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 2 2021

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

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Summary: Quarter 2 2021 findings

Chair's comments

During this year's surveillance programme, we are measuring up to 396 different pesticides in each of the foods we survey. The Quarter 2 programmes surveyed 705 samples of 21 different foods (see contents page for a full list).

Of 705 samples, we found residues in 323 of them and of these 22 samples contained residues over the Maximum Residue Level (MRL). Most of the residues detected did not cause health concern.

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 some of the residues found in more detail. In most of these cases, we concluded that effects on health were either unlikely or not expected. Full details are presented in section 3.

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 banana, beans with pods, grapefruit, melon and olive oil.

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 based on the assessment of dietary intakes being 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.

These samples were collected after the UK had left the EU, so this is the second report where we have reported 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 are, for 2021 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 screen 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 liaise with the Food Standards Agency (FSA) on consumer risk assessment and the FSA also take part in our meetings.

Headlines with links to detailed information

Table 1

Survey title (where samples collected)	Number of pesticides sought	Samples tested	Detailed risk assessment presented?	MRL exceedances (samples)
All Foods tested				
Asparagus (GB)	389	24		3
Asparagus (NI)	389	6		1
Aubergine (GB)	373	24		2
Aubergine (NI)	374	6		0
Banana (GB)	392	20	Yes	2
Banana (NI)	392	2		0
Beans with pods (GB)	389	18	Yes	2
Beans with pods (NI)	389	2		1
Beef (GB)	118	24		0
Beef (NI)	42	19		0
Berries & small fruits (GB)	368	18		0
Berries & small fruits (NI)	368	5		0
Broccoli (GB)	370	17		0
Broccoli (NI)	371	6		1
Cheese (soft) (GB)	116	24		0
Cheese (soft) (NI)	37	18		0
Eggs (GB)	118	23		0
Fish (white) (NI)	38	17		0
Grapefruit (GB)	392	37	Yes	6
Grapefruit (NI)	391	4	Yes	0

Survey title (where samples collected)	Number of pesticides sought	Samples tested	Detailed risk assessment presented?	MRL exceedances (samples)
Grapes (GB)	396	30		0
Grapes (NI)	396	2		0
Melon (GB)	372	27		2
Melon (NI)	372	4	Yes	0
Milk (GB)	115	71		0
Milk (NI)	115	6		0
Mushroom (GB)	395	17		0
Mushroom (NI)	395	3		0
Olive oil (GB)	395	48	Yes	0
Olive oil (NI)	391	6	Yes	0
Peppers (GB)	394	18		0
Peppers (NI)	394	3		0
Potatoes (GB)	390	37		0
Potatoes (NI)	390	3		0
Raspberry (GB)	368	30		1
Raspberry (NI)	368	5		0
Spring greens & kale (GB)	366	30		0
Spring greens & kale (NI)	366	9		1
Wheat (GB)	395	36		0
Wheat (NI)	395	6		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 their enforcement team of samples from GB 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.

- 2 GB samples of raspberries with residues of thiacloprid. HSE Enforcement concluded that for one sample, thiacloprid was used legally while the active was still authorised for use on raspberries. For the other sample the investigation concluded that thiacloprid had been applied to other crops and the residue could be a result of potential contamination from the equipment.

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.

- 1 NI sample of broccoli
- 1 NI sample of extra virgin olive oil

Further information

Further information on the individual sample details is in an accessible format at Pesticide Residues in Food Quarterly Data.

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 year, 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. They 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 (https://www.hse.gov.uk/pesticides/pesticides-registration/data-requirements-handbook/consumer-exposure.htm)

- 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 life-time. 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 ‘cocktail effect’ – the possible implications to health of more than one pesticide being found in samples. We currently focus in detail on selected groups that we think are a priority to consider based on toxicity considerations and prevalence.

Table 2: 2021 Survey Design

Fruit and vegetables

Food	Sampling points	Sampled during	Reporting
Asparagus (GB)	Retail Outlets and Supply chain	Quarters 2 and 4	Quarters 2 and 4
Asparagus (NI)	Retail Outlets	Quarters 2 and 4	Quarters 2 and 4
Aubergine (GB)	Retail Outlets and Supply chain	Quarterly	Quarterly
Aubergine (NI)	Retail Outlets	Quarterly	Quarterly
Banana (GB)	Retail Outlets and Supply chain	Quarterly	Quarterly
Banana (NI)	Retail Outlets	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
Berries and small fruit (GB)	Retail Outlets and Supply chain	Quarterly	Quarterly
Berries and small fruit (NI)	Retail Outlets	Quarterly	Quarterly
Broccoli (GB)	Retail Outlets and Supply chain	Quarterly	Quarterly
Broccoli (NI)	Retail Outlets	Quarterly	Quarterly
Grapefruit (GB)	Retail Outlets and Supply chain	Quarter 2 - 4	Quarter 2 - 4
Grapefruit (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
Melon (GB)	Retail Outlets and Supply chain	Quarterly	Quarterly
Melon (NI)	Retail Outlets	Quarterly	Quarterly
Mushrooms (GB)	Retail Outlets	Quarterly	Quarterly
Mushrooms (NI)	Retail Outlets	Quarterly	Quarterly
Peppers (GB)	Retail Outlets and Supply chain	Quarterly	Quarterly
Peppers (NI)	Retail Outlets	Quarterly	Quarterly
Potatoes (GB)	Supply chain	Quarterly	Rolling and Quarterly
Potatoes (NI)	Retail Outlets	Quarterly	Rolling and Quarterly
Raspberry (GB)	Retail Outlets	Quarterly	Quarterly
Raspberry (NI)	Retail Outlets	Quarterly	Quarterly
Spring green and kale (GB)	Retail Outlets	Quarter 2 - 4	Quarter 2 - 4
Spring green and kale (NI)	Retail Outlets	Quarter 2 - 4	Quarter 2 - 4

Animal products

Food	Sampling points	Sampled during	Reporting
Beef (GB)	Retail Outlets	Quarterly	Quarterly
Beef (NI)	Retail Outlets	Quarterly	Quarterly
Cheese (soft) (GB)	Retail Outlets	Quarterly	Quarters 1, 2 and 4

Cheese (soft) (NI)	Retail Outlets	Quarterly	Quarterly
Eggs (GB)	Retail Outlets	Quarterly	Quarterly
Eggs (NI)	Retail Outlets	Quarterly	Quarters 1, 3 and 4
Fish (white) (NI)	Retail Outlets	Quarterly	Quarterly
Milk (GB)	Retail Outlets	Quarterly	Quarterly
Milk (NI)	Retail Outlets	Quarterly	Quarterly

Cereal products

Food	Sampling points	Sampled during	Reporting
Bread (GB)	Retail Outlets	Quarters 2 - 4	Quarter 3 and 4
Bread (NI)	Retail Outlets	Quarters 2 - 4	Quarter 3 and 4
Rice (GB)	Retail Outlets	Quarter 1 and 3	Quarter 1 and 3
Rice (NI)	Retail Outlets	Quarter 1 and 3	Quarter 1 and 3
Wheat (GB)	Retail Outlets	Quarterly	Quarter 2 and 4
Wheat (NI)	Retail Outlets	Quarterly	Quarter 2 and 4

Miscellaneous products

Food	Sampling points	Sampled during	Reporting
Edible seeds (GB)	Retail Outlets	Quarter 2 and 3	Quarter 3
Infant food (cereal based) (GB)	Retail Outlets	Quarter 3	Quarter 3
Infant food (cereal based) (NI)	Retail Outlets	Quarter 3	Quarter 3
Nuts (GB)	Retail Outlets	Quarters 3 and 4	Quarter 4
Olive Oil (GB)	Retail Outlets	Quarterly	Quarters 2 - 4
Olive oil (NI)	Retail Outlets	Quarterly	Quarters 2 - 4
Processed peppers (GB)	Retail Outlets	Quarter 3	Quarter 4
Soya milk (GB)	Retail Outlets	Quarter 3	Quarter 3
Soya products (GB)	Retail Outlets	Quarter 3	Quarter 3

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 Type	Analysed	With residues at or below the MRL[2]	With residues above the MRL[3]	With residues of unauthorised pesticides	With multiple residues	Organic samples tested	Organic samples with residues
Asparagus (GB)	24	1	3	0	1	0	0
Asparagus (NI)	6	0	1	0	0	0	0
Aubergine (GB)	24	15	2	0	7	2	0
Aubergine (NI)	6	4	0	0	1	0	0
Banana (GB)	20	16	2	0	16	1	0
Banana (NI)	2	2	0	0	2	0	0
Beans with Pods (GB)	18	11	2	0	9	0	0
Beans with pods (NI)	2	0	1	0	0	0	0
Beef (GB)	24	0	0	0	0	2	0
Beef (NI)	19	0	0	0	0	2	0

[2]. In analytical terms this is a reportable value between LOD and the MRL

[3] 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 set MRLs.

