samples came from the EU

Little Gem

- 2 samples came from the EU

Romaine

- 2 samples came from the EU

Pesticide residues detected from those sought

- 2 samples contained no residues from those sought
- 22 samples contained residues above the reporting limit
- None of the contained residues above the MRL
- None of the 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, including
    - Brand name, sampling point and origin information
    - Pesticides sought and residues found

Lettuce (NI)

Samples tested

6 samples were tested for up to 395 pesticide residues

Iceberg

- 3 samples came from the EU

Little Gem

- 1 sample came from the EU

Round

- 2 samples came from the UK

Pesticide residues detected from those sought

- 3 samples contained no residues from those sought
- 3 samples contained residues above the reporting limit
- None of the samples contained residues above the MRL
- None of the 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
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- Detailed reference information in an accessible format at Pesticide Residues in Food Quarterly Data, including
    - Brand name, sampling point and origin information
    - Pesticides sought and residues found

Milk (GB)

Samples tested

72 samples were tested for up to 112 pesticide residues

Cow's milk

- 71 samples came from the UK

Goats milk

- 1 sample came from the UK

Pesticide residues detected from those sought

- 72 samples contained no residues from those sought
- None of the samples contained residues above the reporting limit
- None of the samples contained residues above the MRL
- 17 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
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- HSE Assessment of Risk
- Detailed reference information in an accessible format at Pesticide Residues in Food Quarterly Data, including
    - Brand name, sampling point and origin information
    - Pesticides sought and residues found

Peaches and Nectarines (GB)

Samples tested

24 samples were tested for up to 394 pesticide residues

Nectarines

- 18 samples were imported from outside the EU

Peaches

- 6 samples were imported from outside the EU

Pesticide residues detected from those sought

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

Risk assessments

One sample of nectarines contained a residue of chlorpyrifos at 0.04 mg/kg (above the MRL of 0.01* mg/kg) where the effect on health needed to be considered in more detail. Please see section 3 for the full details of the HSE assessment of the risks.

EFSA's 2019 statement on the human health assessment of chlorpyrifos indicated that no toxicological reference values could be determined for chlorpyrifos. See section 3 for more detail.

Regarding the short-term exposure assessment, although we cannot conclude with certainty whether or not presence of food residues of chlorpyrifos at this level would have any effect on health after eating large portions (97.5th percentile consumption) of nectarines, HSE has stated a number of reasons why the detailed assessment they have performed is especially precautionary. Please refer to the full assessment of risk in section 3 for further details.

The EFSA 2019 statement on the human health assessment of chlorpyrifos also includes a consideration of the potential for genotoxicity (whether damage to genetic material can occur). Regarding genotoxicity, we conclude that on a precautionary basis any findings of chlorpyrifos are undesirable due to the uncertainty regarding genotoxicity. Due to the low level of chlorpyrifos (0.04 mg/kg) in the nectarine 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. 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 a sample with a residue of chlorpyrifos in more detail.

We also concluded any risk of adverse health effect from chlorpyriphos, to be low. We note that market approval for this pesticide has been withdrawn in many jurisdictions. This is consistent with our view that any residue chlorpyrifos is undesirable, due to uncertainty in the genotoxicity safety assessment.

We note that this sample was submitted to the Foods Standards Agency for further consideration.

Residues measured above the MRL

The laboratory detected 3 residues above the MRL in nectarines. Details are available in Table 4

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

- 1 sample of nectarine from South Africa containing pesticide at chlorpyrifos 0.04 mg/kg

Further Information

- Summary table of results
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- HSE Assessment of Risk
- Detailed reference information in an accessible format at Pesticide Residues in Food Quarterly Data, including
    - Brand name, sampling point and origin information
    - Pesticides sought and residues found

Peaches and Nectarines (NI)

Samples tested

6 samples were tested for up to 396 pesticide residues

Nectarines

- 4 samples were imported from outside the EU

Peaches

- 2 samples were imported from outside the EU

Pesticide residues detected from those sought

- All samples contained residues
- 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

All 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
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- HSE Assessment of Risk
- Detailed reference information in an accessible format at Pesticide Residues in Food Quarterly Data, including
    - Brand name, sampling point and origin information
    - Pesticides sought and residues found

Pork (GB)

Samples tested

24 samples were tested for up to 115 pesticide residues

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

The country of origin of samples may not be the same as the country where the pork was produced. It may be where the pork 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
- 1 sample 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 residue 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

One sample of pork contained a residue of DDT at 0.047 mg/kg. As the residue is present in the fat, it is reported on a fat basis. The use of DDT is banned or heavily restricted in many countries because the 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 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, including
    - Brand name, sampling point and origin information
    - Pesticides sought and residues found

Potatoes (GB)

Samples tested

23 samples were tested for up to 390 pesticide residues

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

Pesticide residues detected from those sought

- 9 samples contained no residues from those sought
- 14 samples contained residues above the reporting limit
- 1 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

One sample of potato contained imazalil at 0.1 mg/kg, MRL (0.01* mg/kg). This pesticide is only authorised for use on seed potato. The residue may have arisen from exposure from crates used to transport seed potatoes. Members asked that HSE remind the trade that potatoes cannot go to the ware market if they have been treated with imazalil.

