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Pesticide risk profile for the feeding of apple pomace to cattle and sheep

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Abbreviations

ai	active ingredient
APVMA	Australian Pesticide and Veterinary Medicines Authority
bw	body weight
DM	dry matter
ECRP	Existing Chemical Review Program
EU	European Union
F	MRL is based on the residue in the fat portion of the tissue
FAO	Food and Agriculture Organisation of the United Nations
g	gram
GAP	good agricultural practice
ha	hectare
HAFT	Highest average field trial
JMPR	Joint Meeting on Pesticide Residues
kg	kilogram
LOD	Limit of detection for the analytical method, sometimes also used for limit of determination which is the same as LOQ
LOQ	limit of analytical quantitation
mby	meat by products
mg	milligram = 0.001 grams
MRL	maximum residue limit
N	Negligible residue (when next to US MRL)
PAFC	primary animal feed commodity
PHI	pre-harvest interval
P _{ow}	octanol water partition coefficient
ppm	parts per million = mg/kg
PSD	Pesticide Safety Directorate
TF	transfer factor = concentration in animal tissue or milk divided by concentration in feed
TRR	total radioactive residue
US EPA	United States of America Environmental Protection Agency
WHP	withholding period
*	before MRL indicates that the residue is at or about the LOQ, <i>i.e.</i> should be less than the LOQ.

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Potential for violative residues in cattle and sheep fed apple pomace

For by-products to be useful as animal feeds, they must not present safety or health problems to the animals nor present a risk of contaminating the animal product to be sold. In the production and utilization of by-products, all parties must take care to prevent contamination with pesticides, mycotoxins, and other materials at levels that could be dangerous to the animals or contaminate the animal product.

A relatively abundant potential source of animal feed in Western Australia, Victoria, New South Wales and Queensland is apple pomace. The following details the potential risk that the feeding of such waste to animals may pose to Australian trade in red meat.

Apple pomace (or pulp) is the residual material from pressing apples for juice containing the pulp, peels, and core. Fresh pomace is a high moisture product that spoils rapidly. It is a low protein, high fibre feed which is very digestible. Major disadvantages are its moisture content and availability only in apple-producing areas.

Chemical residues in animal feeds may be transferred to the tissues of livestock on feeding. While it is unlikely that the chemical residues present in meat and offal arising from feeding represent a concern regarding food safety they can result in disruption to trade where the relevant Australian and overseas market standards differ.

The observation of chemical product withholding periods (WHPs) should ensure Australian standards are met, but as pesticide use and tolerances differ internationally observance of the WHP does not guarantee that the chemical residues in the feed are such that when fed to livestock, the residues in milk, meat and offal will meet export market requirements.

The aim of the current report is to profile the risk of violative residues in export meat and edible offal posed by the presence of pesticide residues in apple pomace fed to cattle and sheep.

Assessment of currently registered chemicals that may be used on apple crops

Estimates of residues in livestock tissues and milk are usually made on the basis of the propensity of a chemical to transfer to tissues and milk combined with anticipated animal dietary exposure.

Most experiments in the area of transfer of pesticide residues to animal tissues and milk following ingestion have been designed based on the requirements of regulators. The relevant studies required are livestock metabolism studies (lactating goat or dairy cow) and animal transfer (feeding) studies.

The feeding studies are used to determine transfer factors (TF) that are defined as the ratio of the pesticide residue in the tissue or commodity of interest (fat, muscle, liver, kidney or milk) to the residue in the diet (expressed on a dry matter intake basis).

In utilizing transfer factors derived from feeding or metabolism studies for risk assessment management purposes, the user needs to be aware of the limitations and assumptions used. The TF derived is dependent on the duration of the feeding or dosing, the concentration in the feed or dose level, the nature of the feed (if added to the feed), lactational status, bodyweight, age, sex and breed of the animal studied. For chemicals administered as a mixture, the presence of other chemicals may alter the metabolism and/or rate of excretion by induction of the various routes of decontamination. The duration of a feeding study required for the steady state concentration to be reached in tissue or milk is a function of the elimination half-life. Residue definitions set by different regulators are not always the same and residue definition is a factor that should also be taken into account when utilizing TF for managing residue risks and trade. Care must be taken in extrapolating TFs from goat metabolism studies to all ruminants as is demonstrated by endosulfan, for which the residue definition is the sum of α -endosulfan, β -endosulfan and endosulfan sulphate, where only low levels of residues are found in goats but significant transfer to tissues occurs for cattle^{1,2}.

¹ Indraningsih, McSweeney, C.S. & Ladds, P.W. (1993) Residues of endosulfan in the tissues of lactating goats. *Aust. Vet. J.*, **70**, 59-62.

The transfer factors utilised here were calculated from residues reported in the scientific literature using the highest individual animal tissue divided by the nominal feed level. If the highest residue was not reported the average residue divided by the nominal feed level were used instead. In the case of milk the average residue was divided by the nominal feed level.

For the purposes of profiling risk conservative estimates of animal dietary burden (intake) are required. The APVMA “*Stockfeed Guideline Document 1 Primary Feed Commodities As A Proportion of Livestock Diets*” (Version 1.1 March 2002)³ lists the maximum proportion of apple pomace included in animal feed as 20%, however 30% was used in the current evaluation. Estimates of residues in apple pomace were obtained from scaling of literature studies, MRLs or based on conservative assumptions. The dietary burden is then the residue in crop × maximum proportion in the diet. To overcome errors that may result from differences in moisture contents of feed items it is accepted practice to calculate dietary burdens for a ration on a dry matter basis. Wet apple pomace is reported to typically contain 40% dry matter and this was used where necessary.

The estimated residue in animal commodities is:

$$\text{Residue} = TF \times \text{dietary burden [ppm DM basis]}$$

Unless stated otherwise, the following assumptions have been used in the risk assessment:

- The apples are harvested at maturity and that the pomace is derived on processing.
- The crop has been treated at the maximum rate and with the shortest interval between application and harvest permitted by the product label⁴,
- The maximum rate of incorporation in the ration/diet is 30%
- That residue transfer for cattle is greater than for sheep and therefore that the assessment of residues in cattle also covers sheep

The potential for violative residues in animals is assessed against the Australian, Codex and US tolerances as listed in February 2010⁵. Other markets may have different standards however, for the bulk of Australian meat exports it is assumed that if the lower of these tolerances (or the LOQ of the analytical method if no Codex or US tolerance exists) can be met, the feeding of apple pomace will not pose an unacceptable risk.

Appendix 1 provides the details of a risk assessment for each of the compounds registered in Australia for use on apples.

Most of the compounds registered for use on apples also have registrations in other crops that are major animal feed commodities. Indeed, for most compounds listed in appendix 1 the major route of exposure for animals to the chemical is expected to be through feeding of these other crops (*e.g.* pasture, cereal waste *etc.*).

² Reregistration Eligibility Decision for Endosulfan Case No. 0014 EPA 738-R-02-013 November 2002 Environmental Protection Agency, Office of Pesticide Programs, Special Review and Reregistration Division.
<http://cfpub.epa.gov/opprer/rereg/status.cfm?show=rereg>

³ http://www.apvma.gov.au/residues/Stockfeed_Guideline_1.pdf

⁴ In general, only one or two product labels were selected per pesticide. There is a possibility that the maximum permitted rate may be higher than identified.

⁵ MRLs and approved use patterns change with time. The assessments include the most recent decisions of the Codex Alimentarius Commission (32nd Session, July 2009) with regard to Codex MRLs, US tolerances as listed in the Code of Federal Regulations at February 2010 and MRLs as they appear in Table 1 of the APVMA *MRL Standard* as at February 2010.

The conclusion of the analysis is the potential for residue violations in meat and edible offal posed by the feeding of apple pomace derived from apple crops treated with currently registered products is low for the majority of chemicals. Based on the available information, the following pesticides are identified as requiring further investigation and/or the development of additional risk management strategies:

Pesticide	Tissue	Residue (mg/kg)		Decline information located	
		Estimated ¹	Target ²	Crop	Animal
Alpha-cypermethrin	Fat	0.375	0.05	Yes	Yes
Chlorfenapyr	Fat	0.08	0.01	Yes	Yes
Dicofol	Fat	0.375 Aust (1.9 Codex)	0.01	Yes but no significant decline	No
Diuron	Tissues	0.075	0.01	No	No
Fluquinconazole	Fat	0.27	0.01	No	No
Imazalil ³	Liver	0.06	0.01	No	No
Tetradifon	Fat	0.45	0.01	No	No
Thiacloprid	Liver	0.048	0.02	Yes	No

¹residue in tissue estimated using assumptions outlined above

²target residue = lowest of Australian, Codex and US MRL or in absence of these the LOQ (often assumed to be 0.01 mg/kg)

³The pesticide is applied post-harvest

Adequate data were not located to enable an assessment to be made for the following compounds: naphthalene acetic acid and triforine however, the physicochemical properties of these compounds suggest they are unlikely to be a problem.

The current assessment has only identified pesticides of concern and has not considered industry based QA programs that address the potential for residues in animal feeds to transfer to animals and mitigate risks; The National Vendor Declaration (NVD) form for traded livestock and the Commodity Vendor Declaration (CVD) and By-product Vendor Declaration (BVD) forms which are used for traded livestock feedstuffs.

Appendix 1

2,2-DPA (2,2-dichloropropionic acid also known as dalapon)

- is a systemic herbicide used for the control of annual and perennial grasses and rushes. It is registered on a variety of crops including potential animal feeds sunflower, maize, soybean and pastures. The application rates are 1.5-3.7 kg ai/ha for the crops mentioned above and up to 0.75 kg ai/ha for apples. Application to apples is to trees at least 4 years old with no more than 7.5 kg ai/ha/year.

The Harvest WHP is 7 days.

All crops have the following grazing restraint:

DO NOT graze or cut for stock food for 2 days after application

There are no Codex or USA MRLs for 2,2-DPA in animal tissues. The critical Australian MRL is 0.2 mg/kg for meat (mammalian) and *0.1 mg/kg for milks. Residues are not expected in apples at harvest, the relevant MRL is *0.1 mg/kg. Therefore no residues are expected to result from the feeding of apple pomace to animals. Dalapon and all of its known breakdown products dissolve easily in water. They are readily washed from cells and tissues. Because dalapon is insoluble in organic solvents and lipids, it does not build up in animal tissues^{6,7}.

Note: the US EPA revoked tolerance for apples was 3 ppm. Utilising the US EPA revoked tolerances a conservative TF of 0.01 is estimated for meat and offal and 0.006 for milk. Assuming residues occur at the US revoked tolerance for apple, anticipated maximum residues in tissues are $0.3 \times 3 \times 0.01 = 0.009$ mg/kg.

It is anticipated that animal product residues will be below typical method LOQs.

6-Benzyladenine

is a plant growth regulator that is used up to 30 days after full bloom. Application at rates up to 3 (the permitted Australian rate does not result in detectable residues in apples (<LOQ of 0.05 mg/kg). Essentially a nil residue situation.

It is anticipated that animal product residues will be below typical method LOQs.

Abamectin

- is a macrocyclic lactone insecticide used for the control of various insects and mites. It is registered on apples for the control of pest mites. The application rate is up to 13.5 g ai/ha.

The harvest WHP is 14 days.

Do no feed treated produce to livestock for 14 days after application

There are Australian, Codex and USA MRLs for abamectin (avermectin in the USA) in animal tissues. The MRLs for cattle fat are 0.1 mg/kg in Australia and 0.03 mg/kg in the USA. The Australian cattle milk MRL is 0.02 mg/kg while the US MRL is 0.005 mg/kg. The Codex MRLs are 0.1 mg/kg for cattle fat, 0.05 mg/kg for cattle kidney, *0.01 mg/kg for cattle meat and 0.005 mg/kg for cattle milk. The Australian MRL for apples is 0.01 mg/kg with no MRLs for pomace. The USA MRL for apples of 0.02 mg/kg with an MRL of 0.10 ppm for apple pomace (wet). In the absence of other information the USA pomace (wet) MRL was scaled by the ratio of the Australian to USA application rates to provide an estimate of the likely residue in apple pomace (wet) (0.05 ppm).

A transfer factor of 0.02 for liver when fed at 0.1 ppm in the diet was reported and 0.04 for milk⁸. Applying this TF to the maximum residue in apple pomace (wet) at 30% of the diet and correcting for dry weight (apple pomace contains *ca.* 28% dry matter) gives a liver residue of 0.001 mg/kg ($0.3 \times 0.05 (0.28 \times 0.02)$) and a

⁶ Kuhnert M, Freytag B, Freytag HH, Fuchs V. (1992) [The tolerance and residue accumulation of sodium-2,2-dichloropropionate (Dalapon) administered over 90 days to dairy cows] *Dtsch Tierarztl Wochenschr.* 99 (4), 148-51. German.

⁷ Fertig, S. N.; Schreiber, M. M. (1961). Effects Of Herbicide Ingestion. Effect of dalapon ingestion on performance of dairy cattle and levels of residue in the milk. *J. Ag. Food Chem.* 9:369

⁸ 1992 JMPR Pesticide Residues in Food - 1992 evaluations – Part I: Residues, FAO Plant Production and Protection Paper 118. FAO and WHO 1993 <http://www.fao.org/ag/AGP/AGPP/Pesticid/Default.htm>

milk residue of 0.002 mg/kg ($0.3 \times 0.05 (0.28 \times 0.04)$), less than the relevant Australian, Codex, EU and USA MRLs.

Livestock residues are not anticipated to exceed international and/or domestic market standards.

alpha-Cypermethrin

- is a synthetic pyrethroid insecticide used for the control of various insects in crops. It is registered on apples for control of weevils. The application rate is up to 10 g ai/hL; application is to the trunk and soil around the base of the tree; no direct contact with fruit. MRL set in 1979 on basis of use pattern with no data required.

Alpha-cypermethrin residues decline with typical half-lives of 30 and 5 days for soil and foliage respectively. The half-life for the decline of residues in animal tissues is approximately 7 days.