Food Type	Analysed	With residues at or below the MRL[2]	With residues above the MRL[3]	With residues of unauthorised pesticides	With multiple residues	Organic samples tested	Organic samples with residues
Berries and small fruits (GB)	18	12	0	0	8	1	0
Berries and small fruits (NI)	5	3	0	0	3	0	0
Broccoli (GB)	17	8	0	0	4	3	0
Broccoli (NI)	6	4	1	0	2	2	1
Cheese (soft) (GB)	24	7	0	0	0	0	0
Cheese (soft) (NI)	18	0	0	0	0	0	0
Eggs (GB)	23	0	0	0	0	3	0
Fish (white) (NI)	17	2	0	0	0	0	0
Grapefruit (GB)	37	31	6	0	37	0	0
Grapefruit (NI)	4	4	0	0	4	0	0
Grapes (GB)	30	30	0	0	28	0	0
Grapes (NI)	2	2	0	0	2	0	0
Melon (GB)	27	18	2	0	9	1	0

Food Type	Analysed	With residues at or below the MRL[2]	With residues above the MRL[3]	With residues of unauthorised pesticides	With multiple residues	Organic samples tested	Organic samples with residues
Melon (NI)	4	3	0	0	2	0	0
Milk (GB)	71	0	0	0	0	19	0
Milk (NI)	6	0	0	0	0	0	0
Mushroom (GB)	17	5	0	0	1	8	0
Mushroom (NI)	3	1	0	0	1	0	0
Olive oil (GB)	48	12	0	0	5	14	0
Olive oil (NI)	6	1	0	0	0	1	1
Peppers (GB)	18	15	0	0	6	0	0
Peppers (NI)	3	3	0	0	2	0	0
Potatoes (GB)	37	19	0	0	3	4	0
Potatoes (NI)	3	0	0	0	0	0	0
Raspberry (GB)	30	23	1	2	15	0	0
Raspberry (NI)	5	3	0	0	1	0	0

Food Type	Analysed	With residues at or below the MRL[2]	With residues above the MRL[3]	With residues of unauthorised pesticides	With multiple residues	Organic samples tested	Organic samples with residues
Spring greens and kale (GB)	30	11	0	0	6	5	0
Spring greens and kale (NI)	9	6	1	0	3	1	0
Wheat (GB)	36	23	0	0	14	11	0
Wheat (NI)	6	6	0	0	3	0	0

Table 4: Summary of MRL Exceedances

Sample ID	Food Type	Country of Origin	Pesticide Detected	Residue Detected (mg/kg)	MRL (mg/kg)[I]	MRL exceedance after allowing for measurement uncertainty
Asparagus (GB)						
3260/2021	Fine Asparagus	Mexico	flonicamid (sum)	0.07	0.03*	Yes
3531/2021	Asparagus	Peru	methomyl	0.02	0.01*	No
3615/2021	Asparagus	Mexico	flonicamid (sum)	0.2	0.03*	Yes
Asparagus (NI)						
2420/2021	Asparagus	Mexico	flonicamid (sum)	0.04	0.03*	No
Aubergine (GB)						
2175/2021	Aubergine	Spain	chlorate	0.7	0.4	No
3916/2021	Baby Egg plant	Uganda	profenofos	0.2	0.01*	Yes
Banana (GB)						
3576/2021	Banana (eating)	Ecuador	imazalil	0.6	0.01*	Yes
3599/2021	Plantain	Colombia	buprofezin	0.04	0.01*	Yes
Beans with pods (GB)						
3732/2021	Speciality Beans	Mexico	bifenthrin	0.1	0.01*	Yes
			dithiocarbamates	1.6	1	No

			sulfoxaflor	0.05	0.01*	Yes
4001/2021	Speciality Beans	Spain	dithiocarbamates	1.2	1	No
Beans with pods (NI)						
3071/2021	Runner Beans	Kenya	BAC (sum)	0.4	0.1	Yes
Broccoli (NI)						
3167/2021	Frozen	UK	Fosetyl (sum)	32	10	Yes
Grapefruit (GB)						
3511/2021	Star Ruby Grapefruit	Turkey	chlorpyrifos-methyl	0.04	0.01*	Yes
			Prochloraz (sum)	0.1	0.03*	Yes
3517/2021	Pink Grapefruit	Turkey	chlorpyrifos	0.02	0.01*	No
			pirimiphos-methyl	0.04	0.01*	Yes
3553/2021	Rio Red Grapefruit	Turkey	chlorpyrifos-methyl	0.08	0.01*	Yes
3569/2021	Grapefruit	Morocco	chlorpyrifos	0.1	0.01*	Yes
3893/2021	Red Grapefruit	Turkey	chlorpyrifos-methyl	0.07	0.01*	Yes
			fenbutatin oxide	0.4	0.01*	Yes
3925/2021	Star Ruby Grapefruit	Cyprus	imazalil	4.4	4	No
Melon (GB)						
0095/2021	Honeydew	Spain	chlorate	0.3	0.08	Yes
3232/2021	Honeydew	Spain	chlorate	0.3	0.08	Yes

Raspberry (GB)

1528/2021	Frozen	UK	dithiocarbamates	0.07	0.05*	No

Spring greens and kale (NI)

2391/2021	Spring Greens	UK	fluazifop-p (sum)	0.02	0.01*	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

Asparagus (GB)

Samples tested

24 samples were tested for up to 389 pesticide residues

- 11 samples came from the UK
- 12 samples were imported from outside the EU
- 1 sample came from the EU

Pesticide residues detected from those sought

- 20 samples contained no residues from those sought
- 4 samples contained residues above the reporting limit
- 3 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

We would not expect any of the residues detected to have an effect on health.

Residues measured above the MRL

The laboratory detected 3 residues above the MRL in asparagus. 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

Asparagus (NI)

Samples tested

6 samples were tested for up to 389 pesticide residues

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

Pesticide residues detected from those sought

- 5 samples contained no residues from those sought
- 1 sample 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

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

Additional comments by the PRiF

We would not expect any of the residues detected to have an effect on health.

Residues measured above the MRL

The laboratory detected 1 residue above the MRL in asparagus. 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

Aubergine (GB)

Samples tested

24 samples were tested for up to 373 pesticide residues

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

Pesticide residues detected from those sought

- 7 samples contained no residues from those sought
- 17 samples contained residues above the reporting limit
- 2 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. 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 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

We would not expect any of the residues detected to have an effect on health.

Residues measured above the MRL

The laboratory detected 2 residues above the MRL in aubergine. 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

Aubergine (NI)

Samples tested

6 samples were tested for up to 374 pesticide residues

- 6 samples came from the EU

Pesticide residues detected from those sought

- 2 samples contained no residues from those sought
- 4 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

We would not expect any of the residues detected to have an effect on health.

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

Banana (GB)

Samples tested

20 samples were tested for up to 392 pesticide residues

Banana (eating)

- 16 samples were imported from outside the EU

Plantain

- 4 samples were imported from outside the EU

Pesticide residues detected from those sought

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

Risk assessments

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

Chlorpyrifos: A sample of banana contained a residue of chlorpyrifos at 0.005 mg/kg where the effect on health needed to be considered further.

Based on the HSE assessment of risk for this sample containing chlorpyrifos, if the bananas are consumed without the peel a short-term effect on health is not expected.

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.

Assuming bananas are eaten whole, including all of the peel, this sample containing a residue of chlorpyrifos at 0.005 mg/kg, we consider a short-term effect on health to be unlikely. However, if the peel is not consumed then it is reported that only 2% of the residue remains (EFSA, 2017) and based on this lower intake a short-term 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. However, we consider any risks of adverse health effects are low due to the limited levels of exposure anticipated based on this residue of chlorpyrifos (0.005 mg/kg) in banana.

Thiabendazole: A sample of banana contained a residue of thiabendazole at 1.5 mg/kg where the effect on health needed to be considered further.

Based on the HSE assessment of risk for this sample containing thiabendazole (see section 3), if all the peel is consumed with the banana flesh, we conclude an effect on health would be unlikely. However, if the banana is consumed without the peel a short-term effect on health is not expected. This is because if the peel is removed it is reported that only 3% of the residue remains (EFSA, 2016).

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

The potential short-term effect of two residues we needed to consider in more detail depends on whether the peel is eaten. In neither case would we expect an effect on health if the peel was not eaten and even if all of the peel was eaten an effect is unlikely.

We also concluded any risk of adverse health effect from chlorpyrifos due to genotoxicity to be low.

We note that market approval for chlorpyrifos has been withdrawn in many jurisdictions. This is consistent with our view that any residue of chlorpyrifos is undesirable, due to uncertainty in the genotoxicity safety assessment.

Other risk assessment screening work undertaken did not indicate any other expectation of effects on health.

Residues measured above the MRL

The laboratory detected 2 residues above the MRL in bananas. 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

Banana (NI)

Samples tested

2 samples were tested for up to 392 pesticide residues

Bananas (eating)

- 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

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 would not expect any of the residues detected to have an effect on health.

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

Beans with pods (GB)

Samples tested

18 samples were tested for up to 389 pesticide residues

Dwarf Beans

- 1 sample was imported from outside the EU

Fine Beans

- 6 samples were imported from outside the EU

Green Beans

- 3 samples were imported from outside the EU

Runner Beans

- 2 samples were imported from outside the EU

Speciality Beans

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

Pesticide residues detected from those sought

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

Risk assessments

One sample of Guar beans contained a residue of omethoate where the effect on health needed to be considered in more detail. Omethoate is the main metabolite of dimethoate; dimethoate itself was sought but not found in this sample.

In 2018, EFSA reviewed dimethoate and concluded that no toxicological reference values could be determined for dimethoate and its metabolite omethoate, due to a lack of a fully supporting toxicological database (EFSA Conclusion for dimethoate, 2018). At the anticipated highest exposures following consumption of this Guar beans sample, an effect on health is not expected based on short-term toxicity. Please refer to section 3 for full details of HSE's assessment.