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, including
    - Brand name, sampling point and origin information
    - Pesticides sought and residues found

Potatoes (NI)

Samples tested

6 samples were tested for up to 391 pesticide residues

- 6 samples came from the UK

Pesticide residues detected from those sought

- 5 samples contained no residues from those sought
- 1 sample contained residues above the reporting limit
- None of the samples contained residues above the MRL
- 2 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 this 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, including
    - Brand name, sampling point and origin information
    - Pesticides sought and residues found

Spinach (GB)

Samples tested

24 samples were tested for up to 381 pesticide residues

Baby Leaf - Fresh

- 9 samples came from the EU

Spinach - Fresh

- 15 samples came from the EU

Pesticide residues detected from those sought

- 1 sample contained no residues from those sought
- 23 samples contained residues above the reporting limit
- 6 samples contained residues above the MRL
- 4 samples were labelled as organic. 3 contained residues from those sought

Risk assessments

One sample of spinach contained a residue of lambda-cyhalothrin at 0.5 mg/kg (below the MRL of 0.6 mg/kg) where the effect on health needed to be considered in more detail.

Residues of lambda-cyhalothrin are indistinguishable analytically from gamma-cyhalothrin, and the residue could have arisen from application of either gamma-cyhalothrin or lambda-cyhalothrin. As a worst case, it is assumed that the residues in the sample are possibly derived from application of gamma-cyhalothrin to the crop, and therefore this assessment has used the specific ARfD for gamma-cyhalothrin (which is two-fold lower than that for lambda-cyhalothrin). Based on the HSE assessment of short-term risk, we conclude that an effect on health would be unlikely. However, it is recognised that the residue could have arisen from the different isomeric form (lambda-cyhalothrin) which is less toxic than gamma-cyhalothrin; in this case the ARfD for lambda-cyhalothrin is not exceeded and an effect on health is not expected. Full risk assessment is available at section 3.

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

Based on the HSE Chemicals Regulation Division's risk assessment section 3 of the residues detected we consider an effect on health to be unlikely.

Residues measured above the MRL

The laboratory detected 6 residues above the MRL in spinach. 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, including
    - Brand name, sampling point and origin information
    - Pesticides sought and residues found

Spinach (NI)

Samples tested

6 samples were tested for up to 382 pesticide residues

Baby Leaf - Fresh

- 4 samples came from the EU

Spinach - Fresh

- 1 sample came from the EU

Spinach - Frozen

- 1 sample came from the UK

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

Pesticide residues detected from those sought

- 1 sample 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

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, including
    - Brand name, sampling point and origin information
    - Pesticides sought and residues found

Strawberries (GB)

Samples tested

36 samples were tested for up to 382 pesticide residues

Fresh

- 15 samples were imported from outside the EU
- 17 samples came from the EU

Frozen

- 2 samples came from the UK
- 2 samples came from the EU

The country of origin of samples may not be the same as the country where the strawberries were grown. It may be where the strawberries were grown, 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
- 32 samples contained residues above the reporting limit
- None of the samples contained residues above the MRL
- 2 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. One sample 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. 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

Where frozen berries are labelled as a UK product this reflects either the name of the business the food is marketed under or the address of the business that has imported the food. Usually, the fruit was not grown in the UK.

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, including
    - Brand name, sampling point and origin information
    - Pesticides sought and residues found

Strawberry (NI)

Samples tested

6 samples were tested for up to 384 pesticide residues

Fresh

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

Frozen

- 1 sample came from the UK

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

Pesticide residues detected from those sought

- All samples contained residues
- 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

All 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

Where frozen berries are labelled as a UK product this reflects either the name of the business the food is marketed under or the address of the business that has imported the food. Usually, the fruit was not grown in the UK.

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, including

- Brand name, sampling point and origin information
- Pesticides sought and residues found

Tomatoes (GB)

Samples tested

24 samples were tested for up to 396 pesticide residues

Cherry

- 1 sample was imported from outside the EU

Plum

- 1 sample came from the EU

Round

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

Salad

- 3 samples were imported from outside the EU
- 1 sample came from the EU

Vine

- 1 sample came from the UK
- 2 samples were imported from outside the EU
- 6 samples came from the EU

Pesticide residues detected from those sought

- 5 samples contained no residues from those sought
- 19 samples contained residues above the reporting limit
- None of the samples contained residues above the MRL
- 2 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, including
    - Brand name, sampling point and origin information
    - Pesticides sought and residues found

Tomatoes (NI)

Samples tested

6 samples were tested for up to 398 pesticide residues

Cherry

- 1 sample was imported from outside the EU

Plum

- 1 sample was imported from outside the EU

Vine

- 4 samples came from the EU

Pesticide residues detected from those sought

- 1 sample contained no residues from those sought
- 5 samples contained residues above the reporting limit
- None of the samples contained residues above the MRL
- 2 samples were labelled as organic. 1 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, including
    - 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 ODS format.

About sample information

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

- Date and place of collection
- Description (e.g. 'runner bean', organic milk);
- Country of origin or manufacture;
- Brand name and packer/manufacturer; and
- 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/farms. This policy was reviewed in 2000/1, 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/ growers are notified of the result in advance of publication of reports and given four 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 (e.g. 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.
- The suppliers and certification organisation of all organic samples containing any residues of pesticides.

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 ten consumer groups: adults, infants, toddlers, 4-6 year olds, 7-10 year olds, 11-14 year olds, 15-18 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/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 (e.g. 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 of increasing severity:

Effects on health are not expected (toxicological reference values not exceeded) < unlikely risk (of effects on health) < low risk < higher risk (exposures are undesirable[4]). 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 three 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 don’t often exceed the median residues used in the trials assessed at the time of MRL setting and so don’t 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

[4] 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’).