The harvest WHP is 14 days

There are no grazing restraints

There are Australian, Codex and USA MRLs for cypermethrin in animal tissues. The relevant MRLs for cattle fat are 0.5, 0.2 and 1 mg/kg for Australia, Codex and the USA respectively. The milk MRLs for the same are 1 [in the fat = 0.04 mg/kg whole milk], 0.05 F mg/kg and 0.05 mg/kg respectively. The US also has separate MRLs for zeta cypermethrin of 1 mg/kg for cattle fat and 2.5 mg/kg in milk fat (reflecting a residue of 0.1 mg/kg in whole milk). There is an Australian MRL of 1 mg/kg for Pome fruit and 5 mg/kg for primary animal feed commodities.

The TF for fat is $0.1^{9,10}$. Assuming residues do not concentrate in pomace anticipated residues in fat are $0.3 \times 1 \times 0.1 \div 0.4 = 0.075$ mg/kg if fed at 30% of the diet. If residues in pomace are at the same level as the PAFC MRL, anticipated residues in fat are $0.3 \times 5 \times 0.1 \div 0.4 = 0.375$ mg/kg if fed at 30% of the diet. Anticipated residues in whole milk (TF 0.003-0.1) are the same as for fat.

Livestock residues may exceed international and/or domestic market standards.

Aminoethoxyvinylglycine

-is a plant growth regulator used to improve harvest management and fruit quality for apples. The application rate is 124.5 g ai/ha.

Do not harvest for 7 days after application.

Do not graze treated vegetation or cut for stock food for 14 days after application.

There are no Australian, Codex or US MRLs for aminoethoxyvinylglycine in animal commodities. An MRL has not been established for apples though the USA have set a tolerance of 0.08 mg/kg for apples.

The APVMA reported: Apple (125 g ai/ha, single application, 7 day WHP) Residue field trials conducted in Australia, New Zealand and the US were provided for evaluation. All trials included treatments that were consistent with proposed Australian GAP. Residues in apples harvested 7 days after a single application at 125 g ai/ha were (median underlined) <20, <20, <20, <30, <30, <30, <30, <30, <30, <30, 29, 39, 41, 51, 52 mg/kg (n=15).

Processing studies were undertaken in conjunction with two of the US residue trials on apples. AVG concentrated slightly in pomace (processing factors 1.30 & 2.13) but were depleted in juice (0.59 & 0.51) and wet pomace (0.76 & 0.50). The metabolism study in apples indicated that approximately 50-90% of the total radioactive residue was removed by rinsing the fruit in water. AVG concentrates only slightly in pomace (dry) and this is likely to be due to reduction in water content rather than preferential partitioning into the pomace fraction. Quantifiable residues are unlikely to occur in apple pomace.

It is anticipated that animal product residues will be below typical method LOQs.

⁹ Chen-AW; Fink-JM; Letinski-DJ; Barrett-GP; Pearsall-JC (1997) Residue of cypermethrin and its major acid metabolites in milk and tissues from dairy bovines treated with cypermethrin. *J. Ag. Food Chem.* 45: 12, 4850-4855.

¹⁰ 1981 JMPR Pesticide Residues in Food - 1981 Evaluations, FAO Plant Production and Protection Paper 42. FAO and WHO 1982 <http://www.fao.org/ag/AGP/AGPP/Pesticid/Default.htm>

Amitrole

-is a herbicide used to control weeds in a variety of situations. The application rate for apples is 0.55 kg ai/ha as a directed spray.

Do not apply later than 56 days before harvest

There are Australian but no Codex or US MRLs for amitrole in animal commodities. The Australian MRLs, including milk, have all been set at *0.01 mg/kg. The Australian MRL for pome fruit is *0.01 mg/kg.

The JMPR have stated¹¹ that “*There do not appear to be any grounds for assuming that livestock grazing on plant materials growing on land that had been treated with amitrole for the control of weeds would absorb or retain significant amounts of amitrole or its metabolites*”. The feeding of pomace derived from apples treated with amitrole does not represent a risk for residues in animal commodities.

It is anticipated that animal product residues will be below typical method LOQs.

Asulam

-is a herbicide used to control weeds in a variety of situations. The application rate for apples for dock control is 1.68 kg ai/ha as a directed spray.

No harvest WHP required when used as directed

Do not graze area to be treated for 7 days before and 21 days after application

Do not graze or cut for stock food for 21 days after application

There are Australian and US but no Codex MRLs for asulam in animal commodities. The Australian MRLs, including milk, have all been set at *0.1 mg/kg. The Australian MRL for apple is *0.1 mg/kg. The US MRLs for cattle meat, fat and milk are all set at 0.05 mg/kg.

In a study reported by the US EPA¹² residues were non-detectable in tissues of lactating dairy cows dosed with asulam *per se* at 0.5 ppm (<0.05 mg/kg) while at higher dose rates residues were detected in kidney. At 5 ppm feeding the residues in kidney were 0.06-0.12 mg/kg while at 50 ppm the residues in kidney were 0.11-0.13 mg/kg. Note the method measured the sum of asulam and metabolites containing the sulphanilamide moiety while the Australian definition is parent compound.

It is anticipated that animal product residues will be below typical method LOQs.

Azinphos-methyl

- is an acaricide used for the control of codling moth, scale, beetles and aphids in apples. The application rate is up to 49 g ai/hL.

The harvest WHP is 14 days.

There are Australian but no Codex or US MRLs for azinphos-methyl in animal tissues. The Australian MRLs have all been set at *0.05 mg/kg (meat, edible offal, milk). The Australian MRL for pome fruit is 2 mg/kg. The US and Codex MRLs for apples are 1.5 and 2 mg/kg, respectively.

Residues in the tissues and milk of cattle fed at levels ranging from 11 to 77 ppm in the diet for 28 days were all <0.01 mg/kg¹³. There is no expectation that residues will be detected in animal tissues from the feeding of apple pomace.

It is anticipated that animal product residues will be below typical method LOQs.

¹¹ 1974 JMPR. Evaluations of some pesticide residues in food. FAO/AGP/1974/M/11; WHO Pesticide Residues Series No. 4, 1975

¹² Reregistration Eligibility Decision, Asulam List A Case 0265 EPA 738-R-95-024 September 1995 Environmental Protection Agency, Office of Pesticide Programs, Special Review and Reregistration Division.
<http://cfpub.epa.gov/oppref/rereg/status.cfm?show=rereg>

¹³ Interim Reregistration Eligibility Decision for Azinphos-Methyl Case No. 0235 Environmental Protection Agency, Office of Pesticide Programs, Special Review and Reregistration Division.
<http://cfpub.epa.gov/oppref/rereg/status.cfm?show=rereg>

Bifenazate

- is a hydrazine carboxylate insecticide/acaricide used for the control of various insects in crops. It is registered on apple for control of apple two spotted and European red spider mites. The application rate is up to 31.2 g ai/hL.

The harvest WHP is 7 days

Do not feed treated produce to livestock for 7 days after application

Do not allow livestock to graze in treated area for 28 days after application.

There are Australian MRLs for bifenazate in animal tissues. The relevant MRLs for animal commodities are all *0.01 mg/kg. The US MRLs are 0.1 mg/kg for cattle fat and 0.02 mg/kg for other tissues and milk. The Australian MRL for pome fruit is 2 mg/kg and for apple pomace (dry) 3 ppm.

The APVMA PRS reported a feeding study¹⁴. Dairy cattle were dosed at 1, 3 and 10 ppm in the diet for 28 consecutive days. From the 10 ppm dosing, detectable residues of bifenazate were observed in butterfat (maximum 0.032 mg/kg), omental fat (maximum 0.07 mg/kg) and perirenal fat (maximum 0.10 mg/kg). Residues were <0.01 mg/kg in muscle (loin and round), whole and skim milk and in liver. Residues in kidney were 0.01 mg/kg.

Residues in orchard grass were <1 ppm by 28 days after application to trees.

Feeding apple pomace at 30% of the diet would give rise to anticipated residues in cattle fat of $0.3 \times 3 \times 0.01 = 0.009$ mg/kg.

It is anticipated that animal product residues will be below typical method LOQs.

Bifenthrin

- is a synthetic pyrethroid insecticide used for the control of various insects in crops. It is registered on apple for control of apple dimpling bug and plague thrips. The application rate is up to 1.6 g ai/hL. Bifenthrin residues decline with typical half-lives of 26 and 7 days for soil and foliage respectively.

No harvest WHP required

There are Australian, Codex and USA MRLs for bifenthrin in animal tissues. The relevant MRLs for cattle fat are 2, 0.5 and 1 mg/kg for Australia, Codex and the USA respectively. The MRLs for milk are 0.5 mg/kg, *0.05 mg/kg (cattle milk) and 1 mg/kg (milk fat, 0.1 mg/kg for whole milk). The Australian MRL for apples is *0.05 mg/kg. There are also MRLs for fodder and forage of pulses at 1 and 5 ppm respectively.

As no residues are expected in apples, none are expected in apple pomace, essentially a nil residue situation for animal commodities

It is anticipated that animal product residues will be below typical method LOQs.

Boscalid

- is a fungicide used for the control of blackspot scab and powdery mildew in *apples*. The application rate is up to 10 g ai/hL.

Do not harvest for 4 weeks after application.

Do not treat orchards that will or may be grazed by livestock.

ESI: 7 days.

There are Australian, Codex and USA MRLs for boscalid in animal tissues. The relevant MRLs are 0.1 mg/kg for meat (fat), 0.05 mg/kg for edible offal and *0.02 mg/kg for milk. The Codex MRLs (recommended JMPR 2009) are 0.7 mg/kg for meat (fat), 0.2 mg/kg for edible offal, 0.1 mg/kg for milks and

¹⁴ Public Release Summary on Evaluation of the new active BIFENAZATE in the product Acramite® Miticide, APVMA August 2003, Canberra, Australia.

2 mg/kg for milk fat. The US tolerances are fat 0.3 mg/kg, meat 0.1 mg/kg, edible offal 0.35 mg/kg and milk 0.1 mg/kg. The Australian MRL for apples is 2 mg/kg and for apple pomace, dry 20 mg/kg.

The APVMA reported: In a cow transfer study, dairy cows were fed 0, 0.05, 0.164 and 0.655 mg/kg bw of boscalid once daily for 28 days. The highest residues of boscalid were noted to be present in the cream, kidney, fat and liver of cows dosed at 0.655 mg/kg bw at levels of 0.381, 0.318, 0.292 and 0.182 mg/kg respectively. Residues of 0.096 mg/kg were detected in whole milk on day 18 of the study. No residues were detected in skim milk. Residues of 0.058 mg/kg were detected in the muscle of the cow after feeding for 28 days.

Depuration data were given for a single cow, sacrificed 7 days following last dosing at 0.655 mg/kg bw in the feed. The data show that quantifiable residues were not detected in the milk, muscle, liver, kidney and fat of the cow. Boscalid is rapidly depleted from the cow after removing the animal from dosing for 7 days.

Livestock residues are not anticipated to exceed international and/or domestic market standards.

Bupirimate

- is a fungicide used for the control of powdery mildew in *apples*. The application rate is up to 15 g ai/hL. Do not harvest for 7 days after application.
ESI: 7 days.

There are no Australian, Codex or USA MRLs for bupirimate in animal tissues. The Australian MRL for apples is 1 mg/kg.

EFSA reported a study where a lactating goat was dosed with ¹⁴C-bupirimate for 7 days at a level equivalent to 4.4 ppm in the diet. The goat was sacrificed 4 hours after the last dose. Residues in milk reached a plateau on day 4 at 0.07-0.09 mg eq/kg. Radioactivity in tissues were 0.09 mg eq/kg for liver, 0.1 for kidney and <0.01 mg eq/kg for fat and muscle.

It is anticipated that animal product residues will be below typical method LOQs.

Captan

- is a fungicide used for the control of various diseases in crops. It is registered on apple for control of black spot. The application rate is up to 100 g ai/hL.
The harvest WHP is 7 days
Do not use treated produce for stock food within 7 days of treatment

There are Australian and USA but no Codex MRLs for captan in animal tissues. The relevant MRLs for edible offal and meat in Australia are set at *0.05 mg/kg and milk at *0.01 mg/kg. The US MRL for cattle meat is 0.2 and milk is 0.1 mg/kg. The Australian MRL for apples is 10 mg/kg while the US and Codex MRL is 25 mg/kg. There is also an Australian MRL for apple pomace (dry) of 10 ppm.

JMPR has reported that feeding at rates of up to 100 ppm in the diet did not lead to detectable residues of captan in tissues or milk¹⁵.

It is anticipated that animal product residues will be below typical method LOQs.

Carbaryl

- is a carbamate insecticide used for the control of various insects in crops. It is registered on apples for control of heliothis, codling moth and fruit thinning. The application rate is up to 100 g ai/hL.
The harvest WHP is 3 days.

Carbaryl residues decline with typical half-lives of 10 and 7 days for soil and foliage respectively.

¹⁵ 2000 JMPR Pesticide Residues in Food - 2000 Evaluations – Part I, FAO Plant Production and Protection Paper 165. FAO 2001 <http://www.fao.org/ag/AGP/AGPP/Pesticid/Default.htm>

There are Australian, Codex and USA MRLs for carbaryl in animal tissues. The Australian and Codex residue definition is carbaryl for both plant and animal commodities. The Australian MRLs for edible offal and meat are 0.2 mg/kg while that for milk is 0.05 mg/kg. The Codex MRL for kidney is 3 mg/kg and liver 1 mg/kg while the MRL for meat is 0.05 mg/kg. The Codex milk MRL is 0.05 mg/kg. The Australian MRL for apples is 10 mg/kg (as Pome fruit).

The USA residue definition is the sum of carbaryl and 1-naphthol expressed as carbaryl for plant commodities, the sum of carbaryl, 1-naphthol, 5,6-dihydrodihydroxycarbaryl and 5,6-dihydrodihydroxynaphthol expressed as carbaryl for animal tissues. The US tolerance for cattle meat is 1 and fat is 0.5 mg/kg and that for milk is 1 mg/kg. The US also has tolerances of 12 mg/kg for pome fruit (residue definition, carbaryl).