The EFSA Conclusion (2018) for dimethoate also includes a consideration of the potential for genotoxicity (whether damage to genetic material can occur) for dimethoate and omethoate. We conclude that on a precautionary basis any findings of omethoate are undesirable due to the uncertainty regarding genotoxicity at low doses. However, we consider any risks of adverse health effects are low due to the limited levels of exposure anticipated based on the omethoate residues found in beans with pods in this report.

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 one residue of omethoate at 0.004 mg/kg in more detail and following HSE's assessment of risk, concluded the likelihood of adverse health effects to be low. For full details, please refer to section 3.

There are a small number of examples of older pesticides (no longer approved in the UK) that might be genotoxic, where modern data to further investigate the 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 or have not been formally established due to insufficient toxicological data or concerns regarding their toxicity such as genotoxicity. Omethoate is one such example where a toxicological reference value has not been formally set as there is some evidence that it is genotoxic. We test for some of these older pesticides in some surveys using lower reporting limits to ensure that these residues are found even at very low levels, as we know they are of particular interest to consumers. We have surveyed beans with pods for a number of years and publish the results of this sampling throughout the year as part of our rolling reporting programme as we know that a high percentage of the samples are imported and may contain residues of these older pesticides.

Residues measured above the MRL

The laboratory detected 4 residues above the MRL in beans with pods. 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

Beans with pods (NI)

Samples tested

2 samples were tested for up to 389 pesticide residues

Fine Beans

- 1 sample was imported from outside the EU

Runner Beans

- 1 sample was imported from outside the EU

Pesticide residues detected from those sought

- 1 sample contained no residues from those sought
- 1 sample 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

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

Additional comments by the PRiF

We would not expect any of the residues detected to have an effect on health.

Residues measured above the MRL

The laboratory detected 1 residue above the MRL in beans with pods. 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

Beef (GB)

Samples tested

24 samples were tested for up to 118 pesticide residues

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

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

Pesticide residues detected from those sought

- 24 samples contained no residues from those sought
- None of the samples contained residues above the MRL
- 2 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

The laboratory did not detect any residues at or above the reporting limit

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

Beef (NI)

Samples tested

19 samples were tested for up to 42 pesticide residues

- 19 samples came from the UK

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

Pesticide residues detected from those sought

- 19 samples contained no residues from those sought
- None of the samples contained residues above the MRL
- 2 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

The laboratory did not detect any residues at or above the reporting limit.

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

Berries and small fruits (GB)

Samples tested

18 samples were tested for up to 368 pesticide residues

Fresh: Blackberries

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

Fresh: Blueberries

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

Frozen: Blackberries

- 2 samples came from the UK

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

Pesticide residues detected from those sought

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

Risk assessments

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

Combined risk assessments

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

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

Additional comments by the PRiF

We would not expect any of the residues detected to have an effect on health.

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

Berries and small fruits (NI)

Samples tested

5 samples were tested for up to 368 pesticide residues

Fresh: Blackberries

- 1 sample was imported from outside the EU

Fresh: Blueberries

- 2 samples came from the EU

Frozen: Blueberries

- 1 sample came from the UK
- 1 sample came from the EU

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

Pesticide residues detected from those sought

- 2 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 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

We would not expect any of the residues detected to have an effect on health.

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

Broccoli (GB)

Samples tested

17 samples were tested for up to 370 pesticide residues

Fresh

- 1 sample was imported from outside the EU
- 15 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 broccoli was produced. It may be where the broccoli was processed, where it was packed for consumer purchase or the address of the brand owner.

Pesticide residues detected from those sought

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

Risk assessments

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

Combined risk assessments

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 would not expect any of the residues detected to have an effect on health.

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

Broccoli (NI)

Samples tested

6 samples were tested for up to 371 pesticide residues

Fresh

- 5 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 broccoli was produced. It may be where the broccoli was processed, where it was 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
- 1 sample 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

We would not expect any of the residues detected to have an effect on health.

Residues measured above the MRL

The laboratory detected 1 residue above the MRL in broccoli. 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

Cheese (soft) (GB)

Samples tested

24 samples were tested for up to 116 pesticide residues

Brie

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

Camembert

- 6 samples came from the EU

Cottage Cheese

- 1 sample came from the UK

Cream Cheese

- 1 sample came from the UK

Feta

- 4 samples came from the EU

Mozzarella

- 3 samples came from the EU

Ricotta

- 1 sample came from the UK

Soft Cheese

- 2 samples came from the EU

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

Pesticide residues detected from those sought

- 17 samples contained no residues from those sought
- 7 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

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

Additional comments by the PRiF

We would not expect any of the residues detected to have an effect on health.

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

Cheese (soft) (NI)

Samples tested

18 samples were tested for up to 37 pesticide residues

Brie

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

Camembert

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

Feta

- 1 sample came from the EU

Mozzarella

- 3 samples came from the EU

Ricotta

- 1 sample came from the EU

Soft Cheese

- 4 samples came from the EU

The country of origin of samples may not be the same as the country where the cheese was produced. It may be where the cheese 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
- None of the samples contained residues above the MRL
- None of the samples were labelled as organic.

Risk assessments

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

Additional comments by the PRiF

The laboratory did not detect any residues at or above the reporting limit.

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

Eggs (GB)

Samples tested

23 samples were tested for up to 118 pesticide residues

Hens

- 23 samples came from the UK

Pesticide residues detected from those sought

- 23 samples contained no residues from those sought
- None of the samples contained residues above the MRL
- 3 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

The laboratory did not detect any residues at or above the reporting limit.

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 (white) (NI)

Samples tested

17 samples were tested for up to 38 pesticide residues

Basa

- 1 sample was imported from outside the EU

Cod

- 8 samples were imported from outside the EU

Haddock

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

Pollock

- 1 sample was imported from outside the EU

Sea bass

- 2 samples were imported from outside the EU

Sea bream

- 2 samples were imported from outside the EU

Whiting

- 1 sample came from 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

- 15 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

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

Additional comments by the PRiF

Two samples of sea bass contained residues of DDT. The use of DDT is banned or heavily restricted in many countries because the residues take a long time to break down in the environment and can accumulate in fatty tissue.

An interpretation of the analytical results shows that the DDT residues found were 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 - data.gov.uk, including
    - Brand name, sampling point and origin information
    - Pesticides sought and residues found

Grapefruit (GB)

Samples tested

37 samples were tested for up to 392 pesticide residues

- 27 samples were imported from outside the EU
- 10 samples came from the EU

Pesticide residues detected from those sought

- All samples contained residues
- 6 samples contained residues above the MRL
- None of the samples were labelled as organic.

Risk assessments

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

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.

For all of these four pesticides, if the grapefruits are consumed without the peel a short-term effect on health is not expected.

For the worst case form of the assessment, assuming that all the peel is consumed with the fruit, 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 grapefruit sample being consumed by the most critical consumer infants, high residue in single fruit item, peak consumption levels (97.5th percentile), and a large proportion of peel from the fruit being consumed.

- Chlorpyrifos: Some samples of grapefruit contained chlorpyrifos at up to 0.1 mg/kg. As outlined in HSE's full risk assessment (section 3), 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. For the worst case form of assessment (assuming grapefruit is eaten whole, including all of the peel). Although it is not possible to conclude on the short-term assessment 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 grapefruit (with all of the peel), 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). We conclude that on a precautionary basis any findings of chlorpyrifos are undesirable due to the uncertainty regarding genotoxicity. However, we consider any such risks of adverse health effects are low due to the limited levels of exposure anticipated based on the chlorpyrifos residues found in grapefruit in this report.

- Chlorpyrifos-methyl: Some samples of grapefruit contained chlorpyrifos-methyl at up to 0.08 mg/kg. As outlined in HSE's full risk assessment (section 3), EFSA's 2019 statement on the human health assessment of chlorpyrifos-methyl indicated that no toxicological reference values could be determined for chlorpyrifos-methyl. See section 3 for more detail. For the worst case form of assessment (assuming grapefruit is eaten whole, including all of the peel). Although it is not possible to conclude on the short-term assessment with certainty whether or not presence of food residues of chlorpyrifos-methyl at this level would have any effect on health after eating large portions (97.5th percentile consumption) of grapefruit (with all of the peel), 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-methyl 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 chlorpyrifos are undesirable due to the uncertainty regarding genotoxicity. However, we consider any such risks of adverse health effects are low due to the limited levels of exposure anticipated based on the chlorpyrifos-methyl residues found in grapefruit in this report.

- Thiabendazole: We needed to consider a sample of grapefruit containing thiabendazole at a level of 2.6 mg/kg in further detail. Assuming the grapefruit is eaten whole, including all of the peel, we consider a short- term effect on health to be unlikely. However, if the peel is not consumed then it is reported that only 5% of the residue remains (EFSA, 2021) and based on this lower intake a short-term effect on health is not expected.

- Imazalil: We needed to consider some samples of grapefruit containing imazalil at up to 4.4 mg/kg in further detail. Assuming the grapefruit is eaten whole, including all of the peel, we consider a short-term effect on health to be unlikely. However, if the peel is not consumed then it is reported that only 7% of the residue remains (EFSA, 2017) and based on this 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

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 common effects; these pesticides are known to inhibit the enzyme acetylcholinesterase (please see the glossary on page 139).