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 further consider the long-term exposure to pesticides[5]. 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[6]).

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, x 10 for animal to man, and x10 for within human population differences in sensitivity. However, toxicologists may propose different values (e.g. from 5 to 1000) based on scientific reasoning in accordance with study designs and the quality of the data that has been generated from the studies.

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[5] Total diet studies (e.g. 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 https://doi.org/10.2903/j.efsa.2020.6057).

[6] 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.
https://doi.org/10.2903/j.efsa.2020.6057

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 end-points that can be examined in human volunteers are those involving observation or blood and urine sampling. Human volunteer studies involving 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 (e.g. potatoes) to processed (e.g. wine), dried (e.g. dried fruit) and composite foods (e.g. 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 (e.g. 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 (e.g. 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. 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 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* (e.g. watercress) and *Caricaceae* (e.g. 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.

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/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 triazole, or more than one organophosphate/carbamate is found or the following combinations captan/folpet, BAC/DDAC, chlormequat/mepiquat, we will undertake an additional risk assessment. 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 % 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[7].

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.

[7] Foods Standards Agency Risk Assessment of Mixtures of Pesticides (COT Report, 2002)

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 FAQs:

- EFSA Feb 2021 (Statement): Comparison of cumulative dietary exposure to pesticide residues for the reference periods 2014–2016 and 2016–2018 link
- EFSA Feb 2021 (Scientific Report) Cumulative dietary risk assessment of chronic acetylcholinesterase inhibition by residues of pesticides link
- EFSA April 2020: News Pesticides: first cumulative risk reports published This work is centred on two case studies (outlined below) link
- EFSA April 2020: Cumulative risk assessment of pesticides: FAQ link
- EFSA April 2020: Cumulative dietary risk characterisation of pesticides that have acute effects on the nervous system link
- EFSA April 2020: Cumulative dietary risk characterisation of pesticides that have chronic effects on the thyroid link
- EFSA news update (Jan 2016) Pesticides: breakthrough on cumulative risk assessment link
- EFSA Sept 2019: Establishment of (CAGs) cumulative assessment groups (effects on thyroid) link
- EFSA Sept 2019: Establishment of (CAGs) cumulative assessment groups (effects on the nervous system) link
- 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 link
- 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 link
- 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 link
- 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 link

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 link

- 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/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/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 2022 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 avocado 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 beans with pods were used for all forms of green beans, including speciality beans
- Data on fish were used for all forms of white fish
- Data on meat (excluding poultry and offal) were used for game (venison)
- Data on peaches were used for peaches and nectarines
- Data on meat (excluding poultry and offal) were used for pork
- Data on tomato, with a variability factor of 7 and a unit weight of 85 g, were used for all tomato samples including plum, cherry, salad, round and vine. This is considered a worst case screening assessment for residues found in all these forms of tomatoes.

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

Avocado GB

Crop	Pesticide	Highest residue (mg/kg)	Adult Intake (mg/kg bw/day)	Critical Group Intake (mg/kg bw/day) †	ARfD (mg/kg bw)	Source
Avocado	Prochloraz	1.5	0.025	0.045 infants 0.044 toddlers 0.037 4-6 year old child 0.034 vegetarian	0.025	EU, 2011

Comment on risk assessment

Avocado flesh after peeling

The dietary intakes calculated for when the peel is removed prior to consumption, indicate that there are no exceedances of the ARfD and, 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 is reported that only 8% of the residue of prochloraz remains (JMPR, 2004) in the flesh when the fruit is peeled.

Whole Avocado, 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 (1.5 mg/kg of prochloraz in avocado, high residue in single fruit item, peak consumption levels (97.5th percentile), and a large proportion of peel from the fruit being consumed).

The following risk assessment assuming all of the peel is consumed, is presented, although the PRiF consider this to be a ‘worst case’ form of assessment for the reasons explained above:

The intakes for infants, toddlers, 4-6 year old children and vegetarians exceeded the ARfD. The highest intake was for infants. If infants ate large portions of avocado containing prochloraz at 1.5 mg/kg, their intake of prochloraz could be 181% of the Acute Reference Dose. This intake is 56 times lower than a dose which caused no observed adverse effect in a 90-day dog study, a multigeneration rat study and 14-day dog study. The European Food Safety Authority used these studies 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 56 still sufficient to make an effect on health unlikely.

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

Beans with pods GB

Crop	Pesticide	Highest residue (mg/kg)	Adult Intake (mg/kg bw/day)	Critical group Intake (mg/kg bw/day) †	ARfD (mg/kg bw)	Source
Beans with pods (Guar beans)	Chlorpyrifos	0.04	0.000092	0.00020 (infants) 0.00020 (toddlers) 0.00015 (4-6 year old child) 0.00011 (vegetarians) 0.00011 (15-18 year olds) 0.000092 (adults) 0.000087 (elderly – own home) 0.000081 (7-10 year old child) 0.000078 (11-14 year old child) 0.000044 (elderly – residential)	No toxicological reference values established	EU, 2019

Comment on risk assessment

EFSA (2019)[8] 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.