No data was located for residues of carbaryl in apple pomace. However, it is considered unlikely that residues in pomace dried would exceed 100 ppm when prepared from apples with maximum residues of 5 ppm (concentration factor of 20). The TF for kidney is 0.007 for the Australian/Codex residue definition and 0.012 for the US residue definition¹⁶ giving rise to anticipated maximum residues in kidney from feeding apple pomace at 30% of the diet of $0.3 \times 0.007 \times 100 = 0.21$ mg/kg and $0.3 \times 0.012 \times 100 = 0.36$ mg/kg respectively for the Australian/Codex and USA residue definitions, less than the relevant international tolerances.

The TF for milk is 0.0002 for the Australian/Codex residue definition and 0.002 for the US residue definition giving rise to anticipated maximum residues in milk from feeding pomace at 30% of the diet of $0.3 \times 0.0002 \times 100 \div 0.4 = 0.015$ mg/kg and $0.3 \times 0.002 \times 100 \div 0.4 = 0.15$ mg/kg respectively for the Australian/Codex and USA residue definitions.

Livestock residues are not anticipated to exceed international and/or domestic market standards.

Carbendazim

- is a systemic fungicide used for the control of powdery mildew, black spot and blue moulds in apples. It is registered on apples at an application rate of 25 g ai/100L.

The harvest WHP is 7 days.

There are Australian and Codex but no US MRLs for carbendazim. The relevant MRL for cattle meat is 0.2 mg/kg for Australia. MRLs for milk are all 0.1 mg/kg. There is an Australian MRL for pome fruit at 5 mg/kg.

In studies in which dairy cows were fed either carbendazim or benomyl at levels of 2, 10, or 50 ppm in the diet for 28 days, no carbendazim residues were found in samples of lean muscle, liver, kidney or fat although in the carbendazim feeding study low-level residues of 5-HBC were observed in the liver (0.01 mg/kg) and kidneys (0.06 mg/kg) of cows in the group receiving 50 ppm carbendazim¹⁷. However, residues of this compound were also apparent in a kidney sample in the control group. One week after the end of treatment with the test material no residues were detectable in any tissue sample.

Considering the exaggerated feeding levels, it is unlikely that feeding of apple pomace derived from crops treated with benomyl (or carbendazim) would result in residues above LOQ in tissues.

It is anticipated that animal product residues will be below typical method LOQs.

Carfentrazone-ethyl

-is a herbicide used to control a variety of weeds in apples (pre-flowering young and established trees). The application rate is 18 g ai/ha.

¹⁶ 2002 JMPR. Pesticide Residues in Food - 2002 Evaluations – Part I: Residues Volume 1, FAO Plant Production and Protection Paper 175/1. FAO and WHO 2003 <http://www.fao.org/ag/AGP/AGPP/Pesticid/Default.htm>

¹⁷ 1998 JMPR - Pesticide Residues in Food - 1998 Evaluations, Part I Residues FAO Plant Production and Protection Paper 152/1. FAO and WHO 1999.

No harvest WHP is required.

Do not graze or cut for stock food for 14 days after application.

There are Australian and US but no Codex MRLs for animal commodities. The Australian MRLs have been set at *0.05 mg/kg for edible offal and meat and at *0.025 mg/kg for milk. The US MRLs are 0.1 for meat and meat by-products and 0.05 mg/kg for milk. The Australian MRL for pome fruit is *0.05 mg/kg.

It is anticipated that animal product residues will be below typical method LOQs.

Chlorantraniliprole

- is an insecticide. It is used on apples for the control of codling moth, budworms, oriental fruit moth and light brown apple moth. The application rate is 3.15 g ai/hL.

The harvest WHP is 14 days.

Do not allow livestock to graze vegetation in treated orchards or cut for stock food.

There are Australian, Codex and US MRLs for chlorantraniliprole. The relevant Australian MRLs for meat (fat), edible offal and milk are all *0.01 mg/kg. The US MRLs are 0.3 mg/kg for fat and liver, 0.2 for cattle mby (=offal) except liver, 0.05 mg/kg for meat and milk. The Codex MRLs are all *0.01 mg/kg (meat (fat), offal and milk).

The Australian MRL for pome fruit is 0.3 mg/kg and for apple pomace (dry) 3 ppm.

The 2008 JMPR reported a feeding study where dairy cows were dosed with chlorantraniliprole for 28 days at the equivalent of 1, 3, 10 and 50 ppm in the diet. Average residues of chlorantraniliprole in milk for the 3 ppm dose group were < 0.01 (3) mg/kg. Chlorantraniliprole residues in liver and fat were higher than in other tissues. Average residues for tissues for the 3 ppm dosing level (3 animals per dose group) were all < 0.01 mg/kg for liver, fat, kidney and muscle. A transfer factor of $<0.01/3 = <0.003$ for fat when fed at 3 ppm in the diet was reported[□]. Applying this TF to the Australian MRL for pomace fed at 30% of the diet gives a fat residue of 0.003 mg/kg ($0.3 \times 3 \times 0.003$).

A transfer factor of 0.003 for milk when fed at 3 ppm in the diet was reported. Applying this TF to the Australian MRL for pomace fed at 30% of the diet gives a milk residue of 0.003 mg/kg ($0.3 \times 3 \times 0.003$).

It is anticipated that animal product residues will be below typical method LOQs.

Chlorfenapyr

- is a pyrrole insecticide/miticide. It is used on apples for the control of two-spotted mites. The application rate is 10.8 g ai/hL.

The harvest WHP is 14 days.

Do not allow livestock to graze vegetation in treated orchards or cut for stock food.

There are Australian but no Codex or US MRLs (revoked 31/1/2001) for chlorfenapyr. The relevant Australian MRLs for meat (fat), edible offal and milk are 0.05, *0.05 and *0.01 mg/kg respectively. The revoked US MRLs were 0.1 mg/kg for cattle fat, 0.3 for cattle mby (=offal), 0.01 mg/kg for meat and 0.01 mg/kg for milk.

The Australian MRL for pome fruit is 0.5 mg/kg and for apple pomace (dry) 3 ppm.

A transfer factor of 0.09 for fat when fed at 7 ppm in the diet was reported¹⁹. Applying this TF to the Australian MRL for pomace fed at 30% of the diet gives a fat residue of 0.081 mg/kg ($0.3 \times 3 \times 0.09$). Decline information suggests a half-life of approximately 4 days for fat.

□ US EPA memorandum dated 12 February 1998, Chlorfenapyr - 129093: Health Effects Division Risk Characterization for Use of the Chemical Chlorfenapyr (Alert, EPA File Symbol 5905-GAI) in/on Citrus (6F04623). Case: 287132. Barcode: D221320 from George Kramer, Marion Copley, Susie Chun, Julianna Cruz to Ann Sibold/Marion Johnson, <http://www.epa.gov/opprd001/chlorfenapyr/memohed2.pdf>

¹⁹ US EPA memorandum dated 12 February 1998, Chlorfenapyr - 129093: Health Effects Division Risk Characterization for Use of the Chemical Chlorfenapyr (Alert, EPA File Symbol 5905-GAI) in/on Citrus (6F04623).

A transfer factor of 0.006 for milk when fed at 7 ppm in the diet was reported. Applying this TF to the Australian MRL for pomace fed at 30% of the diet gives a milk residue of 0.0054 mg/kg ($0.3 \times 3 \times 0.006$).

Livestock residues may exceed international and/or domestic market standards.

Chlorpyrifos

- is an organophosphate insecticide used for the control of various insects in crops. It is registered on apples for the control of scale, woolly aphids and wingless grasshopper. The application rate is up to 50 g ai/hL. The harvest WHP is 14 days.

The grazing WHP is 28 days (NB: this applies only to cotton, 2 days for other situations). The label states that the Meat Research Corporation (MLA) determined that an Export Animal Feed Interval was not required.

There are Australian, Codex and USA MRLs for chlorpyrifos in animal tissues. The Australian and Codex residue definition is chlorpyrifos while the USA definition includes the metabolite TCP. The MRLs for cattle fat are 0.5, 1 and 0.3 mg/kg for Australia, Codex and the USA respectively. The MRLs for milk are 0.2 [milk in the fat] mg/kg, 0.02 mg/kg and 0.01 mg/kg (0.25 mg/kg for milk fat). There is an Australian MRL for pome fruit of 0.5 mg/kg. The US MRL for apples is 0.01 mg/kg.

The maximum transfer factor for feeding cattle at 10 ppm in the diet was 0.016 for cattle fat and at 30 ppm 0.0007 for milk²⁰. Residues from feeding apple pomace with residues of 0.5 ppm at 30% of the diet would be $0.3 \times 0.5 \times 0.016 \div 0.4 = 0.005$ mg/kg; below the Australian, Codex and USA MRLs for fat and be $0.3 \times 0.5 \times 0.0007 \div 0.4 = 0.0003$ mg/kg, below the Australian, Codex and USA MRLs for milk.

It is anticipated that animal product residues will be below typical method LOQs.

Clofentezine

- is a miticide used for the control of two spotted and European red mites on apples. The application rate is up to 15 g ai/hL. The harvest WHP is 21 days.

There are Australian, Codex and USA MRLs for clofentezine in animal tissues. The Australian MRLs are all $T \times 0.05$ mg/kg. The Codex and USA definitions for animal commodities include the metabolite 3-(2-chloro-4-hydroxyphenyl)-6-(2-chlorophenyl)-1,2,4,5-tetrazine. The Codex MRLs are meat, edible offal and milk are $*0.05$ mg/kg. The US MRLs are 0.4 mg/kg for liver, 0.05 mg/kg for other tissues and 0.01 mg/kg for milk. There is an Australian MRL for apples (pome fruits) of 0.1 mg/kg.

The TF for liver is 0.026²¹. No detectable residues are expected from feeding clofentezine contaminated apples or apple pomace.

It is anticipated that animal product residues will be below typical method LOQs.

Clothianidin

- is an insecticide. It is used on apples for the control of codling moth, mealybug and woolly aphid. The application rate is 20 g ai/hL.

The harvest WHP is 21 days.

Do not allow livestock to graze vegetation in treated orchards or cut for stock food.

Case: 287132. Barcode: D221320 from George Kramer, Marion Copley, Susie Chun, Julianna Cruz to Ann Sibold/Marion Johnson, <http://www.epa.gov/opprd001/chlorfenapyr/memohed2.pdf>

²⁰ 2000 JMPR. Pesticide Residues in Food - 2000 Evaluations – Part I, FAO Plant Production and Protection Paper 165.

FAO and WHO 2001 <http://www.fao.org/ag/AGP/AGPP/Pesticid/Default.htm>

²¹ data reported in the 1986 and 1990 JMPRs - Pesticide Residues in Food - 1986 Evaluations, Part I Residues FAO Plant Production and Protection Paper 78. FAO and WHO 1986 and Pesticide Residues in Food - 1990 Evaluations, Part I Residues FAO Plant Production and Protection Paper 103/1. FAO and WHO 1990 <http://www.fao.org/ag/AGP/AGPP/Pesticid/Default.htm>

There are Australian and US but no Codex MRLs for clothianidin. The relevant Australian MRLs for meat (fat) and edible offal are *0.02 mg/kg and milk *0.01 mg/kg. The US MRLs are not set for fat, mby (=offal) and meat and 0.01 mg/kg for milk. NOTE: , clothianidin is a major metabolite of thiamethoxam, and tolerances for the combined residues of thiamethoxam and its metabolite clothianidin have been established under 40 CFR part 180.565 for both plant and livestock commodities. US thiamethoxam tolerances in meat, offal and milk are 0.02, 0.04 and 0.02 mg/kg respectively.

The Australian MRL for apples is 0.5 mg/kg.

At the highest dose level, 2.6 ppm feed, residues of clothianidin could be quantified in milk, ranging from < 0.01 ppm to 0.012 ppm. No quantifiable residues above the LOQ (0.01–0.02 ppm) of any analyte (TI-435, TZG, TZU and ATMG-pyruvate) were found in tissues.

It is anticipated that animal product residues will be below typical method LOQs.

Cyanamide

- is a plant growth regulator for regulation of bud burst in apples. The application rate is up to 1.56 kg ai/ha. A WHP is not required.

There are no Australian, Codex or USA MRLs for cyanamide in animal tissues. The Australian MRL for apples is *0.02 mg/kg.

It is anticipated that animal product residues will be below typical method LOQs.

Cyproconazole

- is used as a wound dressing and is not expected to give rise to residues in apples or apple pomace.

It is anticipated that animal product residues will be below typical method LOQs.

Cyprodinil

-is a fungicide that is used in apples for the control of fungal black spot. The application rate is 20 g ai/hL. No harvest WHP is required
Do not use after petal fall

There are Australian and Codex but no US MRLs for cyprodinil in animal tissues. The Australian MRLs have all been set at *0.01 mg/kg. The Codex MRLs are *0.01 mg/kg for tissues and 0.0004 mg/kg for milk. The Australian apple MRL is 0.05 mg/kg. Residues in apples were <0.02 mg/kg; no data for pomace were available. The US MRL for pome fruit is 0.1 mg/kg and for apple pomace (wet) 0.15 ppm.

The 2003 JMPR²² reported a feeding study on lactating dairy cows in which Holstein cows were dosed daily, by gelatin capsule, with cyprodinil at the equivalent of 5, 15 and 50 ppm in the dry-weight diet for 28 consecutive days. Cyprodinil residues were not detected (LOQ 0.01 mg/kg) in the milk (days 0, 1, 3, 7, 14 and 21), kidney or fat of cows from the highest dose group (50 ppm), nor in milk (day 26) or muscle from any dose groups. Cyprodinil was present in liver (highest residue 0.013 mg/kg) from the highest dose group but not from the other groups.

It is anticipated that animal product residues will be below typical method LOQs.

Diazinon

- is an organophosphate insecticide used for the control of various insects in crops. It is registered on apples for the control of scale and woolly aphids. The application rate is up to 52 g ai/hL. The harvest WHP is 14 days.