- Two samples contained chlorpyrifos-methyl and malathion. One sample contained chlorpyrifos and pirimiphos-methyl, and a further sample contained chlorpyrifos-methyl and phosmet.

- HSE's combined risk assessment on all these combinations showed that for the worst case form of assessment, where we assume all of the peel is consumed with the grapefruit flesh, the conclusion from the single substance assessment for either chlorpyrifos or chlorpyrifos-methyl should apply. Please see above (and full details presented in section 3). It is not anticipated that the malathion, pirimiphos-methyl or phosmet residues will contribute significantly to the overall combined intake when compared to the single substance assessment for either chlorpyrifos or chlorpyrifos-methyl for each of these samples. Also at the residue levels for these combinations, these pesticides together will not be expected to inhibit acetyl cholinesterase, the known common effect from exposure to these residues. It is noted that if the peel is removed, an effect on health is not expected for these combined residues.

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 residues of four pesticides (chlorpyrifos, chlorpyrifos-methyl, thiabendazole and imazalil) in more detail and following HSE's short-term assessment of risk, concluded that we would not expect any effects on health if the peel was removed before eating the fruit. For chlorpyrifos and chlorpyrifos-methyl, we concluded the likelihood of adverse health effects due to possible genotoxicity to be low. For full details, please refer to section 3.

There are a small number of examples of older pesticides (no longer approved in the UK) that might be genotoxic, where modern data to further investigate the 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 or have not been formally established due to insufficient toxicological data or concerns regarding their toxicity such as genotoxicity. Chlorpyrifos and chlorpyrifos-methyl are examples where a toxicological reference value has not been formally set as there is some data on these pesticides that is suggestive of genotoxicity, but not certain. We test for them in some surveys using lower reporting limits to ensure that these residues are found even at very low levels, as we know they are of particular interest to consumers.

We note that market approval for chlorpyrifos has been withdrawn in many jurisdictions. This is consistent with our view that any residue of chlorpyrifos is undesirable, due to uncertainty in the genotoxicity safety assessment.

Residues measured above the MRL

The laboratory detected 9 residues above the MRL in grapefruit. 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

Grapefruit (NI)

Samples tested

4 samples were tested for up to 391 pesticide residues

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

One sample of grapefruit contained a residue of imazalil where the effect on health needed to be considered in more detail. This residue (imazalil at 3.0 mg/kg) is lower than the level of imazalil (4.4 mg/kg) reported on the previous food page (Grapefruit-GB). As such, we conclude that an effect on health based on short-term toxicity would not be expected if the peel is removed prior to consuming, and unlikely even if the grapefruit was consumed with all of its peel. Please see section 3 for full details of HSE's assessment.

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 in section 3 of the residues detected we would not expect an effect on health if the grapefruit peel was not eaten. Even if all of the peel was consumed with the fruit, we consider an effect on health unlikely.

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

30 samples were tested for up to 396 pesticide residues

- 30 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

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 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

We would not expect any of the residues detected to have an effect on health.

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 (NI)

Samples tested

2 samples were tested for up to 396 pesticide residues

- 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

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 would not expect any of the residues detected to have an effect on health.

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

Melon (GB)

Samples tested

27 samples were tested for up to 372 pesticide residues

Cantaloupe

- 3 samples were imported from outside the EU

Charentais

- 1 sample was imported from outside the EU

Galia

- 1 sample was imported from outside the EU
- 1 sample came from the EU

Honeydew

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

Prepared Fresh Watermelon

- 2 samples came from the UK

Watermelon

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

Yellow

- 2 samples came from the EU

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

Pesticide residues detected from those sought

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

Risk assessments

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

Combined risk assessments

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

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

Additional comments by the PRiF

We would not expect any of the residues detected to have an effect on health.

Residues measured above the MRL

The laboratory detected 2 residues above the MRL in melons. 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

Melon (NI)

Samples tested

4 samples were tested for up to 372 pesticide residues

Galia

- 1 sample was imported from outside the EU

Honeydew

- 1 sample was imported from outside the EU

Prepared Fresh Melon (except watermelon)

- 1 sample came from the UK

Prepared Fresh Watermelon

- 1 sample came from the UK

The country of origin of the samples may not be the same as the country where the melon was produced. It may be where the melon was processed, where it was 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
- 3 samples contained residues above the reporting limit
- None of the samples contained residues above the MRL
- None of the samples were labelled as organic.

Risk assessments

Following screening assessment there was one sample of Galia melon containing a residue of imazalil at 1.7 mg/kg where the effect on health needed to be considered in more detail.

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

Based on the HSE assessment of risk for this sample containing imazalil (see section 3), if all the peel is consumed with the melon, we conclude an effect on health would be unlikely. However, if the melon is consumed without the peel a short-term effect on health is not expected. This is because if the melon peel is removed it is reported that only 12% of the residue remains (EFSA, 2017).

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 in section 3 of the residues detected we would not expect an effect on health if the melon peel was not eaten. Even if all the peel was consumed with the fruit, we consider an effect on health unlikely.

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

Milk (GB)

Samples tested

71 samples were tested for up to 115 pesticide residues

Cows milk

- 67 samples came from the UK

Goats milk

- 4 samples came from the UK

Pesticide residues detected from those sought

- 71 samples contained no residues from those sought
- None of the samples contained residues above the MRL
- 19 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

The laboratory did not detect any residues at or above the reporting limit.

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

Milk (NI)

Samples tested

6 samples were tested for up to 115 pesticide residues

Cows milk

- 6 samples came from the UK

Pesticide residues detected from those sought

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

Risk assessments

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

Additional comments by the PRiF

The laboratory did not detect any residues at or above the reporting limit.

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

Mushroom (GB)

Samples tested

17 samples were tested for up to 395 pesticide residues

Button

- 6 samples came from the UK
- 1 sample came from the EU

Chestnut

- 8 samples came from the UK
- 1 sample came from the EU

Portabello

- 1 sample came from the UK

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

Pesticide residues detected from those sought

- 12 samples contained no residues from those sought
- 5 samples contained residues above the reporting limit
- None of the samples contained residues above the MRL
- 8 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

We would not expect any of the residues detected to have an effect on health.

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

Mushroom (NI)

Samples tested

3 samples were tested for up to 395 pesticide residues

Button

- 2 samples came from the EU

Chestnut

- 1 sample came from the UK

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

Pesticide residues detected from those sought

- 2 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 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

We would not expect any of the residues detected to have an effect on health.

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

Olive oil (GB)

Samples tested

48 samples were tested for up to 395 pesticide residues

Extra Virgin Olive Oil

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

Virgin Olive Oil

- 3 samples came from the EU

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

Pesticide residues detected from those sought

- 36 samples contained no residues from those sought
- 12 samples contained residues above the reporting limit
- None of the samples contained residues above the MRL
- 14 samples were labelled as organic. None contained residues from those sought

Risk assessments

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

Chlorpyrifos: A sample of extra virgin olive oil contained a residue of chlorpyrifos at 0.01 mg/kg where the effect on health needed to be considered further.

Based on the HSE assessment of risk for this sample containing chlorpyrifos, due to the low dietary intakes, a short-term 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 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 chlorpyrifos are undesirable due to the uncertainty regarding genotoxicity. However, we consider any risks of adverse health effects are low due to the limited levels of exposure anticipated based on this residue of chlorpyrifos (0.01 mg/kg) in olive oil.

Dimethoate: Some samples of extra virgin olive oil contained low level residues (up to 0.004 mg/kg dimethoate) where the effect on health needed to be considered further.

In 2018, EFSA reviewed dimethoate and concluded that no toxicological reference values could be determined for dimethoate, due to a lack of a fully supporting toxicological database (EFSA Conclusion for dimethoate, 2018). At the anticipated highest exposures, an effect on health is not expected based on short-term toxicity. Please refer to section 3 for full details of HSE's assessment.

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 are undesirable due to the uncertainty regarding genotoxicity at low doses. However, we consider any risks of adverse health effects are low due to the limited levels of exposure anticipated based on the dimethoate residues found in olive oil in this report.

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 for the relevant samples, which contained different pesticides which might have common effects; these pesticides are known to inhibit the enzyme acetylcholinesterase (please see the glossary on page 139).

- Some samples of extra virgin olive oil contained dimethoate and phosmet. HSE's combined risk assessment on these combinations (see the detailed multiple exposure assessments in section 3) showed that the combined exposures are not expected to inhibit acetylcholinesterase and a short-term effect on health would not be expected.

- One extra virgin olive oil sample contained chlorpyrifos and dimethoate. HSE's combined risk assessment on this combination (see the detailed multiple exposure assessments in section 3) showed that the combined exposures are not expected to inhibit acetylcholinesterase, and overall, a short-term effect on health would not be expected.

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 residues of two pesticides, chlorpyrifos and dimethoate, in more detail and following HSE's assessment of risk, concluded the likelihood of adverse health effects to be low. For full details, please refer to section 3.

There are a small number of examples of older pesticides (no longer approved in the UK) that might be genotoxic, where modern data to further investigate the 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 or have not been formally established due to insufficient toxicological data or concerns regarding their toxicity such as genotoxicity. Chlorpyrifos and dimethoate are examples where a toxicological reference value has not been formally set as there is some data on these pesticides that is suggestive of genotoxicity, but not certain. We have decided to test for them in some surveys using lower reporting limits to ensure that these residues are found even at very low levels, as we know they are of particular interest to consumers.