[8] EFSA 2019 statement on human health- chlorpyrifos

HSE considers that for short-term risk assessment, an indicative toxicological reference value of 0.0003 mg/kg bw can be used based on the LOAEL set by EFSA for a developmental neurotoxicity study and applying a safety factor of 1000 to account for the severe nature of the findings (effects on brain measurements in a developmental neurotoxicity study). Toxicologists usually use safety factors of between 100 and a 1000 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 on 'Substances that might be genotoxic' 'for HSE's conclusions regarding potential genotoxicity.

Beans with pods GB

Crop	Pesticide	Highest residue (mg/kg)	Adult Intake (mg/kg bw/day)	Critical group Intake (mg/kg bw/day) †	ARfD (mg/kg bw)	Source
Beans with pods (yard long beans)	Dimethoate and Omethoate	0.03 (D: dimethoate) and	D: 0.000069	0.00015 (infants) 0.00015 (toddlers) 0.00011 (4-6 year old child) 0.000083 (vegetarians) 0.000082 (15-18 year olds) 0.000069 (adults) 0.000065 (elderly – own home) 0.000061 (7-10 year old child) 0.000059 (11-14 year old child) 0.000033 (elderly – residential)	Not established	EU, 2019
		0.08 (O: omethoate)	O: 0.00018	0.00040 (infants) 0.00040 (toddlers) 0.00030 (4-6 year old child) 0.00022 (vegetarians) 0.00022 (15-18 year olds) 0.00018 (adults)	Not established	EU, 2019

Crop	Pesticide	Highest residue (mg/kg)	Adult Intake (mg/kg bw/day)	Critical group Intake (mg/kg bw/day) †	ARfD (mg/kg bw)	Source
				0.00017 (elderly – own home) 0.00016 (7-10 year old child) 0.00016 (11-14 year old child) 0.000087 (elderly – residential)		

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. Neither dimethoate nor omethoate is approved in the EU and 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/kg bw/day. Using this indicative value, estimated dietary intakes of dimethoate for infants, toddlers and 4 to 6 year old children exceeded this reference value. The intakes of omethoate for all consumer groups, apart from elderly (residential), exceeded this hypothetical short term toxicological reference value for dimethoate. The highest intake was for infants and toddlers.

If infants and toddlers ate large portions of beans with pods containing dimethoate at 0.03 mg/kg their intake could be 150 % 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 0.08 mg/kg their intake could be 401 % 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 (September, 2019) established an ARfD for dimethoate of 0.02 mg/kg bw; 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. The estimated exposures are not expected to inhibit acetylcholinesterase[9], 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.

[9] This enzyme, acetylcholinesterase, is included I the Glossary on page 117

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

Beans with pods GB

Crop	Pesticide	Highest residue (mg/kg)	Adult Intake (mg/kg bw/day)	Critical group Intake (mg/kg bw/day) †	ARfD (mg/kg bw)	Source
Beans with pods (Guar beans)	Dimethoate and Omethoate	0.04 (D: dimethoate) and 0.05 (O: omethoate)	D: 0.000092 O: 0.00012	0.00020 (infants) 0.00020 (toddlers) 0.00015 (4-6 year old child) 0.00011 (vegetarians) 0.00011 (15-18 year olds) 0.000092 (adults) 0.000087 (elderly – own home) 0.000081 (7-10 year old child) 0.000078 (11-14 year old child) 0.000044 (elderly – residential) 0.00025 (infants) 0.00025 (toddlers) 0.00019 (4-6 year old child) 0.00014 (vegetarians) 0.00014 (15-18 year olds) 0.00012 (adults) 0.00011 (elderly – own home) 0.00010 (7-10 year old child) 0.000098 (11-14 year old child) 0.000054 (elderly – residential)	Not established Not established	EU, 2019 EU, 2019

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 EU 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/kg bw/day. Using this indicative value, estimated dietary intakes of dimethoate for infants, toddlers, 4 to 6 year old children, vegetarians and 15 to 18 year old children exceeded this reference value. The intakes of omethoate for all consumer

groups, apart from 11-14 year old children and elderly (residential), exceeded this hypothetical short term toxicological reference value for dimethoate. The highest intake was for infants and toddlers.

If infants and toddlers ate large portions of beans with pods containing dimethoate at 0.04 mg/kg their intake could be 201 % 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 0.05 mg/kg their intake could be approximately 250 % 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 (September, 2019) established an ARfD for dimethoate of 0.02 mg/kg bw; 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. The estimated exposures are not expected to inhibit acetylcholinesterase[10], 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 on 'Substances that might be genotoxic' for HSE's conclusions regarding potential genotoxicity.

Beans with pods GB

Crop	Pesticide	Highest residue (mg/kg)	Adult Intake (mg/kg bw/day)	Critical group Intake (mg/kg bw/day) †	ARfD (mg/kg bw)	Source
Beans with pods (Yard long beans)	Quinalphos	0.5	0.0012	0.0025 (infants) 0.0025 (toddlers)	0.002	PSD, 1995/HSE 2022

Comment on risk assessment

The intakes for infants and toddlers exceeded the ARfD; This is the same value as the ADI which was based on the NOAEL from a 2-year rat study. This value was also applied by the UK Advisory Committee of Pesticides (ACP[11]) in 2005 for acute (short term) exposure assessment. The highest intake was for infants and toddlers.