²² Pesticide residues in food 2003 Evaluations Part I: Residues FAO Plant Production and Protection Paper. FAO and WHO 2004. <http://www.fao.org/ag/AGP/AGPP/Pesticid/Default.htm>

Do not harvest, graze or cut for stock food crops or pastures for 14 days after application

There are Australian, Codex and USA MRLs for diazinon in animal tissues. The MRLs for cattle fat are 0.7 mg/kg for Australia, 2 mg/kg for Codex and 0.5 mg/kg for the US. For milk the MRLs are 0.5 [in the fat], 0.02 F mg/kg and not specified. There is an Australian MRLs for apples (fruits) at 0.5 mg/kg. The US MRL for apples is also 0.5 mg/kg.

The TF for diazinon in animal fat is 0.001²³. Anticipated residues in cattle fat from feeding apple pomace are $0.3 \times 0.5 \times 0.001 \div 0.4 = 0.000375$ mg/kg, below the relevant international MRLs (Note assumed 30% of the diet, wet pomace has same residues as apples and contains 40% dry matter). No residues were detected in milk of cows dosed at the equivalent of 120 ppm in the diet.

It is anticipated that animal product residues will be below typical method LOQs.

Dichlobenil

- is a selective herbicides used for the control of certain annual grasses and broad-leafed weeds in apples. It is applied to grass/weeds in the orchard. The application rate is up to 6 kg ai/ha (band 2 m wide × 5 km). No harvest WHP required.

Do no graze livestock on treated areas

There are no Australian, Codex or USA MRLs for dichlobenil in animal commodities. The Australian MRLs are 0.1 mg/kg for citrus fruit, pome fruit, stone fruit, grapes and tomatoes (US apple/pear 0.5 mg/kg). No detectable residues are expected to result from the feeding of apple pomace (wet) to animals.

It is anticipated that animal product residues will be below typical method LOQs.

Dicofol

- is an organochlorine miticide used for the control of various pests in a variety of crops. In apples it is used for the control of mites. The application rate is up to 48 g ai/hL.

The harvest WHP is 7 days.

Do not graze or cut for stock food.

There are no Australian or USA MRLs for animal commodities. The Australian and Codex residue definitions differ. The Australian residue definition is the sum of dicofol + 2,2,2-trichloro-1-(4-chlorophenyl)-1-(2-chlorophenyl)ethanol calculated as dicofol while the Codex residue definition for animal commodities is the sum of dicofol + 2,2-dichloro-1,1-bis(4-chlorophenyl)ethanol (p,p'-FW152) calculated as dicofol. There is a Codex MRL of 3 mg/kg for cattle fat, 0.1 mg/kg for milk (F) and 1 mg/kg for cattle edible offal. The EU MRLs are 0.5 mg/kg for cattle and sheep meat, *0.05 mg/kg for cattle and sheep edible offal and 0.02 mg/kg for milk. The Australian MRL for apples has been set at 5 mg/kg (fruits other than strawberries).

Residues in soil and foliage decline with typical half-lives of 16- 60 days and >6 months respectively.

The TF for fat for the Australian and Codex residue definitions are 0.05-0.1 for Australia and 0.3-0.5 for the Codex residue definition²⁴. The corresponding TFs for milk are 0.003-0.006 and 0.02-0.04 respectively. If it is assumed that residues do not concentrate in wet pomace the anticipated residues in fat are $0.3 \times 5 \times 0.5 \div 0.4 = 1.9$ mg/kg for the Codex and $0.3 \times 5 \times 0.1 \div 0.4 = 0.375$ for the Australian residue definition. Anticipated residues in milk (TFs 0.003-0.006 and 0.02-0.04 respectively.) are $0.3 \times 5 \times 0.04 \div 0.4 = 0.25$ mg/kg for the Codex and $0.3 \times 5 \times 0.006 \div 0.4 = 0.0225$ for the Australian residue definition. Residues above LOQ are expected if pomace derived from dicofol treated apples is fed to animals.

²³ 1996 JMPR - Pesticide Residues in Food - 1996 Evaluations, Part I: Residues FAO Plant Production and Protection Paper 142. FAO and WHO 1997

²⁴ 1994 JMPR - Pesticide Residues in Food - 1994 Evaluations, Part I Residues FAO Plant Production and Protection Paper 78. FAO and WHO 1995

Dicofol can contain up to 1000 mg/kg DDT and related compounds²⁵, an application rate of 48 g ai/hL corresponds to a potential application of DDT at 0.48 g/ha assuming 1000L/ha spray volume. The TF for fat and milk fat are estimated to be 1.8 and 2.1 respectively. If residues DDT are present at the same ratio to dicofol as in the technical active ingredient and do not concentrate at more than 10× in dry pomace, the anticipated residues are $0.3 \times (10 \times 5 / 1000) \times 1.8 = 0.027$ mg/kg in subcutaneous fat and $0.3 \times (10 \times 5 / 1000) \times 2.1 = 0.03$ mg/kg in milk fat. Assuming a fruit diameter of 5 cm, residues based on planar surface area an application rate are 3 ppm for application at 1 kg ai/ha and when scaled for the application rate are 0.001 ppm for application. Assuming DDT residues do not concentrate more than 10× in pomace, the anticipated residues are $0.3 \times (10 \times 0.001) \times 1.8 = 0.0054$ mg/kg in subcutaneous fat and $0.3 \times (10 \times 0.001) \times 2.1 = 0.006$ mg/kg in milk fat.

Livestock residues may exceed international and/or domestic market standards.

Difenoconazole

-is a triazole fungicide that is used in apples for the control of fungal black spot. The application rate is 2.5 g ai/hL.

Do not harvest for 4 weeks after application

There are Australian and US and Codex MRLs for difenoconazole in animal tissues. The Australian and MRLs have all been set at *0.05 mg/kg for tissues and *0.01 mg/kg for milk. The US MRLs for meat, liver and milk are 0.05, 0.2 and 0.01 respectively. Codex MRLs for edible offal, meat and milk are 0.2, 0.05 and *0.005 mg/kg. The Australian apple MRL is 0.3 mg/kg and the apple pomace (dry) MRL is 1 ppm.

The US EPA reported²⁶ “two metabolism studies were performed on ruminants (lactating goats) in a 10-day study with a dose rate of 4.17 ppm (14 × the 0.30 ppm estimated dietary burden) and a 3-day study with a dose rate of 100 ppm (333 × the 0.30 ppm estimated dietary burden). The total radioactive residue (TRR) in the goat tissues was used to estimate the expected residues in a feeding study with a dose rate of 0.30 ppm. The maximum residue observed was in liver, estimated to be at a level of 0.02 ppm from both metabolism studies. This value is 2.5 × below the LOQ of the proposed analytical enforcement method (0.05 ppm).”

It is considered unlikely that feeding pomace derived from difenoconazole treated apple crops would give rise to residues at levels of concern in animal tissues.

It is anticipated that animal product residues will be below typical method LOQs.

Dimethoate

- is an organophosphate insecticide used for the control of various insects in crops. It is registered on apples for the control of fruit fly, aphids, thrips and wingless grasshoppers. The application rate is up to 60 g ai/hL. The harvest WHP is 7 days.

There are Australian, Codex and USA MRLs for dimethoate in animal tissues. The Australian and Codex MRLs for animal commodities have been set at *0.05 mg/kg. The US MRLs for cattle meat byproducts and milk are set at 0.02 and 0.002 mg/kg. There are Australian MRLs of 5 mg/kg for fruits (includes apples).

A metabolism study with lactating goats dosed orally with dimethoate suggests that residues are not expected in animal tissues²⁷.

It is anticipated that animal product residues will be below typical method LOQs.

²⁵ Australian Pesticides and Veterinary Medicines Authority, Minimum Compositional Standards (MCS) for Active Constituents as of 30 January 2004, <http://www.apvma.gov.au/tgac/mincompstandards.pdf>

²⁶ Difenoconazole Pesticide Tolerance Federal Register: September 15, 2000 (Volume 65, Number 180) Page 55911-55921

²⁷

Diphenylamine (DPA)

-is a scald inhibitor used to prevent scald in stored apples. The application rate is 409.5 g ai/hL as a post-harvest dip

No WHPs required.

There are Australian, Codex and US MRLs for diphenylamine in animal tissues. The Australian MRLs are *0.01 mg/kg except for liver of cattle, goats, sheep and pigs which is 0.05 mg/kg. The Codex MRLs are 0.05 mg/kg for cattle liver, *0.01 mg/kg for cattle kidney, *0.01 mg/kg for cattle fat and *0.0004 mg/kg for milk. The US MRLs are 0.1 mg/kg for liver and 0.01 mg/kg for other tissues and milk. The Australian and US apple MRLs are both 10 mg/kg. The Australian MRL for apple pomace wet is 20 ppm.

The transfer factors for liver and fat are 0.002 and 0.0002 respectively²⁸. Feeding pomace at 30% of the diet, anticipated residues in cattle tissues are $0.3 \times 20 \times 0.002 \div 0.4 = 0.03$ mg/kg for liver and 0.003 mg/kg for fat.

Livestock residues are not expected to exceed international and/or domestic market standards.

Diquat

- is a herbicide used for the control of weeds in various crops. It is applied to apples at an application rate of up to 0.3 kg ai/ha (30 g ai/hL).

Do not graze or cut sprayed vegetation for stock food for 1 day after application.

The Australian and Codex MRLs for diquat in meat (mammalian) are the same at *0.05 mg/kg. The US MRL for meat and other tissues is 0.05 mg/kg. The MRLs for milk are *0.01 mg/kg, *0.01 mg/kg and 0.02 mg/kg. Residues in soil and foliage decline with typical half-lives of *ca.* 1000 and 30 days respectively. The MRL for apples (fruits) is *0.05 mg/kg.

No residues were detected in tissues of cows fed diquat for 28 days at 100 ppm in the diet and slaughtered on the last day of dosing (LOD 0.01 mg/kg)²⁹. Residues in pomace (dried) would be expected to be less than 100 ppm. This suggests that no residues would be detected in animal tissues if fed apple pomace.

It is anticipated that animal product residues will be below typical method LOQs.

Dithianon

-is a fungicide that is used in apples for the control of fungal black spot. The application rate is 12.6 g ai/hL. Do not harvest for 21 days after application

There are no Australian, US or Codex MRLs for dithianon in animal tissues. The Australian apple MRL is 2 mg/kg (fruits).

In a goat metabolism study the concentrations of radioactivity in milk, muscle and fat were less than 0.003 and 0.03 mg equiv./kg for animals dosed orally at *ca.* 3 and 30 ppm respectively in the feed for 5 days³⁰. The levels in liver (0.02 and 0.17 mg equiv./kg) and kidneys (0.06 and 0.49 mg equiv./kg) were higher. No information was available on the proportion of the radioactivity that was due to dithianon *per se*.

Using the radioactive residues in fat as a basis for a TF, residues in fat are anticipated to be $0.3 \times 2 \times 0.001 \div 0.4 = 0.0015$ mg/kg, less than likely LOQs of regulatory methods.

It is anticipated that animal product residues will be below typical method LOQs.

²⁸ 2001 JMPR Pesticide Residues in Food - 2001 Evaluations – Part I, FAO Plant Production and Protection Paper 171. FAO and WHO 2002 <http://www.fao.org/ag/AGP/AGPP/Pesticid/Default.htm>

²⁹ Reregistration Eligibility Decision, Diquat Dibromide, List A, Case 0288, EPA 738-R-95-016 July 1995 Environmental Protection Agency, Office of Pesticide Programs, Special Review and Reregistration Division. <http://cfpub.epa.gov/oppref/rereg/status.cfm?show=rereg>

³⁰ 1992 JMPR - Pesticide Residues in Food – 1992 evaluations. Part II. Toxicology. WHO, WHO/PCS/93.34, Geneva, 1993

Diuron

- is a herbicide used for the control of weeds in crop. It is applied to bare ground in spring and autumn with an instruction to not allow spray or drift to contact fruit of apple foliage. The application rate is up to 1.8 (split spring/autumn)-3.6 (after harvest) kg ai/ha.
No harvest or grazing WHP is required.

There are no Codex MRLs for diuron. The US and Australian residue definitions differ with the Australian definition including a metabolite in addition to the parent compound. The relevant US MRL for animal tissues is 1 mg/kg for cattle mbyop while the Australian MRL for edible offal of cattle is 3 mg/kg (the higher value probably reflecting the inclusion of the metabolite in the residue definition). The Australian MRL for milk is 0.1 mg/kg. Residues in soil and foliage decline with typical half-lives of 90 and 30 days respectively. Australia has a primary animal feed commodity MRL of 50 mg/kg while the MRL for apples (fruits) is 0.5 mg/kg. The USA MRL for apples is 0.1 mg/kg. It is considered unlikely that residues in pomace would exceed 10 ppm, much less than the Australian primary animal feed commodity MRL.

NOTE: US MRLs have been established for animal feed items (including alfalfa forage and hay at 2 ppm and citrus pulp dry at 4 ppm) as well as for animal commodities. If the US MRLs are used to estimate the dietary burden using the US EPA Guideline, a dietary burden of ca. 4.8 ppm is estimated. An anticipated TF is the 1 ppm (animal commodity tolerances) (4.8 ppm (dietary burden) = 0.2 (overestimate).

Assuming maximum residues in apple pomace are at the apple MRL, anticipated residues in tissues are $0.3 \times 0.5 \times 0.2 \div 0.4 = 0.075$ mg/kg.

Livestock residues may exceed international and/or domestic market standards.

Dodine

-is a fungicide that is used in apples for the control of fungal black spot. The application rate is 48 g ai/hL.
Do not harvest for 5 days after application
Do not cut fodder for stock feed or allow livestock to graze vegetation in treated areas.

There are US (set at 0 for meat and milk) but no Australian or Codex MRLs for dodine in animal tissues. The Australian, Codex and US apple MRL is 5 mg/kg (Pome fruit in Australia).