Additional assessments that HSE undertook to consider samples which contained more than one residue of pesticides which may have similar toxicological effects (inhibition of acetyl cholinesterase) indicated that a short-term effect on health would not be expected.

We note that market approval for chlorpyrifos has been withdrawn in many jurisdictions. This is consistent with our view that any residue of chlorpyrifos is undesirable, due to uncertainty in the genotoxicity safety assessment.

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

Olive oil (NI)

Samples tested

6 samples were tested for up to 391 pesticide residues

Extra Virgin Olive Oil

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

Virgin Olive Oil

- 1 sample 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 olive oil was produced. It may be where the olive oil was processed, where it was packed for consumer purchase or the address of the brand owner.

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
- 1 sample was labelled as organic.1 contained residues from those sought

Risk assessments

One sample of extra virgin olive oil contained a residue of dimethoate where the effect on health needed to be considered in more detail. This residue (dimethoate at 0.002 mg/kg) is lower than the level of dimethoate (0.004 mg/kg) reported on the previous food page (Olive Oil-GB). As such, we conclude that an effect on health based on short-term toxicity would not be expected, and any risks of adverse health effects due to genotoxicity are low due to the limited levels of exposure anticipated based on the dimethoate residues found in olive oil in this report. Please see section 3 for full details of HSE's assessment.

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, therefore we did not carry out a combined risk assessment.

Additional comments by the PRiF

Based on the HSE Chemicals Regulation Division's risk assessment in section 3 of the low level of dimethoate detected we consider an effect on health to be low.

There are a small number of examples of older pesticides (no longer approved in the UK) that might be genotoxic, where modern data to further investigate the 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 or have not been formally established due to insufficient toxicological data or concerns regarding their toxicity such as genotoxicity. Dimethoate is an example where a toxicological reference value has not been formally set as there is some data for this pesticide that is suggestive of genotoxicity, but not certain. We have decided to test for some of these older pesticides in some surveys using lower reporting limits to ensure that these residues are found even at very low levels, as we know they are of particular interest to consumers

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

Peppers (GB)

Samples tested

18 samples were tested for up to 394 pesticide residues

Fresh

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

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

Pesticide residues detected from those sought

- 3 samples contained no residues from those sought
- 15 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

We would not expect any of the residues detected to have an effect on health.

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

Peppers (NI)

Samples tested

3 samples were tested for up to 394 pesticide residues

Fresh

- 3 samples came from the EU

The country of origin of samples may not be the same as the country where the peppers were produced. It may be where the peppers were processed, 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

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 would not expect any of the residues detected to have an effect on health.

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

38 samples were tested for up to 390 pesticide residues

- 24 samples came from the UK
- 12 samples were imported from outside the EU
- 2 samples came from the EU

Pesticide residues detected from those sought

- 19 samples contained no residues from those sought
- 19 samples contained residues above the reporting limit
- None of the 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. 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 would not expect any of the residues detected to have an effect on health.

We note that most of the residues detected in this survey were from post-harvest use, generally used in the storage of potatoes as sprout suppressants.

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

3 samples were tested for up to 390 pesticide residues

- 3 samples came from the UK

Pesticide residues detected from those sought

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

Risk assessments

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

Additional comments by the PRiF

The laboratory did not detect any residues at or above the reporting limit.

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

Raspberry (GB)

Samples tested

30 samples were tested for up to 368 pesticide residues

Fresh

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

Frozen

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

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

Pesticide residues detected from those sought

- 6 samples contained no residues from those sought
- 24 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

We would not expect any of the residues detected to have an effect on health.

Residues measured above the MRL

The laboratory detected 1 residue above the MRL in raspberries. 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

Raspberry (NI)

Samples tested

5 samples were tested for up to 368 pesticide residues

Fresh

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

Frozen

- 1 sample came from the UK

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

Pesticide residues detected from those sought

- 2 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 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

We would not expect any of the residues detected to have an effect on health.

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

Spring greens and kale (GB)

Samples tested

30 samples were tested for up to 366 pesticide residues

Baby leaf spring greens

- 1 sample came from the UK

Kale

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

Spring Greens

- 14 samples came from the UK

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

Pesticide residues detected from those sought

- 19 samples contained no residues from those sought
- 11 samples contained residues above the reporting limit
- None of the samples contained residues above the MRL
- 5 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

We would not expect any of the residues detected to have an effect on health.

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

Spring greens and kale (NI)

Samples tested

9 samples were tested for up to 366 pesticide residues

Kale

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

Spring Greens

- 3 samples came from the UK

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

Pesticide residues detected from those sought

- 2 samples contained no residues from those sought
- 7 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

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

We would not expect any of the residues detected to have an effect on health.

Residues measured above the MRL

The laboratory detected 1 residue above the MRL in spring greens. 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

Wheat (GB)

Samples tested

36 samples were tested for up to 395 pesticide residues

Other Wheat Flour

- 1 sample came from the UK

Wheat Flour

- 26 samples came from the UK

Wholemeal Wheat Flour

- 9 samples came from the UK

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

Pesticide residues detected from those sought

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

Risk assessments

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

Combined risk assessments

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

HSE carried out a combined risk assessment of the relevant 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

We would not expect any of the residues detected to have an effect on health.

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

Wheat (NI)

Samples tested

6 samples were tested for up to 395 pesticide residues

Wheat Flour

- 6 samples came from the UK

The country of origin of samples may not be the same as the country where the flour was produced. It may be where the flour was processed, where it was 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

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 would not expect any of the residues detected to have an effect on health.

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 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

Asparagus sample 3531/2021: Response from Total Worldfresh

We have been in contact with the supplier of the sample, and have obtained an undertaking from them that they will no longer use the chemical that contains methomyl in the production process of asparagus.

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.

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 ‘cocktail effect’- 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 at residue levels.

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.

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

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

- 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 Q2 (2021) 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 asparagus were used for adults and vegetarians and data on broccoli were used for the other groups for asparagus, after taking account of the low numbers of consumers in the survey data for other groups and the comparison to other data.
- Data on aubergine were used, although there are a low number of consumers in several of the sub-groups for aubergine. However, use of these consumption data was considered reasonable after comparison with alternative data.
- Data on banana were used for plantain
- 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 all forms of beef
- Data on cheese were used for all forms of cheese
- Data on melon were used for all forms of melon and watermelon
- Data on both blackberries and raspberries were used for raspberries, blackberries and blueberries
- Data on oil was used for all types of olive oil

- Consumption values were provided by the Food Standards Agency for grapefruit to identify the various contributions of grapefruit in the diet. The consumption values used here (and as used in 2018 and 2016) cover consumption for fresh grapefruit excluding juice, canned grapefruit and grapefruit consumed in other recipe forms. For the current assessments, the consumer groups covered represent infants (4 to 18 months old), toddlers (1.5 to 3 years), 4-6 year olds, 7-10 year olds, 11-14 year olds, 15-18 year olds, and elderly. These are slightly different to the groups used previously. Vegetarians, elderly residential and elderly in their own home are not reported separately. For some of the consumer groups, the number of grapefruit consumers in the surveys (from years 2008 to 2012) are very low e.g. infants which is not unexpected. The highest number of young consumers out of all the young consumer groups was three persons for infants (3 out of 2863 infant consumers). These data are used as they represent the best available data. Adults and elderly consume fresh grapefruit at a higher frequency (a higher number of consumers) than the other consumer groups, and of these adults is the most critical consumer group.
- Data on cabbage were used for spring greens and kale
- Data on wheat were used for all forms of wheat flour

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

Banana

Crop	Pesticide	Highest residue (mg/kg)	Intake (mg/kg bw/day)		ARfD (mg/kg bw)	Source
			Adult	Critical group†		
Banana	Chlorpyrifos	0.005	0.000061	0.00042 (Infant) 0.00028 (Toddler) 0.00021 (4-6 year old child) 0.00015 (7-10 year old child) 0.000087 (11-14 year old child) 0.000074 (15-18 year old child) 0.000071 (Vegetarian)	No toxicological reference values established	EU, 2019

				0.000064 (Elderly – residential) 0.000061 (Adult) 0.000056 (Elderly – Own home)		

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.

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.

Banana flesh after peeling

The dietary intakes calculated for when the peel is removed prior to consumption, indicate that there are no exceedances of indicative toxicological reference value and, in this case, a short-term effect on health is not expected.

The below risk assessment only applies if all of the peel is consumed. This is because it has been reported that only 2% of the residue of chlorpyrifos remains (EFSA, 2017) in the flesh when the fruit is peeled.

Whole banana, including all the peel

We consider that an effect on the nervous system 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 infant (0.005 mg/kg of chlorpyrifos in bananas), high residue in single fruit item, peak consumption levels (97.5th percentile), and a large proportion of peel from the fruit being consumed).

[8] EFSA 2019 statement on human health- chlorpyrifos

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 exceeded the HSE proposed indicative toxicological reference value for short-term exposure. Intakes for all other consumer groups were below the reference dose. If infants ate large portions of bananas (including the peel) containing chlorpyrifos at 0.005 mg/kg, their intake of chlorpyrifos could be 139 % of the above mentioned HSE proposed indicative toxicological reference value for short-term exposure. Intakes are approximately 700 times lower than the lowest intake in repeat-dose animal studies which was reported to cause effects in a developmental neurotoxicity study where pregnant rats were dosed from day 6 of pregnancy through until the pups were 11 days old. The proposed (short-term) indicative toxicological reference value from HSE is precautionary. These exposures are undesirable but are unlikely to cause any adverse short-term effect.