If infants and toddlers ate large portions of beans with pods containing quinalphos at 0.5 mg/kg, their intake of quinalphos could be 125 % of the Acute Reference Dose. This intake is 60 times lower than a dose which caused no observed adverse effect in a 2 year rat study (based on the NOAEL of 0.15 mg/kg bw/day). Toxicologists usually apply a factor of 100 to this dose to take into

[10] This enzyme, acetylcholinesterase, is included I the Glossary on page 117
[11] ACP- Advisory Committee on Pesticide, which preceded the UK ECP, Expert Committee of Pesticides.

account uncertainties caused by using animal data and possible differences in susceptibility between people. However, in this case the factor was smaller (75) based on rounding applied at the time the reference value was set. We consider the reduced factor of 60 (from 75) still sufficient to make an effect on health unlikely.

Grapes GB

Crop	Pesticide	Highest residue (mg/kg)	Adult Intake (mg/kg bw/day)	Critical group Intake (mg/kg bw/day) †	ARfD (mg/kg bw)	Source
Grapes	Lambda-cyhalothrin or gamma-cyhalothrin	0.07	0.0014	0.0043 (toddler) 0.0035 (4-6 year old child) 0.0033 (7-10 year old child)	0.0025 (gamma-cyhalothrin)	EU, 2014

Comment on risk assessment

Residues of lambda-cyhalothrin are indistinguishable analytically from gamma-cyhalothrin, and the residue could have arisen from application of either gamma-cyhalothrin or lambda-cyhalothrin. As a worst case, it is assumed that the residues in the sample are possibly derived from application of gamma-cyhalothrin to the crop, and therefore this assessment has used the specific ARfD for gamma-cyhalothrin (which is two-fold lower than that for lambda-cyhalothrin). However, it is recognised that the residue could have arisen from the different isomeric form (lambda-cyhalothrin) which is less toxic than gamma-cyhalothrin. If the residue arises from lambda-cyhalothrin there are no exceedances of the ARfD, and an effect on health would not be expected.

Gamma-cyhalothrin:

The intakes for toddlers, 4-6 year old children and 7-10 year old children exceeded the ARfD for gamma-cyhalothrin. The highest intake was for toddlers.

If toddlers ate large portions of grapes containing gamma-cyhalothrin at 0.07 mg/kg, their intake of gamma-cyhalothrin could be 171 % of the Acute Reference Dose. This intake is 116 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. However, the factor used for gamma-cyhalothrin was two-fold greater (200) to reflect the greater toxicity of gamma-cyhalothrin compared to lambda-cyhalothrin. We consider the reduced factor of 116 still enough to make an effect on health unlikely.

Grapes GB

Crop	Pesticide	Highest residue (mg/kg)	Adult Intake (mg/kg bw/day)	Critical group Intake (mg/kg bw/day) †	ARfD (mg/kg bw)	Source
Grapes	Ethephon	1.6	0.032	0.098 (toddler) 0.081 (4-6 year old child) 0.074 (7-10 year old child) 0.058 (11-14 year old child)	0.05	EU, 2008

Comment on risk assessment

The intakes for toddlers, 4-6 year old children, 7-10 year old children and 11-14 year old children exceeded the ARfD. The highest intake was for toddlers.

If toddlers ate large portions of grapes containing ethephon at 1.6 mg/kg, their intake of ethephon could be 195 % of the Acute Reference Dose. This intake is 61 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 61 (from 120) still sufficient to make an effect on health unlikely. More detail on the factors applied is on page 81 of this report.

Based on this assessment, we conclude that a short term effect on health is unlikely.

Peach/Nectarine GB

Crop	Pesticide	Highest residue (mg/kg)	Adult Intake (mg/kg bw/day)	Critical group Intake (mg/kg bw/day) †	ARfD (mg/kg bw)	Source
Nectarine	Chlorpyrifos	0.04	0.00049	0.0022 (toddler) 0.0015 (4-6 year old child) 0.0014 (infant) 0.0010 (7-10 year old child) 0.00074 (11-14 year old child) 0.00054 (15-18 year old child) 0.00051 (vegetarian) 0.00049 (adult) 0.00047 (elderly – own home) 0.00046 (elderly – residential)	No toxicological reference values established	EU, 2019

Comment on risk assessment

EFSA (2019)[12] 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/kg bw can be used based on the LOAEL set by EFSA for a developmental neurotoxicity study and applying a safety factor of 1000 to account for the severe nature of the findings (effects on brain measurements in a developmental neurotoxicity study). Toxicologists usually use safety factors of between 100 and a 1000 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.

[12] EFSA 2019 statement on human health- chlorpyrifos

The intakes for all of the consumer groups exceeded this HSE proposed indicative toxicological reference value. The highest intake was for toddlers. If toddlers ate large portions of nectarine containing chlorpyrifos at 0.04 mg/kg their intake could be 730 % of the above mentioned HSE proposed indicative toxicological reference value for short term exposure. This intake is approximately 140 times lower than the lowest intake in repeat-dose animal studies at which effects were observed in a developmental neurotoxicity study where pregnant rats were dosed from day 6 of pregnancy through until the pups were 11 days old. Toxicologists usually apply a factor of between 100 and 1000 to this dose to take into account the uncertainties caused by using animal data and possible differences in susceptibility between people. However, given the nature of the findings, HSE took a precautionary approach and applied a factor of 1000. We consider this significant reduction in the uncertainty factor from 1000 to 140 undesirable. The developmental neurotoxicity study in which the effects on the brain measurements were observed reported no behavioural or developmental deficits, and there is an indication that the changes in brain measurement might be reversible. The interpretation of this study by regulatory assessors is uncertain, and, despite the precautionary nature of HSE's assessment, it is not possible to conclude on whether there might be any adverse short term health effects after eating large portions (97.5th percentile consumption) of nectarine containing the level found in this report.