The 2003 JMPR reported a processing factor of 5.1 for wet pomace. In a goat metabolism study where the animal was dosed at the equivalent of 10 ppm in the feed the TF for liver of 0.0004³¹. Feeding wet pomace (40% dry matter) at 30% of the diet, anticipated residues in cattle tissues are $0.3 \times 5.1 \times 5(0.4 \times 0.0004 = 0.00765$ mg/kg for liver.

It is anticipated that animal product residues will be below typical method LOQs.

Endosulfan

- is an organochlorine insecticide used for the control of various pests in a variety of crops. In apples it is used for the control of the dimpling bugs, heliothis, aphids and various other bugs. The application rate is up to 66.5 g ai/hL.
The harvest WHP is 28 days.
Do not graze orchards after application.
ESI: Livestock that have been grazing on or fed treated crops should be placed on clean feed for 21 days prior to export slaughter.

There are Australian, Codex and USA MRLs for animal commodities. The Australian and Codex MRL for cattle fat is 0.2 mg/kg while the US MRL is 13 mg/kg. The Australian MRL for milk is 0.02 mg/kg, USA 2 mg/kg for milk fat and Codex 0.1 F mg/kg. There is an Australian MRL for apples (pome fruits) set at 1

³¹ 2003 JMPR. Pesticide Residues in Food - 2003 Evaluations – Part I: Residues, FAO Plant Production and Protection Paper xxx. FAO and WHO 2004 <http://www.fao.org/ag/AGP/AGPP/Pesticid/Default.htm>

mg/kg and a primary animal feed commodity MRL of 0.3 mg/kg. The revised MRL for apples is 1 mg/kg based on an HR (highest residue) of 0.21 mg/kg.

Residues in soil and foliage decline with typical half-lives of 50 and 3 days respectively although the decline of residues in senescent foliage is much slower.

The TF for fat is 0.3-0.4³². The APVMA report an HR for pomace (dry) of 0.64 mg/kg though 1.2 mg/kg may be more appropriate. Anticipated residues in fat from feeding apple pomace at 30% of the diet are $0.3 \times 0.64 \times 0.4 = 0.077$ mg/kg or 0.15 mg/kg if use 1.2 ppm for pomace (dry).

The TF for milk is 0.02. Residues in milk would be $0.3 \times 2 \times 0.02 \div 0.4 = 0.03$ mg/kg. The TF for cream is 0.12. Residues in cream would be $0.3 \times 2 \times 0.12 \div 0.4 = 0.18$ mg/kg.

Livestock residues are not anticipated to exceed international and/or domestic market standards.

Ethephon

- is a plant growth regulator. It is applied for thinning to increase fruit size etc. The application rate is up to 48 g ai/hL.

The harvest WHP is 7 days

The Codex and Australian MRLs for ethephon in edible offal are the same at 0.2 mg/kg. The Codex and Australian milk MRLs are *0.05 and 0.1 mg/kg. The US tolerance for offal is 0.2 mg/kg and tolerance for milk is 0.01 mg/kg. Residues in soil and foliage decline with typical half-lives of 10 and 5 days respectively. Australia has a primary animal feed commodity MRL of 10 mg/kg. The MRL for apples is 1 mg/kg. JMPR reported a PF for dry pomace of 2³³. Applying the PF to the MRL gives an estimate of 2 ppm for the maximum residue in apple pomace (dry).

In a study where dairy cows were fed at up to 150 ppm in the diet for 28 days, residues in tissues were <0.1 mg/kg for muscle, <0.2 mg/kg for fat, liver and kidney and <0.12 mg/kg in milk³⁴. It is considered unlikely that feeding of pomace would lead to residues in animal tissues that are above likely LOQs of regulatory methods.

It is anticipated that animal product residues will be below typical method LOQs.

Etoxazole

-is an oxazoline miticide used for control of two spotted mite and European red spider mite. The application rate is 3.85 g ai/hL.

The harvest WHP is 21 days.

Do not graze treated area or cut for stockfeed.

There are Australian and US but no Codex MRLs for etoxazole in animal commodities. The Australian MRLs are *0.01 mg/kg for edible offal and milks and *0.02 mg/kg for mammalian fat. The US MRLs are 0.02 mg/kg for cattle fat, 0.01 mg/kg for liver and milk fat. The MRL for apples is 0.2 mg/kg and for apple pomace, dry 2 ppm.

The APVMA reported a study where dairy cattle were fed etoxazole for 28 consecutive days at rates equivalent to 1.2, 3.6 and 11.4 ppm in the diet³⁵. Residues of etoxazole in milk were <LOQ/<LOD in all

³² Reregistration Eligibility Decision for Endosulfan Case No. 0014 EPA 738-R-02-013 November 2002
Environmental Protection Agency, Office of Pesticide Programs, Special Review and Reregistration Division.
<http://cfpub.epa.gov/opprereg/status.cfm?show=rereg>

³³ 1994 JMPR - Pesticide Residues in Food - 1994 Evaluations, Part I Residues FAO Plant Production and Protection Paper 78. FAO and WHO 1995

³⁴ 1994 JMPR - Pesticide Residues in Food - 1994 Evaluations, Part I Residues FAO Plant Production and Protection Paper 78. FAO and WHO 1995

³⁵ Public Release Summary on Evaluation of the new active ETOXAZOLE in the product Paramite Selective Miticide, APVMA May 2004, Canberra, Australia

samples from the two lowest dose groups. The highest residue in milk from the high dose group was observed after 6 days dosing, indicating residues plateau quickly. Etoxazole showed a low potential for transfer to tissues with transfer factors in the range <0.004 to 0.013. Residues in the 1.2 ppm dose group were <0.005 mg/kg in muscle, milk, kidney and liver with a maximum residue in fat of 0.015 mg/kg.

Feeding apple pomace (dry) at 30% of the diet would give rise to anticipated maximum residues in fat (TF = 0.0125) of $0.3 \times 0.0125 \times 2 = 0.0075$ mg/kg, less than the limit of detection for this tissue. No residues are anticipated in other tissues.

It is anticipated that animal product residues will be below typical method LOQs.

Fenarimol

- is a fungicide used for the control of black spot and powdery mildew on apples. The application rate is up to 3.6 g ai/hL (54 g ai/ha).

The harvest WHP is 14 days

There are Codex and US but no Australian MRLs for fenarimol in animal tissues. The Codex MRLs are 0.05 mg/kg for cattle liver and *0.02 mg/kg for cattle kidney and meat. The relevant USA MRLs for fenarimol in animal tissues are 0.01 mg/kg for cattle fat, liver and kidney and 0.05 mg/kg for meat and meat by-products (other offals). The US MRL for apples is and apple pomace (wet) is 0.3 ppm. The Australian MRL for pome fruit is 0.2 mg/kg. JMPR reported a PF of 13 for dry pomace³⁶. Applying the PF to the Australian MRL gives an estimated maximum residue in pomace (dry) of 2.6 ppm.

In a goat metabolism study where goats were dosed with fenarimol at the equivalent of 10 ppm in the diet for 5 days, no residues of fenarimol (parent compound) were detected in liver and kidney³⁷. Radioactive residues in fat and muscle were 0.01-0.03 mg equiv/kg. Inclusion of pomace (dry) at 30% of the diet would result in anticipated maximum residues in fat of $0.3 \times 2.6 \times 0.003 = 0.002$ mg/kg. The anticipated residue is less than likely regulatory method LOQs (0.01 mg/kg).

In a feeding study in cattle and pigs, animals were fed at levels up to 1 ppm, residues in tissues were below 0.01 mg/kg³⁸.

It is anticipated that animal product residues will be below typical method LOQs.

Fenbutatin oxide

- is a miticide. Application to apples is for control of mites and is at an application rate of 22 g ai/hL.

The harvest WHP is 2 days.

Do not graze or feed animals on cover crops in sprayed orchards

There are Codex but no Australian or US MRLs for fenbutatin oxide in animal tissues. The Codex MRLs are 0.2 mg/kg for edible offal and *0.05 mg/kg for meat and milk. The Australian MRL for apples is 3 mg/kg.

Feeding at 96 ppm for 28 days resulted in residues of up to 0.06 mg/kg in fat and 0.22 mg/kg in liver/kidney and 0.11 mg/kg in cream and <0.02 mg/kg in skim milk (US residue definition)³⁹. Anticipated residues in fat, assuming no concentration of residues in wet pomace and feeding at 30% of the diet are $0.3 \times 3 \times 0.0006 \div 0.4 = 0.0014$ mg/kg, less than likely regulatory method LOQs for fat.

It is anticipated that animal product residues will be below typical method LOQs.

³⁶ 1995 JMPR - Pesticide Residues in Food - 1995 Evaluations, Part I Residues FAO Plant Production and Protection Paper 137. FAO and WHO 1996

³⁷ 1995 JMPR - Pesticide Residues in Food - 1995 Evaluations, Part I Residues FAO Plant Production and Protection Paper 137. FAO and WHO 1996

³⁸ 1995 JMPR - Pesticide Residues in Food - 1995 Evaluations, Part I Residues FAO Plant Production and Protection Paper 137. FAO and WHO 1996

³⁹ 1979 JMPR - Pesticide Residues in Food - 1979 Evaluations, Part I Residues FAO Plant Production and Protection Paper 20 Suppl. FAO and WHO 1980

Fenitrothion

-is an OP insecticide used to control plague locust in various crops. The application rate is up to 400 g ai/ha. No harvest WHP required (NB: Most labels show 14 days).

There are Australian and Codex but no US MRLs for fenitrothion in animal tissues. The relevant Australian and Codex MRLs for cattle edible offal, meat and fat are the same at *0.05 mg/kg. The Australian MRL for milks is *0.05 [in the fat] mg/kg and the Codex MRL is *0.01 mg/kg. The Australian MRL for apples is 1 mg/kg (fruits).

Residues in tissues were <0.05 mg/kg in a 28 day lactating cow feeding study conducted at a feeding level equivalent to 100 ppm in the feed⁴⁰. There is no reasonable expectation of finite residues in milk or cattle tissues as a result of the feeding of apple pomace.

It is anticipated that animal product residues will be below typical method LOQs.

Fenoxycarb

-is a carbamate insecticide. It is used on apples for the control of codling moth, light brown apple moth and scale at an application rate of 10 g ai/hL.

The harvest WHP is 14 days.

There are no Australian, Codex or US MRLs for fenoxycarb in animal tissues. The Australian MRL for apples is 2 mg/kg.

In a goat metabolism study where lactating goats were orally dosed with ¹⁴C-fenoxycarb at the equivalent of 10 ppm in the diet, total radioactive residues in liver, kidney, muscle and fat were 2.5, 2.6, 0.1 and 0.15 mg fenoxycarb equivalents/kg at 8 hours after the final dose and 0.13, 0.1, 0.003 and 0.011 mg fenoxycarb equivalents/kg at 72 hours after the final dose⁴¹. Although individual metabolites were not identified it was noted that muscle comprised two metabolites in a ratio of 4:1 and liver and kidney a plethora of metabolites. It is considered unlikely that residues of parent fenoxycarb would be detected at levels above 0.01 mg/kg in tissues of animals on feeding at 0.6 ppm in the diet (30% apple pomace with residues of 2 ppm).

It is anticipated that animal product residues will be below typical method LOQs.

Fenpyroximate

-is an insecticide. It is used on apples for the control of mites at an application rate of 5 g ai/hL.

The harvest WHP is 14 days.

Do not graze treated area. Do not feed produce harvested from treated area to livestock, including poultry.

There are Codex and US but no Australian MRLs for fenpyroximate in animal tissues. The Codex MRL for cattle meat (fat) is 0.02 mg/kg, kidney and liver *0.01 and milk *0.005 (F) mg/kg. The US MRLs are 0.03 mg/kg for animal tissues except liver and kidney for which the tolerance is 0.25 mg/kg. The US MRL for milk is 0.015 mg/kg. The residue definition for milk and animal tissues includes some metabolites. The Australian MRL for apples is 0.3 mg/kg.

EFSA reported a lactating cow feeding study where cows were dosed at the equivalent of 1, 3 and 10 ppm in the diet for 29 days. Animals were sacrificed 15-22 hours after the last dose. Mean residues (fenpyroximate and Fen-OH) in milk of the 10 ppm dose group ranged from 0.007-0.017 mg/kg. Mean residues in liver were <0.01 mg/kg, kidney 0.012 mg/kg, muscle 0.028 mg/kg and fat 0.054 mg/kg. Residues of metabolite M-3 in liver were 0.8 mg/kg, kidney 0.33 mg/kg, muscle <0.01 mg/kg and fat <0.01 mg/kg.

⁴⁰ The NRA Review of Fenitrothion Interim Report Volume 2, June 1999, Existing Chemicals Review Program National Registration Authority for Agricultural and Veterinary Chemicals – Residues Assessment

⁴¹ Evaluation of fully approved or provisionally approved products. Issue 161: Evaluation on fenoxycarb, February 1997, Department of Environment Food and Rural Affairs, Pesticide Safety Directorate. UK

EFSA also reported a processing factor of 2.6 for apples to pomace suggesting residues in pomace would be <0.3 ppm (median residues in apples are <0.1 mg/kg \times 2.6 = <0.3 ppm)

It is anticipated that animal product residues will be below typical method LOQs.

Fenthion

- is an organophosphate insecticide used for the control of various insects and nematodes. It is registered on apples for the control of fruit fly. The application rate is up to 82.5 g ai/hL.

The harvest WHP is 7 days.

There are Australian and US (due to expire 1/4/06) but no Codex MRLs for fenthion in animal tissues. The relevant Australian and USA MRLs for fenthion in animal tissues are 1 mg/kg in Australia and 0.1 mg/kg in the US. The relevant milk MRLs are 0.2 and 0.01 (N) mg/kg respectively. The Australian MRL for apples is 2 mg/kg.

Residues in tissues and milk of lactating dairy cows fed at a nominal feed level of 7.6 ppm were all <0.05 mg/kg⁴². It is considered unlikely that feeding of pomace derived from fenthion treated apples would give rise to residues above regulatory method LOQs in tissues.

It is anticipated that animal product residues will be below typical method LOQs.