Overall, HSE concludes that a short-term effect on health would be unlikely in the case of consumption including all of the peel, and not expected in the case of peeling banana prior to consumption.

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

Crop	Pesticide	Highest residue (mg/kg)	Intake (mg/kg bw/day)		ARfD (mg/kg bw)	Source
			Adult	Critical group†		
Banana	Thiabendazole	1.5	0.018	0.13 (Infant)	0.1	EU, 2017

Comment on risk assessment

Banana 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 has been reported that only 3 % of the residue of thiabendazole remains (EFSA, 2016) in the flesh when the fruit is peeled.

Whole banana, 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

infant (1.5 mg/kg of thiabendazole in bananas), 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 exceeded the ARfD. Intakes for all other consumer groups were below the reference dose. If infants ate large portions of bananas (including the peel) containing thiabendazole at 1.5 mg/kg, their intake of thiabendazole could be 125 % of the Acute Reference Dose. This intake is 80 times lower than a dose which caused no observed adverse effect in a developmental study in rats over 11 days. The European Food Safety Authority used this study as the basis of the ARfD. Toxicologists usually apply a factor of 100 to this dose to take into account uncertainties caused by using animal data and possible differences in susceptibility between people. We consider the reduced factor of 80 still sufficient to make an effect on health unlikely.

This estimate assumes that peel of bananas 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.

Overall, HSE concludes that a short-term effect on health would be unlikely in the case of consumption including all of the peel, and not expected in the case of peeling banana prior to consumption.

Beans with pods

Crop	Pesticide	Highest residue (mg/kg)	Intake (mg/kg bw/day)		ARfD (mg/kg bw)	Source
			Adult	Critical group†		
Beans with pods (Guar beans)	Omethoate	0.004	0.0000092	0.000020 (infant) 0.000020 (toddler) 0.000015 (4-6 year old child) 0.000011 (vegetarian) 0.000011 (15-18 year old child) 0.0000092 (adult) 0.0000087 (elderly – own home) 0.0000081 (7-10 year old child)	Not established	EU, 2019

				0.0000078 (11-14 year old child) 0.0000044 (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 it's 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.

Omethoate is the main metabolite of dimethoate; dimethoate itself was sought but not found in this sample. For dimethoate, EFSA (2018) stated an indicative value for a hypothetical toxicological reference value for short-term exposure of 0.0001 mg/kg bw. Using this indicative value, estimated dietary intakes of omethoate do not exceed this reference value for any consumer group.

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 short-term reference value from the EFSA Conclusion is precautionary.

The estimated exposures are low and 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 not expected after eating large portions (97.5th percentile consumption) of Guar beans (beans with pods) containing the levels found in this report.

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

Grapefruit

Crop	Pesticide	Highest residue (mg/kg)	Intake (mg/kg bw/day)		ARfD (mg/kg bw)	Source
			Adult	Critical group†		
Grapefruit	Chlorpyrifos	0.1	0.0014	0.0055 (infant)	Not established	EU, 2019

[9] this enzyme, acetylcholinesterase, is included in the Glossary on page 139

				0.0018 (7-10 year old child) 0.0014 (adult) 0.0011 (elderly) 0.0011 (11-14 year old child)		

Comment on risk assessment

EFSA (2019)[10] 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.

Grapefruit flesh after peeling

The dietary intakes calculated for when the peel is removed prior to consumption, indicate that there are no exceedances of the indicative toxicological reference value and, in this case, a short-term effect on health is not expected.

The below risk assessment only applies if all of the peel is consumed. This is because it has been reported that only 2% of the residue of chlorpyrifos remains (EFSA, 2017) in the flesh when the fruit is peeled.

Whole grapefruit, including all the peel

We cannot conclude whether residues of chlorpyrifos at this level would have any effect on health. As well as the precautionary nature of the toxicological assessment (see above), any effect on health would depend on a number of factors which would need to come together at the same time (the high residue (0.1 mg/kg of chlorpyrifos in grapefruit) found in the sample being consumed

[10] EFSA 2019 statement on human health- chlorpyrifos

by the most critical consumer infants, 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 all consumer groups exceeded the HSE proposed indicative toxicological reference value for short-term exposure. The highest intake was for infants. If infants ate large portions of grapefruit containing chlorpyrifos at 0.1 mg/kg their intake could be around 1800 % of the HSE proposed indicative toxicological reference value for short-term exposure. This intake is 55 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 55 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 grapefruit (including all the peel) containing the level found in this report.

This estimate assumes that peel of grapefruit is consumed. However, if the peel is not consumed then intakes in all groups are within the indicative reference value and a short-term effect on health is not expected.

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

Crop	**Pesticide**	**Highest residue (mg/kg)**	**Intake (mg/kg bw/day)**		**ARfD (mg/kg bw)**	**Source**
			Adult	**Critical group**[†]		
Grapefruit	Chlorpyrifos-methyl	0.08	0.0012	0.0044 (infant) 0.0014 (7-10 year old child) 0.0012 (adult) 0.00087 (elderly) 0.00085 (11-14 year old child)	Not established	EU, 2019

Comment on risk assessment

EFSA (2019)[11] has indicated that no toxicological reference values could be determined for chlorpyrifos-methyl, due to concerns over genotoxicity. Additionally, EFSA raised concerns over neurological effects in the developing foetus and young child. Chlorpyrifos-methyl 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 with chlorpyrifos 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 (DNT)). EFSA applied the results of the DNT study with chlorpyrifos to chlorpyrifos-methyl as the DNT study with chlorpyrifos-methyl was found to have significant limitations. However, it was noted that there were no effects on brain measurements observed in the DNT study with chlorpyrifos-methyl. Consequently, EFSA concluded that applying the LOAEL from the DNT with chlorpyrifos to chlorpyrifos-methyl was a conservative approach. Toxicologists usually use safety factors of between 100 and a 1000 when a NOAEL cannot be determined within a study. The HSE proposed (short-term) 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 using chlorpyrifos rather than chlorpyrifos-methyl. Overall, the HSE approach is considered precautionary in protecting the nervous system in the developing foetus and child.

Grapefruit flesh after peeling

The dietary intakes calculated for when the peel is removed prior to consumption, indicate that there are no exceedances of the indicative toxicological reference value and, in this case, a short-term effect on health is not expected.

The below risk assessment only applies if all of the peel is consumed. This is because it has been reported that only 5% of the residue of chlorpyrifos-methyl remains (EFSA, 2017) in the flesh when the fruit is peeled.

Whole grapefruit, including all the peel

We cannot conclude whether residues of chlorpyrifos-methyl at this level would have any effect on health. As well as the precautionary nature of the toxicological assessment (see above), any effect on health would depend on a number of factors which would need to come together at the same time (the high residue (0.08 mg/kg of chlorpyrifos-methyl in grapefruit) found in the sample being consumed by the most critical consumer infants, 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:

[11] EFSA 2019 statement on human health- chlorpyrifos-methyl

The intakes for all consumer groups exceeded the HSE proposed indicative toxicological reference value for short-term exposure. The highest intake was for infants. If infants ate large portions of grapefruit containing chlorpyrifos at 0.08 mg/kg their intake could be around 1500 % of the HSE proposed indicative toxicological reference value for short-term exposure. This intake is 68 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, to the LOAEL from a study with chlorpyrifos (use of data from chlorpyrifos for the assessment of chlorpyrifos-methyl has previously been considered by EFSA to be a conservative approach). We consider this significant reduction in the uncertainty factor from 1000 to 68 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 grapefruit (including all of the peel) containing the level found in this report.

This estimate assumes that peel of grapefruit is consumed. However, if the peel is not consumed then intakes in all groups are within the indicative reference value and a short-term effect on health is not expected.

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

Crop	**Pesticide**	**Highest residue (mg/kg)**	**Intake (mg/kg bw/day)**		**ARfD (mg/kg bw)**	**Source**
			Adult	**Critical group**[†]		
Grapefruit	Imazalil	4.4	0.064	0.24 (Infant) 0.064 (Adult)	General population 0.1 Pregnant and nursing females 0.05	EFSA, 2007

Comment on risk assessment

<u>Grapefruit flesh after peeling</u>

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 has been reported that only 7 % of the residue of imazalil remains (EFSA, 2017) in the flesh when the fruit is peeled.

Whole grapefruit, including all the peel

Pregnant and nursing females

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 adults (4.4 mg/kg of imazalil in grapefruit), 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 adults exceeded the ARfD for pregnant and nursing females. If adults ate large portions of grapefruit containing imazalil at 4.4 mg/kg, their intake of imazalil could be 127 % of the Acute Reference Dose. This intake is 78 times lower than a dose which caused no observed adverse effect in in a 13 day repeat dose rabbit developmental study (the ARfD is based on a NOAEL of 5 mg/kg bw/day for fetal toxicity (increased resorptions; a marker of early foetal deaths)). The European Food Safety Authority used this study as the basis of the ARfD. Toxicologists usually apply a factor of 100 to this dose to take into account uncertainties caused by using animal data and possible differences in susceptibility between people. We consider the reduced factor of 78 still sufficient to make an effect on health unlikely.