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

Spinach GB

Crop	Pesticide	Highest residue (mg/kg)	Adult Intake (mg/kg bw/day)	Critical group Intake (mg/kg bw/day) †	ARfD (mg/kg bw)	Source
Spinach	Lambda-cyhalothrin or gamma-cyhalothrin	0.5	0.0013	0.0028 (4-6 year old child) 0.0026 (toddler)	0.0025 (gamma-cyhalothrin)	EU, 2014

Comment on risk assessment

Residues of lambda-cyhalothrin are indistinguishable analytically from gamma-cyhalothrin, and the residue could have arisen from application of either gamma-cyhalothrin or lambda-cyhalothrin. As a worst case, it is assumed that the residues in the sample are possibly derived from application of gamma-cyhalothrin to the crop, and therefore this assessment has used the specific ARfD for gamma-cyhalothrin (which is two-fold lower than that for lambda-cyhalothrin). However, it is recognised that the residue could have arisen from the different isomeric form (lambda-cyhalothrin) which is less toxic than gamma-cyhalothrin. If the residue arises from lambda-cyhalothrin there are no exceedances of the ARfD, and an effect on health would not be expected.

Gamma-cyhalothrin:

The intakes for 4-6 year old children and toddlers exceeded the ARfD for gamma-cyhalothrin. The highest intake was for 4-6 year old children.

If 4-6 year old children ate large portions of spinach containing gamma-cyhalothrin at 0.5 mg/kg, their intake of gamma-cyhalothrin could be 114 % of the Acute Reference Dose. This intake is 179 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. However, the factor used for gamma-cyhalothrin was two-fold greater (200) to reflect the greater toxicity of gamma-cyhalothrin compared to lambda-cyhalothrin. We consider the reduced factor of 179 still enough to make an effect on health unlikely.

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 (samples containing more than one organophosphorus/carbamate or captan/folpet or DDAC/BAC or mepiquat/chlormequat or triazoles) and where a more detailed assessment was needed following screening.

Crop/Critical group	Pesticide	Residue mg/kg	Intake - mg/kg bw	Intake - %ARfD		ARfD	Source
Beans with pods/ Infants	Omethoate	0.02	0.00010	-	Total	Not established	EU, 2019
Beans with pods/ Infants	Quinalphos	0.5	0.0025	125.3		0.002	PSD, 1995/HSE 2022

Comment on risk assessment:

The estimated highest intake of quinalphos represents around 125 % of the hypothetical short-term reference value for quinalphos proposed by PSD (1995) and HSE (2022); This is the same value as the ADI which was based on the NOAEL from a 2-year rat study; it was also applied by the UK Advisory Committee of Pesticides (ACP[13]) in 2005 for acute (short term) exposure assessment.

The estimated highest intake of omethoate represents around 100 % of the hypothetical short-term reference value for dimethoate proposed by EFSA (EFSA Conclusion for dimethoate, 2018). 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.

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 omethoate and quinalphos in this sample of beans with pods (Yard long beans) is unlikely.

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

[13] ACP- Advisory Committee on Pesticide, which preceded the UK ECP, Expert Committee of Pesticides.

Crop/Critical group	Pesticide	Residue mg/kg	Intake - mg/kg bw	Intake - %ARfD		ARfD	Source
Beans with pods/Infants	Dimethoate	0.01	0.000050	-	Total	Not established	EU, 2019
	Omethoate	0.02	0.00010	-		Not established	EU, 2019
	Chlorpyrifos	0.04	0.00020	-		Not established	EU, 2019

Comment on risk assessment:

The estimated highest intake of dimethoate represents around 50 % of the hypothetical short-term reference value for dimethoate proposed by EFSA (EFSA Conclusion for dimethoate, 2018) and the estimated highest intake of omethoate represents around 100 % of the hypothetical short-term reference value for dimethoate proposed by EFSA (EFSA Conclusion for dimethoate, 2018). 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/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 and in which exposure to omethoate would have been expected. 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, omethoate 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 4 % 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 and omethoate in the single substance risk assessments.

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, omethoate and chlorpyrifos 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.

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.

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.

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 2022) and conclusions:

Residues found in this report that have genotoxic potential (concluded from laboratory studies on animals): omethoate

There is some evidence (*in vitro* and/or *in vivo*[14]) that these residues can damage genetic material (are genotoxic). 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 increase cancer incidence in studies with repeat daily doses over their life-span in rats or mice. The doses used in both the genotoxicity tests and the cancer 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.

Residues found in this report where toxicological data are suggestive of genotoxicity but not certain: dimethoate, chlorpyrifos

It is unclear whether these pesticides can damage genetic material (are genotoxic). There is some evidence from studies performed *in vitro* and/or *in vivo* that they may be genotoxic. Whilst there are negative results in the available *in vivo* studies, the currently recommended *in vivo* 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.

Conclusions: Overall, we conclude that on a precautionary basis any of these residue findings of these pesticides are 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.

[14] *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 at https://www.chilledfood.org/fbig/.