Fluazifop-p

- is a selective post-emergent herbicide used for the control of certain grasses in crops such as canola, cotton, sunflower, legumes and pastures. The application rate for apples is up to 0.212 kg ai/ha.

A WHP is not required when used as directed

There are Australian and USA but no Codex animal tissue MRLs for fluazifop. The relevant Australian MRLs are *0.05 mg/kg for edible offal and meat and 0.1 mg/kg for milk. The US tolerances for animal commodities have all been set at 0.05 mg/kg (fluazifop-butyl). The Australian MRL relevant to apples is *0.01 mg/kg. As no residues are expected in apples or apple pomace, feeding of these commodities to animals should not result in residues in animal commodities.

It is anticipated that animal product residues will be below typical method LOQs.

Fluazinam

-application is to dormant trees for white root rot control, a nil residue situation.

The Australian MRL for pome fruits is *0.01 mg/kg.

It is anticipated that animal product residues will be below typical method LOQs.

Fluquinconazole

-is a fungicide used for the control of powdery mildew and black spot in apples. It is applied as a foliar spray at an application rate of 3.75 g ai/hL.

No harvest WHP required.

Do not graze any treated area or cut for stock food

There are Australian but no Codex or US MRLs for fluquinconazole in animal commodities. The Australian MRLs are 0.2 mg/kg for edible offal, 0.5 mg/kg for meat (mammalian)(in the fat) and *0.02 mg/kg for milk. The Australian MRL for apples is 0.3 mg/kg (pome fruit). Last application is up 4 weeks after petal fall.

The Australian MRL for pome fruit pomace, dry is 3 ppm.

⁴² 2000 JMPR. Pesticide Residues in Food - 2000 Evaluations – Part I, FAO Plant Production and Protection Paper 165. FAO and WHO 2001 <http://www.fao.org/ag/AGP/AGPP/Pesticid/Default.htm>

The TF for fluquinconazole in fat is 0.3 and in milk 0.04⁴³. Anticipated residues in fat from feeding apple pomace (dry) at 30% of the diet are $0.3 \times 3 \times 0.3 = 0.27$ mg/kg. Residues in milk would be $0.3 \times 3 \times 0.04 = 0.036$ mg/kg.

Livestock residues may exceed international and/or domestic market standards.

Flusilazole

- is a fungicide used for the control of black spot and powdery mildew on apples. The application rate is up to 3 g ai/hL.

The harvest WHP is 14 days

There are Codex but no Australian or US MRLs for flusilazole in animal tissues. The Codex MRLs for cattle edible offal is *0.02, meat is 1 (fat) and milk is 0.05 (F) mg/kg. The Australian MRL for pome fruit is 0.2 mg/kg. The residue definition for flusilazole is parent compound, *i.e.* flusilazole.

The TF for liver, fat and cream are 0.015, 0.0012 and 0.001 respectively⁴⁴. Anticipated residues in liver are $0.3 \times 0.015 \times 0.2 = 0.0009$ mg/kg. It is considered unlikely that feeding of pomace derived from flusilazole treated apples would give rise to residues above regulatory method LOQs in tissues or milk.

It is anticipated that animal product residues will be below typical method LOQs.

Fosetyl-Aluminium

-is a fungicide used for the control of collar rot in apples. It is applied both as a soil drench and foliar spray, the later at 200 g ai/hL.

The harvest WHP is 14 days.

The Australian MRL for apples is 1 mg/kg. Animal metabolism studies show that the major components of the residue are phosphorous acid and aluminium⁴⁵. There is no expectation of residues.

It is anticipated that animal product residues will be below typical method LOQs.

Glufosinate ammonium

-is a non-selective foliar herbicide used for the control of broadleaf weeds and grasses in crops such as cotton, maize, sorghum and winter cereals as well as pastures. It is applied as a shielded spray to apples. The application rate is up to 1 kg ai/ha.

The harvest WHP is 21 days.

Do not graze or cut treated areas for stock food for 8 weeks after application

The Australian MRLs are 5 mg/kg for offal, 0.1 mg/kg for meat and *0.05 mg/kg for milk. The Codex MRLs are *0.1 mg/kg for edible offal, *0.05 mg/kg for meat and *0.02 mg/kg for milks. The relevant USA MRL is 6 mg/kg for cattle mbyp while the MRLs for meat and fat are 0.15 and 0.4 mg/kg respectively. The US MRL for milk is 0.15 mg/kg. There is an MRL for mixed pasture of 15 mg/kg while the apple MRL is *0.1 mg/kg (pome fruit). The US MRL for apples is 0.05 mg/kg.

The JMPR have reported that residues were <0.01 mg/kg in edible offal and meat of cattle fed at the equivalent of 27 ppm in the diet⁴⁶.

It is anticipated that animal product residues will be below typical method LOQs.

⁴³ UK PSD (Evaluation of fully approved or provisionally approved products. Issue 184: Evaluation on fluquinconazole, May 1999, Department of Environment Food and Rural Affairs, Pesticide Safety Directorate. UK)

⁴⁴ 1986 JMPR - Pesticide Residues in Food - 1986 Evaluations, Part I Residues FAO Plant Production

⁴⁵ Reregistration Eligibility Document. Aluminum tris(*o*-ethyl-phosphonate) (referred to as fosetyl-Al) December 1990 Environmental Protection Agency, Office of Pesticide Programs, Special Review and Reregistration Division.

<http://cfpub.epa.gov/oppref/rereg/status.cfm?show=rereg>

⁴⁶ 1998 JMPR - Pesticide Residues in Food - 1998 Evaluations, Part I Residues FAO Plant Production and Protection Paper 152/1. FAO and WHO 1999

Glyphosate

-is a non-selective foliar herbicide used for the control of broadleaf weeds and grasses in crops such as cotton, maize, sorghum and winter cereals as well as pastures. It is applied as a shielded spray to apples. The application rate is up to 0.36 kg ai/ha for late season application to weeds (apples not treated, shielded spray). No harvest or grazing WHPs are required.

The relevant Australian and Codex MRLs are at 2 mg/kg and 5 mg/kg for cattle offal and *0.1 and *0.05 mg/kg for milk. The relevant USA MRL is 5 mg/kg for cattle meat byproducts. The primary animal feed commodity MRL for glyphosate is 150 mg/kg, the apples MRL is *0.05 mg/kg (pome fruit). It is considered unlikely that residues in apple pomace (dry or wet) would exceed the PAFC MRL. The US MRL for apples is 0.2 mg/kg.

It is anticipated that animal product residues will be below typical method LOQs.

Haloxifop-R

- is a selective post-emergent herbicide used for the control of certain grasses in crops such as grain legumes, oilseeds (including cotton) and legume pastures. The application rate for apples is up to 416 g ai/ha as a directed spray.
No harvest WHP required

There are Australian but no USA or Codex animal tissue MRLs for haloxifop. The relevant Australian MRLs are 0.5 mg/kg for edible offal, 0.02 mg/kg for meat (fat) and 0.02 mg/kg for milk. The Australian MRL relevant to apples is *0.05 mg/kg. As no residues are expected in apples it is considered unlikely that detectable residues would be observed in tissues of animals feeding on derived pomace.

It is anticipated that animal product residues will be below typical method LOQs.

Hexaconazole

-is a fungicide used for the control of powdery mildew and black spot in apples. It is applied as a foliar spray at an application rate of 2 g ai/hL.

The harvest WHP is 7 days.

Do not feed produce from treated areas or by-products from treated crops to animals, including poultry

There are no Australian, Codex or US MRLs for animal tissues. The Australian MRL for apples is 0.1 mg/kg.

In a goat metabolism study where lactating goats were dosed for 4 consecutive days with ¹⁴C-hexaconazole, at a rate of about 15 ppm in the diet, the mean radioactive residues in the meat, fat, liver and kidney, calculated as hexaconazole, were 0.035, 0.025, 0.47 and 0.31 mg/kg respectively⁴⁷. No hexaconazole was found in either meat or milk. Based on the goat metabolism study it is considered unlikely that residues above regulatory method LOQs would be detected in animal tissues from the feeding of pomace derived from hexaconazole treated apples.

It is anticipated that animal product residues will be below typical method LOQs.

Hexythiazox

-is a miticide used to control European red mites and two spotted mites on apples. The application rate is 2.5 g ai/hL.

The harvest WHP is 3 days.

The Australian and US residue definitions differ, parent compound in Australia and sum of hexythiazox, trans-5-(4-chlorophenyl)-N-cyclohexyl-4-methyl-2-oxothiazolidine-3-carboxamide and its metabolites

⁴⁷ 1990 JMPR. Pesticide Residues in Food - 1990 Evaluations, Part I Residues FAO Plant Production and Protection Paper 103/1. FAO and WHO 1990 <http://www.fao.org/ag/AGP/AGPP/Pesticid/Default.htm>

containing the (4-chlorophenyl)-4-methyl-2-oxo-3-thiazolidine moiety (expressed as hexythiazox) in the US. There are US but no Australian or Codex MRLs for hexythiazox in animal tissues. The US MRLs have all been set at 0.02 mg/kg. The US MRL for apples is 0.25 mg/kg while the MRL for apple pomace wet is 0.4 ppm. The Australian MRL for apples is 1 mg/kg.

The US EPA reported that for apples a total of 20 trials were conducted in the US⁴⁸. The maximum residue in apples having a preharvest interval of 1-month was 0.38 ppm and the average residue was 0.14 ppm. Processing studies indicated that hexythiazox residues concentrate by a factor of 1.7 in wet apple pomace.

NOTE: US MRLs have been established for animal feed items (almond hulls and apple pomace (wet)) as well as for animal commodities. If the US MRLs are used to estimate the dietary burden using the US EPA Guideline, a dietary burden of 1.9 ppm is estimated. An anticipated TF is the 0.02 ppm (animal commodity tolerances) (1.9 ppm (dietary burden) = 0.01 (crude estimate).

Anticipated residues (US residue definition) in tissues are $0.3 \times 1 \times 1.7 \times 0.01 \div 0.4 = 0.0125$ mg/kg.

EFSA reported a feeding study where lactating cows were dosed with hexythiazox at the equivalent of 5, 15 and 50 ppm in the diet for 28 days. No residues were found in whole milk of cows at the 5 and 15 ppm levels. The maximum found in milk of cows at the 50 ppm level was 0.03 mg/kg. Residues were <LOD in subcutaneous fat and skeletal muscle. At the 50 ppm feed level, maximum residues in liver were 0.19 mg/kg, kidney 0.025 mg/kg, renal and omental fat 0.03 mg/kg. No residues were detected in any tissue except liver (0.03 mg/kg) at 7 days after last dosing.

It is anticipated that animal product residues will be below typical method LOQs.

Imazalil

- is a systemic fungicide used for the post-harvest control of blue moulds in apples. It is registered on apples as a post-harvest dip at 50 g ai/100L.

Not required when used as directed.

Do not feed treated produce or by-products to food producing animals, including poultry.

There are USA but no Australian and Codex MRLs for imazalil in cattle tissues. There is an Australian MRL for apples at 5 mg/kg (pome fruit). The US MRL for cattle meat byproducts is 0.2 mg/kg while the other MRLs for cattle tissues and milk are set at 0.01 mg/kg. The US residue definition is the sum of imazalil and its metabolites 1-(2,4-dichlorophenyl)-2-(1H-imidazole-1-yl)-1-ethanol and 3-[1-(2,4-dichlorophenyl)-2-(1H-imidazole-1-yl)ethoxyl]-1,2-propane diol. The Australian residue definition is parent compound.

Residues of imazalil in tissues (parent compound) following dosing at a rate equivalent to a feed level of 33 ppm were 0.00-0.014 mg/kg in fat and muscle and 0.14-0.51 mg/kg in liver⁴⁹. Residues in milk were 0.005-0.017 mg/kg. Assuming residues are present at the Australian MRL for apples and that they do not concentrate in pomace, anticipated residues in liver are $0.3 \times 5 \times 0.015 \div 0.4 = 0.06$ mg/kg while anticipated residues in milk are $0.3 \times 5 \times 0.0005 \div 0.4 = 0.002$ mg/kg.

Livestock residues may exceed international and/or domestic market standards.

Imidacloprid

- is a chloronicotinyl (pyridylmethylamine) insecticide. Application to apples is for control of woolly aphids and is at an application rate of 2.4 g ai/tree with no more than one treatment in any 3 year period

No harvest WHP when used as directed

Do not graze any treated areas or cut for stock food.

Do not feed produce harvested from treated areas to animals including poultry

⁴⁸ □ Notice of Filing a Pesticide Petition, Federal Register: August 26, 1998 (Volume 63, Number 165) Page 45487-45497

⁴⁹ Reregistration Eligibility Decision Residue Chemistry Considerations PC Code No. 111901; Case 2325 Imazalil. Environmental Protection Agency, Office of Pesticide Programs, Special Review and Reregistration Division

There are Australian, Codex and US MRLs for imidacloprid in animal tissues. The relevant Australian and US tolerances for imidacloprid in edible offal are 0.2 and 0.3 mg/kg respectively and for milk 0.05 and 0.1 mg/kg. The Codex MRLs are 0.05 mg/kg for edible offal and *0.02 mg/kg for meat and milk. The Australian MRL for apples is 0.3 mg/kg, apple pomace (dry) 2 ppm while the USA MRL for apples is 0.5 mg/kg and apple pomace (wet) 3.0 ppm.

The TF for liver is 0.01⁵⁰. Feeding apple pomace with residues 2 ppm at 30% of the diet would give rise to residues in liver of $0.3 \times 2 \times 0.01 = 0.006$ mg/kg, less than the Australian and USA tolerances and less than the LOD and LOQ of the analytical method (0.02 mg/kg).

The TF for milk is 0.003. Feeding apple pomace with residues 2 ppm at 30% of the diet would give rise to residues in milk of $0.3 \times 2 \times 0.003 = 0.002$ mg/kg.

It is anticipated that animal product residues will be below typical method LOQs.

Indoxacarb

- is a oxadiazine insecticide. Application to apples is for control of codling moth, light brown apple moth and heliothis and is at an application rate of 10 g ai/hL.