General population

We consider that an effect on health would be low. 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 infant (4.4 mg/kg of imazalil in grapefruit), 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 exceeded the ARfD for the general population. If infants ate large portions of grapefruit containing imazalil at 4.4 mg/kg, their intake of imazalil could be 240 % of the Acute Reference Dose. This intake is 42 times lower than a dose which caused no observed adverse effects in a rabbit developmental study, used as the basis of the ARfD (the ARfD is based on a NOAEL of 10 mg/kg bw/day for reduced bodyweight gain and food consumption in dams). The European Food Safety Authority used this study as the basis of the ARfD. Toxicologists usually apply a factor of 100 to this dose to take into account the uncertainties caused by using animal data and possible differences in susceptibility between people. We consider the reduced

factor of 42 still enough to account for these uncertainties, also noting that an ARfD based on maternal toxicity in a developmental study with repeated dosing (13 days) is likely to be very protective for the general population. Based on this assessment an effect on health is unlikely.

These estimates assume that peel of grapefruit 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 ARfDs and an effect on health is not expected.

Crop	Pesticide	Highest residue (mg/kg)	Intake (mg/kg bw/day)		ARfD (mg/kg bw)	Source
			Adult	Critical group†		
Grapefruit	Thiabendazole	2.6	0.038	0.14 (infants)	0.1	EU, 2017

Comment on risk assessment

Grapefruit 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 has been reported that only 5 % of the residue of thiabendazole remains (EFSA, 2021) in the flesh when the fruit is peeled.

Whole grapefruit, 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 infants (2.6 mg/kg of thiabendazole in grapefruit, 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 exceeded the ARfD. If infants ate large portions of grapefruit containing thiabendazole at 2.6 mg/kg, their intake of thiabendazole could be 142 % of the Acute Reference Dose. This intake is 70 times lower than a dose which caused no observed adverse effects in a developmental study in rats over 11 days. The European Food Safety Authority used this study as the basis of the ARfD. Toxicologists usually apply a factor of 100 to this dose to take into account the uncertainties caused by

using animal data and possible differences in susceptibility between people. We consider the reduced factor of 70 still sufficient to make an effect on health unlikely.

This estimate assumes that peel of grapefruit 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.

Melon

Crop	Pesticide	Highest residue (mg/kg)	Intake (mg/kg bw/day)		ARfD (mg/kg bw)	Source
			Adult	Critical group†		
Melon	Imazalil	1.7	0.063	0.14 (4-6 year old child) 0.12 (7-10 year old child) 0.12 (infant) 0.12 (toddler) 0.083 (11-14 year old child) 0.067 (15-18 year old child) 0.063 (adult) 0.051 (vegetarian)	General population 0.1 Pregnant and nursing females 0.05	EFSA, 2007

Comment on risk assessment

Melon 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 has been reported that only 12 % of the residue of imazalil remains (EFSA, 2017) in the flesh when the fruit is peeled.

Whole melon, 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 4-6

year old child (1.7 mg/kg of imazalil in melon), 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:

Pregnant and nursing females

The intakes for 11-14 year old children, 15-18 year old children, adults and vegetarians exceeded the ARfD. The highest intake was for 11-14 year old children. If 11-14 year old children ate large portions of melon containing imazalil at 1.7 mg/kg, their intake of imazalil could be 165 % of the Acute Reference Dose. This intake is 60 times lower than a dose which caused no observed adverse effect in a 13 day repeat dose rabbit developmental study (the ARfD is based on a NOAEL of 5 mg/kg bw/day for fetal toxicity (increased resorptions; a marker of early foetal deaths)). The European Food Safety Authority used this study as the basis of the ARfD. Toxicologists usually apply a factor of 100 to this dose to take into account uncertainties caused by using animal data and possible differences in susceptibility between people. We consider the reduced factor of 60 still sufficient to make an effect on health unlikely.

General population

The intakes for 4-6 year old children, 7-10 year old children, infants and toddlers exceeded the ARfD. The highest intake was for 4-6 year old children. If 4-6 year old children ate large portions of melon containing imazalil at 1.7 mg/kg, their intake of imazalil could be 141 % of the Acute Reference Dose. This intake is 71 times lower than a dose which caused no observed adverse effect a rabbit developmental study, used as the basis of the ARfD (the ARfD is based on a NOAEL of 10 mg/kg bw/day for reduced bodyweight gain and food consumption in dams). The European Food Safety Authority used this study as the basis of the ARfD. Toxicologists usually apply a factor of 100 to this dose to take into account uncertainties caused by using animal data and possible differences in susceptibility between people. Also, it is noted that an ARfD based on maternal toxicity in a developmental study with repeated dosing (13 days) might be over-protective for the general population. Based on this assessment, we consider the reduced factor of 71 still sufficient to make an effect on health unlikely.

These estimates assume that peel of melon 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 ARfDs and an effect on health is not expected.

Olive oil

Crop	**Pesticide**	**Highest residue (mg/kg)**	**Intake (mg/kg bw/day)**		**ARfD (mg/kg bw)**	**Source**
			Adult	**Critical group**[†]		

Olive oil	Dimethoate	0.004	0.0000052	0.000012 (4-6 year old child) 0.000012 (toddler) 0.000010 (infant) 0.0000095 (7-10 year old child) 0.0000083 (vegetarian) 0.0000071 (11-14 year old child) 0.0000061 (15-18 year old child) 0.0000052 (adult) 0.0000048 (elderly – residential) 0.0000041 (elderly – own home)	Not established	EU, 2019

Comment on risk assessment

The EFSA Conclusion (2018) for dimethoate has indicated that no toxicological reference values could be determined for dimethoate due to the lack of a fully supporting toxicological database. Dimethoate is 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 do not exceed this reference value for any consumer group. 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. Based on the low short-term intakes, HSE concludes that a short-term effect on health is not expected.

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

Crop	**Pesticide**	**Highest residue (mg/kg)**	**Intake (mg/kg bw/day)**		**ARfD (mg/kg bw)**	**Source**
			Adult	**Critical group†**		

Olive oil	Chlorpyrifos	0.01	0.000013	0.000031 (4-6 year old child) 0.000029 (toddler) 0.000025 (infant) 0.000024 (7-10 year old child) 0.000021 (vegetarian) 0.000018 (11-14 year old child) 0.000015 (15-18 year old child) 0.000013 (adult) 0.000012 (elderly – residential) 0.000010 (elderly – own home)	Not established	EU, 2019

Comment on risk assessment

EFSA (2019) 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.

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

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

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			ARfD	Source
			mg/kg bw	%ARfD			
Grapefruit/Infant	Chlorpyrifos	0.02	0.0011	- }	Total -	Not established	EU, 2019
	Pirimiphos-methyl	0.04	0.0022	1.5 }		0.15	EFSA, 2005

Comment on risk assessment:

The presence of pirimiphos-methyl in the sample does not significantly contribute to the overall combined intake when compared to the presence of chlorpyrifos alone. The estimated highest intake of chlorpyrifos represents around 370% of the above noted indicative toxicological reference value of 0.0003 mg/kg bw/day for short-term assessment (see explanation above of this indicative value in the single substance assessment for grapefruit-chlorpyrifos above). The overall risk assessment for this sample is covered by the single substance risk assessment for grapefruit-chlorpyrifos when a worst-case form of assessment has been performed, assuming all of the peel is consumed and applying the suggested precautionary approach to the toxicological assessment (see the above details for HSE's single substance assessment for grapefruit-chlorpyrifos for a residue finding that is five-fold higher than in this sample containing chlorpyrifos and pirimiphos-methyl). At these intake levels, these pesticides together will not be expected to inhibit acetyl cholinesterase, the known common effect from exposure to these residues. It is noted that if the peel is removed, an effect on health is not expected as the contribution of each of chlorpyrifos and pirimiphos-methyl in terms of take up of its own reference value is low (each <10%).

Crop/Critical group	Pesticide	Residue mg/kg	Intake			ARfD	Source
			mg/kg bw	%ARfD			
Grapefruit/Infant	Malathion	0.02	0.0011	0.4 }	Total	0.3	EU, 2018
	Chlorpyrifos-methyl	0.07	0.0038	- }	-	Not established	EU, 2019

Comment on risk assessment:

The presence of malathion in the sample does not significantly contribute to the overall combined intake when compared to the presence of chlorpyrifos-methyl alone. The estimated highest intake of chlorpyrifos-methyl represents around 1300% of the above noted indicative toxicological reference value of 0.0003 mg/kg bw/day for short-term assessment (see explanation above of this indicative value in the single substance assessment for grapefruit-chlorpyrifos-methyl above). The overall risk assessment for this

sample is covered by the single substance risk assessment for grapefruit-chlorpyrifos-methyl when a worst-case form of assessment has been performed, assuming all of the peel is consumed and applying the suggested precautionary approach to the toxicological assessment (see the above details for HSE's single substance assessment for grapefruit-chlorpyrifos-methyl for a residue finding of 0.08 mg/kg, similar to the level of chlorpyrifos-methyl in this sample containing chlorpyrifos-methyl and malathion). At these intake levels, these pesticides together will not be expected to inhibit acetyl cholinesterase, the known common effect from exposure to these residues. It is noted that if the peel is removed, an effect on health is not expected as the contribution of chlorpyrifos-methyl is less than the indicative toxicological reference value and malathion intake is very low.