Fosetyl-Al (sum)

The full residue definition is "Fosetyl-Al (sum of fosetyl, phosphonic acid and their salts, expressed as fosetyl)". All the residues reported as fosetyl-Al (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.

So, we do not think that these findings necessarily indicate use of any of fosetyl-Al, disodium phosphonate, or potassium phosphonates. However, where we have detected phosphonic

acid in a sample grown in the UK either fosetyl-Al or potassium phosphonates is authorised for use on that crop.

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.

Best practice for use

The Food Standards Agency is working with the food industry to develop and promote best practice in the use of sanitisers. This is important because 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 can contain small amounts of chlorate.

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[15] establishes appropriate health-based guidance values for chlorate exposure to protect against acute and chronic risks to health.

DDT

The use of DDT is banned of heavily restricted in many countries. It isn't 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,

[15] EFSA Journal 2015;13(6):4135 [103 pp.]
http://ec.europa.eu/food/plant/standing_committees/sc_phytopharmaceuticals/index_en.htm

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 (which is what we usually find). 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.

Processing factors

As the surveillance programme monitors residues in all types of food, from raw commodities (e.g. potatoes) to processed (e.g. wine), dried (e.g. dried fruit) and composite foods (e.g. fruit bread), consumer risk assessments are specifically tailored to address processed and mixed food products. MRLs are generally set for raw commodities, although when MRLs are established the assessment of dietary intakes takes into account the potential for residues to remain in processed foods produced from the raw agricultural commodities. MRLs have been set for processed infant foods, and in future may be extended to other processed food products.

MRLs apply to all traded foods, including foods used as ingredients. The law specifies the level to apply to foods as they are traded. For almost all foods that means their raw, unprocessed form. But MRLs also apply to prepared and processed foods in which case the effect of processing needs to be taken into account.

In nearly all cases the MRL is set for the food in its raw, unprocessed form (the form of each food to which MRLs apply is listed in Annex I of Regulation 396/2005). These MRLs can be applied to processed foods using appropriate processing factors. Processing factors take account of the effect of processing on the food as traded. Different forms of processing may remove, concentrate, or dilute residues, and the effect may vary depending on the food and the pesticide concerned. Multiplying the processing factor by the original MRL gives a calculated MRL that can indicate the food was made with an ingredient or ingredients which had residues over the original MRL.

Calculating the MRLs for processed goods is dependent on the information available. HSE will contact the supplier if residues exceed the calculated MRL to give them an opportunity to provide relevant information to support the calculation.

Processing factors for olive oil. PRiF use the general principle that is used in the EU reports. The general principle that for virgin olive oil, and for fat soluble compounds a default x 5 factor can be applied (in the absence of a more specific experimentally derived PF), see the link below.

https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32018R0555&from=EN

Virgin olive oil (if no specific oil processing factor is available, a default factor of 5 may be applied for fat-soluble substances, taking into account an olive oil production standard yield of 20 % of the olive harvest; for non-fat- soluble substances a default oil processing factor of 1 may be used).

Follow-up from Previous Reports

Quarter 4 2021

GB Berries and small fruits

Cyantraniliprole: Sample numbers 0623/2021 and 5914/2021

We passed details of samples of blackberries from the UK that contained residues of cyantraniliprole to HSE. HSE enquiries are not yet complete and an update will appear in a future report.

GB Broccoli/Calabrese

Triallate: Sample numbers 4312/2021 and 5514/2021

We passed details of samples of broccoli and calabrese from the UK that contained residues of triallate to HSE. HSE enquiries are not yet complete and an update will appear in a future report.

NI Mushrooms

Deltamethrin: Sample number 0667/2021

We passed details of a sample of button mushrooms from the UK that contained a residue of deltamethrin to HSE NI, these enquiries are not yet complete and an update will appear in a future report.

GB Raspberries

Thiacloprid: Sample numbers 2681/2021

We passed details of a sample of raspberries from the UK that contained a residue of thiacloprid to HSE. HSE enquiries concluded this residue was as a result of legal application under an extant extension of authorisation for minor use (EAMU). This conclusion was supported by the spray records provided

GB Spring greens and kale

Prosulfocarb and Triallate: Sample numbers 5561/2021 and 5799/2021

We passed details of these samples of kale from the UK that contained residues of prosulfocarb and triallate to HSE. It was established that these samples originated from the same grower. HSE's investigation concluded that there was no evidence of misuse of prosulfocarb or triallate. Although prosulfocarb had been applied legally to preceding crops, evidence was provided that tank washing protocols were followed by the grower before application to kale. HSE is considering other contributing sources of these residues and therefore in this instance is not considered indicative of unapproved use.

Triallate: Sample numbers 5536/2021, 1440/2021 and 0544/2021

We passed details of samples of kale to HSE which contained residues of triallate. HSE investigation concluded that there was no evidence of misuse of triallate. HSE's risk assessment published in Quarter 4 2021 indicates that, although undesirable a risk of adverse health effects from the levels of triallate found in this survey are low. HSE is

considering other contributing sources of this residue and is in this instance therefore not considered indicative of unapproved use. The details of the organic kale sample (5536/2021) have been passed to Defra organics and the appropriate organic body.

Triallate: Sample number 5551/2021

We passed details of samples of kale from the UK that contained residues of triallate to HSE. HSE investigation concluded that there was no evidence of misuse of triallate, this conclusion was supported by spray records. HSE is considering other contributing sources of this residue and therefore in this instance is not considered indicative of unapproved use.