The harvest WHP is 14 days.

Do not allow livestock to graze crops or waste that has been treated

There are Australian, Codex and US MRLs for indoxacarb in animal tissues. The relevant Australian and US tolerances for indoxacarb in cattle fat are 1 and 1.5 mg/kg respectively and for milk 0.1 and 0.15 (4 mg/kg for milkfat) mg/kg. The Codex MRLs are meat (fat) 1 mg/kg, edible offal 0.05 and milk 0.1 mg/kg (2 mg/kg for milk fat). The Australian MRL for apples is 2 mg/kg and 20 ppm for apple pomace (dry) while the USA MRL for apples (fruit, pome) is 1 mg/kg and apple pomace (wet) 3 ppm.

The TF for fat is 0.03⁵¹. Anticipated residues in fat of animals fed pomace at 30% of the diet are $0.3 \times 20 \times 0.03 = 0.18$ mg/kg. The depletion half-life for cattle tissues is estimated to be <4 days.

The TF for milk is 0.002. Anticipated residues in milk of animals fed pomace at 30% of the diet are $0.3 \times 20 \times 0.002 = 0.012$ mg/kg.

Livestock residues should not exceed international and/or domestic market standards.

Iodocarb

-wound dressing, essentially a nil residue situation.

It is anticipated that animal product residues will be below typical method LOQs.

Iprodione

- is a systemic fungicide used for the post-harvest control of storage moulds in apples. It is registered on apples as a post-harvest dip at 50 g ai/100L.

Not required when used as directed.

There are Australian and US MRLs but no Codex MRLs for iprodione in animal tissues. The Australian MRLs have all been set at *0.1 mg/kg. The US MRLs are 3 mg/kg for cattle liver and kidney and 0.5 mg/kg for cattle fat, meat and meat by-products (except liver and kidney) and milk. The US residue definition is the sum of iprodione + isomer (RP-30228) + metabolite (RP-32490) + metabolite (RP-36114). There is an Australian MRL for apples at 3 mg/kg (pome fruit).

⁵⁰ 2002 JMPR. Pesticide Residues in Food - 2002 Evaluations – Part I: Residues Volume 1, FAO Plant Production and Protection Paper 175/1. FAO and WHO 2003 <http://www.fao.org/ag/AGP/AGPP/Pesticid/Default.htm>

⁵¹ Indoxacarb; Notice of Filing a Pesticide Petition to Establish a Tolerance for a Certain Pesticide Chemical in or on Food, Federal Register: March 17, 2004 (Volume 69, Number 52) Page 12664-12670

The TF for fat and milk (US residue definition) are 0.03 and 0.007 respectively (at 15 ppm feeding level)⁵². Assuming residues in apple pomace do not concentrate and are the same as in apples and feeding pomace at 30% of the diet the anticipated residues in fat are $0.3 \times 3 \times 0.03 \div 0.4 = 0.0675$ mg/kg, below the US tolerance. Anticipated residues in milk are $0.3 \times 3 \times 0.007 \div 0.4 = 0.016$ mg/kg. If parent compound is monitored in tissues in other countries, as in Australia, residues in tissues are expected to be below the method LOQ.

Livestock residues are not anticipated to exceed international and/or domestic market standards.

Kresoxim methyl

-is a fungicide used for the control of powdery mildew and black spot in apples. It is applied as a foliar spray at an application rate of 5 g ai/hL.

The harvest WHP is 6 weeks (42 days).

Do not graze areas under or surrounding treated trees, or cut for stock food, for 2 weeks after application.

There are Australian, Codex and US MRLs for kresoxim methyl. The Codex MRLs are *0.05 mg/kg for mammalian meat, fat and edible offal and *0.01 mg/kg for milk. The US MRLs are 0.01 mg/kg for meat by-products. The Australian MRLs for animal tissues have all been set at *0.01 mg/kg while the MRL for milk is *0.001 mg/kg. The Australian MRL for apples is 0.1 mg/kg and for apple pomace (dry) 0.5 mg/kg.

The TF for fat and kidney are <0.002 and 0.006 respectively. Assuming a feeding rate of 30% of the diet, anticipated residues in fat are $0.3 \times 0.5 \times <0.002 = <0.0003$ mg/kg, less than the LOQ of regulatory methods⁵³. The TF for milk is <0.00007. Assuming a feeding rate of 30% of the diet, anticipated residues in milk are $0.3 \times 0.5 \times <0.00007 = <0.00001$ mg/kg, less than the LOQ of regulatory methods.

It is anticipated that animal product residues will be below typical method LOQs.

Maldison (malathion)

- is an organophosphate insecticide used for the control of various insects and nematodes. It is registered on apples for the control of fruit fly, scale and various other bugs. The application rate is up to 62.5 g ai/hL.

The harvest WHP is 3 days.

There are Australian and US but no Codex MRLs malathion in animal tissues. The relevant Australian and USA MRLs for malathion in animal tissues are 1 mg/kg in Australia and 4 mg/kg in the US. The Australian MRL for milk is 1 [in the fat] mg/kg while the US MRL is 0.5 mg/kg for milk fat (from application to dairy cows). The MRL for apples is 2 mg/kg in Australia and 8 mg/kg in the US.

No residues of malathion were detected in tissues in a goat metabolism study conducted at a nominal feeding level of 115 ppm⁵⁴.

It is anticipated that animal product residues will be below typical method LOQs.

Mancozeb

- is a dithiocarbamate fungicide used on a variety of crops. It is used on apples for the control of black spot and mites at an application rate of 160 g ai/hl.

The harvest WHP is 14 days

There are Australian, Codex and US MRLs for mancozeb in animal commodities. The Australian MRL for edible offal is *0.05 mg/kg while the Codex MRL is 0.1 mg/kg, both as CS₂. The USA residue definition is

⁵² 1994 JMPR - Pesticide Residues in Food - 1994 Evaluations, Part I Residues FAO Plant Production and Protection Paper 78. FAO and WHO 1995

⁵³ 1998 JMPR Pesticide Residues in Food - 1998 Evaluations, Part I Residues FAO Plant Production and Protection Paper 152/1. FAO and WHO 1999

⁵⁴ 1999 JMPR - Pesticide Residues in Food - 1999 Evaluations, Part I Residues FAO Plant Production and Protection Paper 157. FAO and WHO 2000

zinc ethylenebisdithiocarbamate and the MRL 0.5 mg/kg for liver and kidney. The Australian MRL for milk is *0.05 mg/kg. The Australian PAFC MRL is 50 ppm and the apple MRL 3 mg/kg.

Residues in apple pomace (dry) would be expected to be much less than 50 ppm. The target tissue is liver. The TF for liver (45 ppm feeding study) was 0.003⁵⁵ giving an anticipated maximum residue from the feeding of apple pomace (dry) at 30% of the diet of $0.3 \times 50 \times 0.003 = <0.05$ mg/kg, less than the relevant international MRLs.

The TF for milk was <0.008. No detectable residues are expected in milk from feeding apple pomace to dairy cattle.

It is anticipated that animal product residues will be below typical method LOQs.

Methidathion

- is an organophosphate insecticide used for the control scale, mealy bugs and aphids etc in apples. The application rate is up to 50 g ai/hL. Methidathion residues decline with typical half-lives of 7 and 3 days for soil and foliage respectively.

The harvest WHP is 14 days

There are Australian and Codex but no USA MRLs for methidathion in animal tissues. The Australian (Codex) and USA residue definitions differ: methidathion (Australia, Codex), sum of methidathion, its oxygen analogue, the sulfoxide and the sulfone (USA). The Australian and Codex that apply to animal tissues are 0.5 and *0.02 mg/kg respectively. The corresponding milk MRLs are 0.5 [in the fat] and 0.001 mg/kg. The Australian and US MRLs for apple are 0.2 and 0.05 mg/kg respectively.

No residues of methidathion were observed in tissues of cows fed at up to 50 ppm in the diet when measured by the Australian or USA residue definitions⁵⁶.

It is anticipated that animal product residues will be below typical method LOQs.

Methomyl

- is a carbamate insecticide used for the control of thrips, heliothis, codling moth, light brown apple moth etc in apples. The application rate is up to 45 g ai/hL. Methomyl residues decline with typical half-lives of 7 and 4 days for soil and foliage respectively.

The harvest WHP is 1 day.

There are Australian and Codex but no USA MRLs for methomyl (as thiodicarb) in animal tissues. The MRLs have all been set at 0.05 mg/kg). The Australian MRL for apples is 1 mg/kg.

No residues of methomyl/thiodicarb were observed in tissues (<0.01 mg/kg) of cows fed at up to 86 ppm in the diet when measured by the Australian or USA residue definitions⁵⁷.

It is anticipated that animal product residues will be below typical method LOQs.

Methoxyfenozide

- is an insecticide used for the control of light brown apple moth and loopers in apples. The application rate is up to 6 g ai/hL.

The harvest WHP is 14 days

⁵⁵ 1993 JMPR - Pesticide Residues in Food - 1993 Evaluations, Part I Residues FAO Plant Production and Protection Paper 124. FAO and WHO 1994

⁵⁶ Methidathion Reregistration Eligibility Decision Residue Chemistry Considerations Shaughnessy No. 100301; Case No. 0034 Environmental Protection Agency, Office of Pesticide Programs, Special Review and Reregistration Division

⁵⁷ 2001 JMPR Pesticide Residues in Food - 2001 Evaluations – Part I, FAO Plant Production and Protection Paper 171. FAO and WHO 2002

There are Australian, Codex and USA MRLs for methoxyfenozide in animal tissues. The Australian MRLs have all been set at the LOQ (*0.01 mg/kg). The Codex MRLs are 0.05 mg/kg for fat, 0.02 mg/kg for edible offal and 0.01 mg/kg for milk. The US tolerances are 0.5 mg/kg for fat, 0.02 mg/kg for meat and 0.1 mg/kg for milk. The Australian MRL for apples is 0.5 mg/kg.

Based on available cattle feeding studies, there is no expectation of residues in animal tissues when fed at a maximum of 22 ppm in the diet

It is anticipated that animal product residues will be below typical method LOQs.

Metiram

- is a dithiocarbamate fungicide used on a variety of crops. It is used on apples for the control of black spot at an application rate of 140 g ai/hl.

The harvest WHP is 21 days

There are Australian and Codex but no US MRLs for metiram in animal commodities. The Australian MRL for edible offal is *0.05 mg/kg while the Codex MRL is 0.1 mg/kg, both as CS₂. The MRLs for milk are *0.05 mg/kg and *0.05 mg/kg respectively.

The Australian PAFC MRL is 50 ppm and the apple MRL 3 mg/kg. Residues in apple pomace (dry) would be expected to be much less than 50 ppm. The target tissue is liver. The TF for liver (1000 ppm feeding study for metiram) was 0.01⁵⁸ giving an anticipated maximum residue from the feeding of apple pomace (dry) at 30% of the diet of $0.3 \times 50 \times 0.01 = <0.15$ mg/kg, less than the relevant international MRLs. The TF for milk was 0.0002.

It is anticipated that animal product residues will be below typical method LOQs.

Myclobutanil

-is a fungicide used for the control of powdery mildew and black spot in apples. It is applied as a foliar spray at an application rate of 4.8 g ai/hL.

The harvest WHP is 21 days

There are Codex and US but no Australian MRLs for myclobutanil in animal tissues. The Australian and Codex residue definition is myclobutanil *per se*. The Codex MRLs for cattle commodities, including milk have been set at *0.01 mg/kg. The US residue definition is the sum of myclobutanil alpha-butyl-alpha-(4-chlorophenyl)-1H-1,2,4-triazole-1-propanenitrile and its alcohol metabolite (alpha-(3-hydroxybutyl)-alpha-(4-chlorophenyl)-1H-1,2,4-triazole-1-propanenitrile (free and bound). The relevant cattle MRLs are liver 1 mg/kg, fat 0.05 mg/kg, meat 0.1 mg/kg, meat by-products (except liver) 0.2 mg/kg and milk 0.2 mg/kg. There are US MRLs for apples, apple pomace (wet) and apple pomace (wet and dry) of 0.5, 5 and 5 mg/kg respectively. The Australian MRL for apples is 0.5 mg/kg (pome fruit).

The livestock metabolism studies evaluated indicate that if residues of myclobutanil and its metabolites do not exceed 3 ppm in total livestock diet then residues in all livestock tissues and products, including milk and eggs, will not exceed 0.1 ppm⁵⁹.

Residue data from the feeding of animals with myclobutanil at 30 ppm may result in significant residues in milk (0.258 ppm), cattle tissues such as kidney (0.182 ppm) and liver (0.965 ppm), and chicken eggs (0.122 ppm) (all US residue definition).

The TF for myclobutanil in liver is 0.032 (feeding at 30 ppm in the diet, US residue definition) resulting in an anticipated maximum residue from feeding apple pomace (dry) at 30% of the diet of $0.3 \times 5 \times 0.032 = 0.05$ mg/kg, less than the relevant US MRL.

⁵⁸ Evaluation of fully approved or provisionally approved products. Issue 36: Evaluation on ethylenebisdithiocarbamates (2), April 1991, Department of Environment Food and Rural Affairs, Pesticide Safety Directorate. UK

⁵⁹ PMRA Decision Document E93-01, June 1993, Health Canada

Livestock residues are not anticipated to exceed international and/or domestic market standards.

Naphthylacetic acid

-is a plant growth regulator.

The harvest WHP is 1 day.

The US tolerance for apples is 0.15 mg/kg; there are no pomace tolerances.

The Australian MRL for apples is 1 mg/kg.

Insufficient data were located to provide confident opinion on livestock residue risks.

Norflurazon

-is a fluorinated pyridazinone herbicide used for the pre-emergent control of annual grasses and broadleaf weeds in cotton, citrus, grapes and stone fruit etc. It is applied to apples at an application rate of up to 2 kg ai/ha as a shielded spray.

No harvest or grazing WHPs are required.