Crop/Critical group	Pesticide	Residue mg/kg	Intake			ARfD	Source
			mg/kg bw	%ARfD			
Grapefruit/Infant	Malathion	0.08	0.0044	1.5 }	Total	0.3	EU, 2018
	Chlorpyrifos-methyl	0.01	0.00055	- }	-	Not established	EU, 2019

Comment on risk assessment:

See the above written risk assessment for the combination of malathion (0.02 mg/kg) and chlorpyrifos-methyl (0.07 mg/kg) which represents a higher intake when considering the level of chlorpyrifos-methyl. As per this above example, presence of malathion in the sample does not significantly contribute to the overall combined intake when compared to the presence of chlorpyrifos-methyl alone.

Crop/Critical group	Pesticide	Residue mg/kg	Intake			ARfD	Source
			mg/kg bw	%ARfD			
Grapefruit/Infant	Chlorpyrifos-methyl	0.08	0.0044	- }	Total -	Not established	EU, 2019
	Phosmet	0.1	0.0055	12.1 }		0.045	EU, 2007

Comment on risk assessment:

The presence of phosmet in the sample does not contribute a large amount to the overall combined intake when compared to the presence of chlorpyrifos-methyl alone. The estimated highest intake of chlorpyrifos-methyl represents around 1500% of the above noted indicative toxicological reference value of 0.0003 mg/kg bw/day for short-term assessment (see explanation above of this indicative value in the single substance assessment for grapefruit-chlorpyrifos-methyl above). The overall risk is covered by the single substance risk assessment for grapefruit-chlorpyrifos-methyl when a worst-case form of assessment has been performed, assuming all of the peel is consumed and applying the suggested precautionary approach to the toxicological assessment (see the above details for HSE's single substance assessment for grapefruit-chlorpyrifos-methyl for this residue finding of 0.08 mg/kg). At these intake levels, these pesticides together will not be expected to inhibit acetyl cholinesterase, the known common effect from exposure to these residues. It is noted that if the peel is removed, an effect on health is not expected as the contribution of chlorpyrifos-methyl is less than the indicative toxicological reference value and phosmet intake is low (a peeling factor is not

available for phosmet, although JMPR data for various citrus fruits (JMPR, 2002) indicates residues are around three-fold lower in the flesh compared to the whole fruit, and after removal of the peel the contribution of phosmet in terms of take up of its own reference value is low (<10%)).

Crop/Critical group	Pesticide	Residue mg/kg	Intake			ARfD	Source
			mg/kg bw	%ARfD			
Olive oil/4-6 year old child	Dimethoate	0.002	0.0000062	- }	Total -	Not established	EU, 2019
	Phosmet	0.03	0.000093	0.2 }		0.045	EU, 2007

Comment on risk assessment:

These highest calculated dietary intakes are low and we conclude that for this combined assessment of these residues of dimethoate and phosmet together in the same sample, a short-term effect on health is not expected. The estimated highest intake of dimethoate represents around 6% of the hypothetical short-term reference value for dimethoate proposed by EFSA (EFSA Conclusion for dimethoate, 2018). At these low levels, these pesticides together will not be expected to inhibit acetyl cholinesterase, the known common effect from exposure to these residues. Furthermore, the presence of phosmet in the sample does not significantly contribute to the overall combined intake.

Crop/Critical group	Pesticide	Residue mg/kg	Intake			ARfD	Source
			mg/kg bw	%ARfD			
Olive oil/4-6 year old child	Dimethoate	0.004	0.000012	- }	Total -	Not established	EU, 2019
	Phosmet	0.02	0.000062	0.1 }		0.045	EU, 2007

Comment on risk assessment:

These highest calculated dietary intakes are low and we conclude that for this combined assessment of these residues of dimethoate and phosmet together in the same sample, a short-term effect on health is not expected. The estimated highest intake of dimethoate represents around 12% of the hypothetical short-term reference value for dimethoate proposed by EFSA (EFSA Conclusion for dimethoate, 2018). At these low levels, these pesticides together will not be expected to inhibit acetyl cholinesterase, the known common effect from exposure to these residues. Furthermore, the presence of phosmet in the sample does not significantly contribute to the overall combined intake.

Crop/Critical group	Pesticide	Residue mg/kg	Intake			ARfD	Source
			mg/kg bw	%ARfD			
Olive oil/4-6 year old child	Chlorpyrifos	0.01	0.000031	- }	Total -	Not established	EU, 2019
	Dimethoate	0.002	0.0000062	- }		Not established	EU, 2019

Comment on risk assessment:

These highest calculated dietary intakes are low and we conclude that for this combined assessment of these residues of chlorpyrifos and dimethoate together in the same sample, a short-term effect on health is not expected. The estimated highest intake of dimethoate represents around 6% of the above mentioned hypothetical short-term reference value for dimethoate proposed by EFSA (EFSA Conclusion for dimethoate, 2018) and the estimated highest intake of chlorpyrifos represents around 10% of the above indicative toxicological reference value proposed by HSE following a precautionary approach to the assessment. At these low levels, these pesticides together will not be expected to inhibit acetyl cholinesterase, the known common effect from exposure to these residues.

Please refer to the section below on ‘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 (Q2 2021) 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*[12]) that these pesticides 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, chlorpyrifos-methyl

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.

[12] *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. 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.

MRLs after 20 June 2020

After detailed discussion and consultation with stakeholders the EU agreed new MRLs for chlorate that came into force on 20 June 2020. All samples covered by this report were taken after 20 June 2020 when the new, higher MRLs were in place.

The new chlorate MRLs include a footnote referring specifically to taking account of the use of biocides during processing in addition to the MRLs for food as harvested or initially produced. The footnote exceptionally specifies that for considering compliance with chlorate MRLs, simple types of processing that do not affect the other residue levels, such as packing, washing, chopping and freezing can be taken into account.

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/.

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 are 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[13] 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, 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.

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

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 2020

Cauliflower

Flonicamid (sum): Sample number 4634/2020

We passed details of a sample of cauliflower from the UK that contained flonicamid (sum) to HSE. HSE enquiries are not yet complete and an update will appear in a future report.

In our next report:

In Quarter 3 of 2021 we will look at results for:

Samples collected in GB

- Aubergine
- Banana
- Beans with pods
- Beef
- Berries and small fruits
- Bread (ordinary)
- Bread (morning bakery)
- Broccoli
- Edible seeds
- Eggs
- Grapefruit
- Grapes
- Infant food (cereal based)
- Melon
- Milk
- Mushrooms
- Olive oil
- Pepper
- Potatoes
- Raspberry
- Rice
- Soya milk
- Soya products
- Spring greens and kale

Samples collected in NI

- Aubergine
- Banana
- Beans with pods
- Beef
- Berries and small fruits
- Bread (ordinary)
- Broccoli
- Cheese (soft)
- Eggs
- Fish (white)
- Grapefruit
- Grapes
- Melon
- Milk
- Mushrooms
- Olive oil
- Pepper
- Potatoes
- Raspberry
- Rice
- Spring greens and kale

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 0.024mg/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. 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 EU MRL definitions for pesticide residues at the European Commission’s pesticide database at EU-Pesticide Database

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

carbendazim (animal products)	Carbendazim and thiophanate-methyl, expressed as carbendazim
Carbendazim (sum)	Carbendazim and benomyl (sum of benomyl and carbendazim expressed as carbendazim)
carbofuran (sum)	Carbofuran (sum of carbofuran and 3-hydroxy-carbofuran expressed as carbofuran)
chlordane (animal products)	Chlordane (sum of cis- and trans-isomers and oxychlordane expressed as chlordane) This definition applies to animal products only
chlordane (sum)	Chlordane (sum of cis- and trans- isomers) This definition applies to all foods except animal products
chlorpropham (potatoes)	Chlorpropham only This definition applies only to potatoes
chlorpropham (sum for animal products)	Chlorpropham and 4-hydroxychlorpropham-O-sulphonic acid (4-HSA), expressed as chlorpropham This definition applies only to animal products
chlorpropham (sum)	Chlorpropham (Chlorpropham and 3-chloroaniline, expressed as Chlorpropham) This definition applies to all foods except potatoes and animal products
DDAC (sum)	Didecyldimethylammonium chloride (mixture of alkyl-quaternary ammonium salts with alkyl chain lengths of C_8, C_{10} and C_{12})
DDT (sum)	DDT (sum of p,p'-DDT, o,p'-DDT, p-p'-DDE and p,p'-TDE (DDD) expressed as DDT)
Dichlorprop	Sum of Dichlorprop, including dichlorprop-p and its conjugates, expressed as dichlorprop
dicofol (sum)	Dicofol (sum of p, p' and o,p' isomers)
Dimethenamid	Dimethenamid–p (Dimethenamid-p including other mixtures of constituent isomers (sum of isomers))
dimethoate (sum)	Dimethoate (sum of dimethoate and omethoate expressed as dimethoate)
disulfoton (sum)	Disulfoton (sum of disulfoton, disulfoton sulfoxide and disulfoton sulfone expressed as disulfoton)

dithiocarbamates	Dithiocarbamates are a group of pesticides that are chemically similar. Testing for them individually in routine analysis is not possible, so MRLs are set for a test for the group.
endosulfan (sum)	Endosulfan (sum of alpha- and beta-isomers and endosulfan-sulphate expresses as endosulfan)
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)
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)
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.

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.

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.

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.