Triallate: Sample numbers 0697/2021 and 5915/2021

We passed details of samples of kale from the UK that contained residues of triallate to HSE. HSE enquiries are not yet complete and an update will appear in a future report.

Triallate: Sample numbers 2876/2021, 0730/2021 and 1157/2021

We passed details of samples of spring greens from the UK that contained residues of triallate to HSE. HSE enquiries are not yet complete and an update will appear in a future report.

NI Spring greens and kale

Triallate: Sample number 0593/2021

We passed details of a sample of kale from the UK that contained a residue of triallate to HSE. HSEs investigation concluded that there was no evidence of misuse of triallate. HSE's risk assessment published in Quarter 4 2021 indicates that, although undesirable a risk of adverse health effects from the levels of triallate found in this survey are low. HSE is considering other contributing sources of this residue and therefore in this instance is not considered indicative of unapproved use.

Prosulfocarb and Triallate: Sample number 5658/2021

We passed details of a sample of kale from the UK that contained residues of prosulfocarb and triallate to HSE. HSEs investigation concluded that there was no evidence of misuse of prosulfocarb or triallate. Although prosulfocarb had been applied legally to preceding crops, evidence was provided that tank washing protocols were followed by the grower before application to kale. HSE is considering other contributing sources of these residues and therefore in this instance are not considered indicative of unapproved use..

Brand name details of samples where follow-up action is now complete are included in the data file for Quarter 1 2022

In our next report:

In Quarter 2 of 2022 we will look at results for:

Samples collected in GB

- Apples (eating)
- Apricots
- Avocado
- Barley products
- Beans with pods
- Cabbage
- Cherries
- Cucumber
- Fish (sea)
- Grapes
- Lettuce
- Milk
- Oat products
- Pasta
- Peaches and nectarines
- Pork
- Potatoes
- Spinach
- Strawberry
- Sundried tomatoes
- Tomatoes
- Wine

Samples collected in NI

- Apples (eating)
- Apricots
- Barley products
- Beans with pods
- Cabbage
- Cherries
- Cucumber
- Fish (sea)
- Game
- Grapes
- Lettuce
- Milk
- Oat products
- Peaches and nectarines
- Pork
- Potatoes
- Spinach
- Strawberry
- Tomatoes

2023 provisional Monitoring plan

- Beans (dried)
- Beans with pods
- Bread
- Carrots
- Cauliflower
- Cheese
- Chicken
- Crisps
- Fish
- Free-from products (bread, cereal, flour, pasta)
- Fruit juice
- Grapes
- Infant formula
- Kiwi fruit
- Lemons
- Milk
- Onions
- Oranges
- Pears
- Peas
- Pineapple
- Potatoes
- Pulses, dahls, chickpeas etc
- Rice
- Rye
- Soft citrus
- Speciality snacks (rice cakes seaweed etc)
- Speciality vegetables
- Spices

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

- We include information about the survey (for instance where samples came from) for each commodity
- Detailed tabulated results are at the back of this report - these tables are also available for download from our website
- We summarise our findings and any follow-up action taken.

Risk assessments – single 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

- 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

- 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.

- 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

- 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/kg and 0.025 mg/kg giving an average value of 0.024 mg/kg. For reporting purpose this value would be 0.02 mg/kg.
- If measurement uncertainty is then applied to the reported value of 0.02 mg/kg it could take the value to between 0.01 - 0.03 mg/kg. If the MRL is 0.01 mg/kg the lower value would be at the MRL and there is no exceedance.
- However, if measurement uncertainty is applied to the measured result, e.g. 0.024 mg/kg the value could then be in the range of 0.012 – 0.036 mg/kg. In this case the lower value is above the MRL and so will be treated as an exceedance.

Residues in 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.

Brand Name Annex

- 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 below which explains the complex residue definitions used in our reports. 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)

Short name we use in our reports	Legal residue definition – These definitions apply to all foods unless otherwise stated
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
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)

Short name we use in our reports	Legal residue definition – These definitions apply to all foods unless otherwise stated
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)
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)
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 & 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 (sum)	Fosetyl-Al (sum of fosetyl, phosphonic acid and their salts, expressed as fosetyl)

Short name we use in our reports	Legal residue definition – These definitions apply to all foods unless otherwise stated
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)
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)

Short name we use in our reports	Legal residue definition – These definitions apply to all foods unless otherwise stated
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.
Prothioconazole (sum)	Prothioconazole (sum of prothioconazole-desthio and its glucuronide conjugate, expressed as prothioconazoledesthio) This definition applies to animal products only
PTU & 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)
Prochloraz (sum)	Prochloraz (sum of prochloraz and its metabolites containing the 2,4,6-Trichlorophenol moiety expressed as prochloraz)
Terbufos (sum)	Terbufos (sum of terbufos, its sulfoxide and sulfone This definition applies only to foods for babies
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 & 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, e.g. 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”**

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 (e.g. 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 97.5^{th} 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 under 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/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 Northern Ireland Protocol so where appropriate will email notifications via the RASFF network, including for non-compliances under AAC procedures.

JMPR: Joint FAO/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.

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 i.e. 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/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, i.e. 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/kg bw/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/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, e.g. 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/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 e.g. 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/food/commodity (mg/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 (i.e. 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, e.g. melon, or a small number of units e.g. apples and potatoes.