There are no Codex MRLs for norflurazon in animal tissues. The Australian (parent) and US (parent + metabolite) residue definitions differ. The relevant US MRLs for animal tissues are 0.5 mg/kg for cattle liver and 0.1 mg/kg for other tissues and milk. There are no Australian MRLs for animal commodities, the MRL for apples is *0.2 mg/kg. The US MRL for apples is 0.1 mg/kg.

The US EPA noted that “metabolism of norflurazon in livestock has been studied and tolerances for livestock commodities have been established⁶⁰. A ruminant study adequately identified the metabolites in milk, liver and kidney. Norflurazon was not detected in ruminant milk or tissue, and total radioactive residues in fat and muscle were <0.01 part per million (ppm)”.

NOTE: US MRLs have been established for animal feed items (alfalfa forage and hay at 3 and 5 ppm respectively) as well as for animal commodities. If the US MRLs are used to estimate the dietary burden using the US EPA Guideline, a dietary burden of 7.7 ppm is estimated (3 ppm grass forage, 35% DM, 70% diet + 5 ppm hay, 89% DM 30% diet). An anticipated TF is the 0.25 ppm (animal commodity tolerances, liver) (7.7 ppm (dietary burden) = 0.03 (crude estimate). An anticipated TF is the 0.1 ppm (animal commodity tolerances, fat) (7.7 ppm (dietary burden) = 0.01 (crude estimate).

It is anticipated that animal product residues will be below typical method LOQs.

Omethoate

- is an organophosphate insecticide used for the control of various insects in crops. It is registered on apples for the control of two spotted mites, red mites and woolly aphids. The application rate is up to 60 g ai/hL.

The harvest WHP is 7 days.

There are Australian but no Codex or US MRLs for omethoate in animal tissues. The Australian MRLs for animal commodities including milk have been set at *0.05 mg/kg. There are Australian MRLs of 2 mg/kg for fruits and 20 ppm for a series of miscellaneous forage and fodder crops.

A metabolism study with lactating goats dosed orally with dimethoate suggests that residues of omethoate are not expected in animal tissues⁶¹.

It is anticipated that animal product residues will be below typical method LOQs.

⁶⁰ Reregistration Eligibility Decision Norflurazon List A Case 0229, Environmental Protection Agency, Office of Pesticide Programs, Special Review and Reregistration Division

⁶¹ 1998 JMPR - Pesticide Residues in Food - 1998 Evaluations, Part I Residues FAO Plant Production and Protection Paper 152/1. FAO and WHO 1999

Oryzalin

- is a dinitroaniline herbicide used for the control of weeds in various crops. The application rate is up to 3.4 kg ai/ha as a directed spray.
There is no harvest WHP.

There are no Australian, US or Codex MRLs for oryzalin animal commodities. The Australian MRL for apples is 0.1 mg/kg and the US one 0.05 mg/kg.

The US EPA reported in their assessment on oryzalin⁶² that studies conducted at highly exaggerated feeding levels with laying hens and beef and dairy cattle indicated that oryzalin is either poorly absorbed or rapidly metabolized via hydroxylation and cleavage of the alkyl side chain to yield polar components that are excreted and that there is „*No reasonable expectation of finite residues in animal commodities*„.

It is anticipated that animal product residues will be below typical method LOQs.

Oxyfluorfen

- is a diphenyl ether herbicide used for the control of weeds in various crops. The application rate is up to 18 g ai/ha.
There is no harvest WHP.
Do not graze treated weeds

There are Australian and US but no Codex MRLs for oxyfluorfen in animal commodities. The Australian MRLs have all been set at *0.01 and the US ones at 0.01 mg/kg. The Australian and US MRL for apples (pome fruit group) is the same at 0.05 mg/kg.

The TF for fat is 0.035 and for milk is 0.003⁶³.

It is anticipated that animal product residues will be below typical method LOQs.

Oxythioquinox

-post-harvest use on trees only.

It is anticipated that animal product residues will be below typical method LOQs.

Paclobutrazol

-is a triazole plant growth regulator that is applied to apples at 250 g ai/ha.
The harvest WHP is 21 days.

There are no Australian, Codex or US MRLs for paclobutrazol in animal tissues.
The Australian MRL for apples is 1 mg/kg.

Residues in Australian trials were 0.74 and 1.2 mg/kg at 21 days after application. The JMPR reported a PF for apples to pomace of 14; applying to the MRL this gives a maximum anticipated residue of 14 ppm for apple pomace.

Residues of paclobutrazol in a goat metabolism study where goats were orally dosed at the equivalent of 10 ppm for 7 days were 0.018 mg/kg in liver and <0.001 mg/kg in fat⁶⁴. No significant residues were detected in milk.

⁶² Reregistration Eligibility Decision Oryzalin List A Case 0186, Environmental Protection Agency, Office of Pesticide Programs, Special Review and Reregistration Division

⁶³ Reregistration Eligibility Decision (RED) Oxyfluorfen List A Case 2490, Environmental Protection Agency, Office of Pesticide Programs, Special Review and Reregistration Division

⁶⁴ Evaluation of fully approved or provisionally approved products. Issue 142: Evaluation on paclobutrazol, September 1995, Department of Environment Food and Rural Affairs, Pesticide Safety Directorate. UK

The TF for paclobutrazol in liver is 0.0018 resulting in an anticipated maximum residue from feeding apple pomace at 30% of the diet of $0.3 \times 14 \times 0.0018 = 0.008$ mg/kg, less than the likely regulatory method LOQ (assumed to be 0.01 mg/kg).

It is anticipated that animal product residues will be below typical method LOQs.

Paraquat

-is a herbicide used for the control of weeds in various crops. The application rate is up to 4 L/ha as a directed spray = 500 g ai/ha or 50 g ai/hL. (NOTE diquat = 300 g ai/ha or 30 g ai/hL)

No harvest WHP required

Do not graze or cut sprayed vegetation for stock food for at least 1 day.

Remove stock from treated areas 3 days before slaughter.

The Australian and Codex MRLs for paraquat in kidney and milk are 0.5 and *0.01 mg/kg, and 0.05 and *0.005 mg/kg, respectively. The US MRL for kidney is 0.5 mg/kg and for milk 0.01 (N) mg/kg. Residues in soil and foliage decline with typical half-lives of *ca.* 1000 and 30 days respectively. The MRL for apples is *0.05 mg/kg in both Australia and the US. Noting the application rates and that the MRL for apples is *0.05 mg/kg, it is considered unlikely that residues in apple pomace (dried) would exceed 80 ppm.

It is anticipated that animal product residues will be below typical method LOQs.

Parathion-methyl

- is an organophosphate insecticide used for the control of various insects in crops. It is registered on apples for the control of woolly aphids, jassids, codling moth, light brown apple moth and scale etc. The application rate is up to 49.5 g ai/hL.

The harvest WHP is 14 days.

Do not graze or cut for stock food for 14 days after application

There are Australian but no Codex or US MRLs for parathion methyl in animal commodities. The Australian MRLs for animal commodities have been set at T*0.05 mg/kg. There are Australian MRLs of T0.5 mg/kg for pome fruit and T0.5 ppm for legume vegetables.

A metabolism study with lactating goats dosed orally with parathion methyl at the equivalent of 6.25 ppm in the diet suggests that residues of parathion methyl are not expected in animal tissues⁶⁵.

It is anticipated that animal product residues will be below typical method LOQs.

Penconazole

-is a fungicide used for the control of powdery mildew and black spot in apples. It is applied as a foliar spray at an application rate of 2.5 g ai/hL.

The harvest WHP is 14 days

There are Codex but no Australian or US MRLs for penconazole in animal tissues. The Codex MRLs are *0.05 mg/kg for cattle meat and edible offal and *0.01 mg/kg for cattle milk. The Australian MRL for apples is 0.1 mg/kg (pome fruit).

Milk, muscle and fat residues (total radioactivity) in a goat metabolism study where lactating goats were orally dosed at a rate equivalent to 5 ppm in the feed were <0.017 mg equiv./kg⁶⁶.

It is anticipated that animal product residues will be below typical method LOQs.

⁶⁵ 2000 JMPR. Pesticide Residues in Food - 2000 Evaluations – Part I, FAO Plant Production and Protection Paper 165. FAO and WHO 2001

⁶⁶ 1992 JMPR - Pesticide Residues in Food – 1992 evaluations. Part II. Toxicology. WHO, WHO/PCS/93.34, Geneva, 1993

Pendimethalin

-is a selective herbicide used for the control of annual ryegrass and certain broadleaf weeds in cotton, cereals etc. It is applied at an application rate of up to 3.96 kg ai/ha as a directed spray. No harvest or grazing WHPs are required.

There are no Codex or US MRLs for pendimethalin in animal tissues while the Australian MRLs are all *0.01 mg/kg (offal, meat & milk). Residues decline in soil and foliage with typical half-lives of 90 and 50 days respectively. The Australian MRL for pome fruit is *0.05 mg/kg.

The US EPA notes⁶⁷ that animal metabolism studies in goats conducted at exaggerated feeding levels indicate that there is no reasonable expectation for residues of pendimethalin in tissues.

It is anticipated that animal product residues will be below typical method LOQs.

Piperonyl butoxide (PBO)

- is a synergist used to increase the effectiveness of various synthetic pyrethroid (SP) insecticides. It is registered for use with various pyrethrin in the control of insect pests on apples. The application rate is up to 32 g ai/hL.

The harvest WHP is 1 day

There are Australian, Codex and US MRLs for PBO in animal commodities. PBO is exempt from the requirement for tolerances in the US. The Australian and US MRLs for animal tissues have all been set at 0.1 mg/kg. The Codex MRL for mammalian meat (fat) (except cattle) is 2 mg/kg and for cattle meat (fat) 5 mg/kg. The Australian MRL for milks is 0.05 mg/kg. There is an Australian and US MRL of 8 mg/kg for apples (fruits).

The TF for PBO in fat is 0.004 (feeding at 100 ppm in the diet)⁶⁸ resulting in an anticipated maximum residue from feeding apple pomace at 30% of the diet of 0.02 mg/kg, less than the relevant Australian, proposed Codex and US MRLs and likely regulatory method LOQ.

The TF for PBO in milk is 0.0001 (feeding at 100 ppm in the diet) resulting in an anticipated maximum residue from feeding apple pomace at 30% of the diet of $0.3 \times 8 \times 0.0001 \div 0.4 = 0.0006$ mg/kg, less than the relevant Australian, proposed Codex and US MRLs and likely regulatory method LOQ.

Livestock residues are not anticipated to exceed international and/or domestic market standards.

Pirimicarb

- is a carbamate aphicide used for the control of aphids in various crops. It is registered on apples for control of woolly aphids. The application rate is up to 25 g ai/hL or 850 g ai/ha.

The harvest WHP is 2 days

There are Australian and Codex but no USA MRLs for pirimicarb in animal commodities. The Australian and Codex MRLs for meat and milk are *0.1 mg/kg both set at the limit of analytical quantitation and are essentially the same. The Australian MRL for apples is 0.5 mg/kg (fruits).

No data was located for residues of pirimicarb in apple pomace, however in a feeding study reported by JMPR residues of pirimicarb in tissues were <0.05 mg/kg for animals dosed at the equivalent of 200 ppm in the diet⁶⁹, a level of exposure much greater than would be anticipated to arise from apple pomace. The TF for milk is 0.00065 indicating a little likelihood that residues would be detected in milk.

⁶⁷ Reregistration Eligibility Decision Pendimethalin List A Case 0187, Environmental Protection Agency, Office of Pesticide Programs, Special Review and Reregistration Division

⁶⁸ 2002 JMPR. Pesticide Residues in Food - 2002 Evaluations – Part I: Residues Volume 1, FAO Plant Production and Protection Paper 175/1. FAO and WHO 2003

⁶⁹ 1978 JMPR - Pesticide Residues in Food - 1978 Evaluations, FAO Plant Production and Protection Paper 15 Suppl. FAO and WHO 1979

It is anticipated that animal product residues will be below typical method LOQs.

Prohexadione

- is a plant growth regulator used for shoot growth reduction in apples. The application rate is up to 7.5 g ai/hL.

DO NOT harvest for 8 weeks after application.

DO NOT graze or cut forage in treated orchards for stock food until 8 weeks after application.

There are Australian and US but no Codex MRLs for prohexadione in animal commodities. The Australian MRLs for meat and offal are *0.05 mg/kg and for milk are *0.01 mg/kg. The US MRLs are 0.1 mg/kg for kidney and 0.05 mg/kg for other offal. No other tolerances were set. The Australian MRL for apples is *0.02 mg/kg and for apple pomace (dry) 0.1 mg/kg.

Data from the animal transfer study conducted in lactating goat show that, when fed the equivalent of 380 ppm in the feed, the levels of prohexadione-calcium residues in milk and edible tissues were above the method LOQ. Extrapolation of these residues to a $0.3 \times 0.1 = 0.03$ ppm feed level demonstrate residues above the method LOQ would not occur in animal commodities. Metabolism data demonstrate that prohexadione-calcium undergoes rapid absorption and excretion as the free acid metabolite (bound or unbound to glucuronides).

It is anticipated that animal product residues will be below typical method LOQs.

Propargite

- is an acaricide used for the control of mites in apples. The application rate is up to 60 g ai/hL or 2.55 kg ai/ha. Propargite residues decline with typical half-lives of 56 and 5 days for soil and foliage respectively.

The harvest WHP is 7 days.

There are Australian, Codex and US MRLs for propargite in animal commodities. The MRLs applicable to cattle fat (target tissue) have all been set at *0.1 mg/kg. The US MRL for milk fat is 2 mg/kg (0.08 mg/kg for whole milk). The Australian MRL for milk is *0.1 mg/kg while the Codex MRL is 0.1 F mg/kg. There is an Australian MRL of 3 mg/kg for apples.

The TF for cattle fat (50 ppm feeding study) was 0.004^{70} giving an anticipated residue in fat from feeding pomace at 30% of the diet of *ca.* $0.3 \times 3 \times 0.004 \div 0.4 = 0.009$ mg/kg, less than the relevant international MRLs. The TF for milk (50 ppm feeding study) was 0.0002 giving an anticipated residue in fat from feeding pomace at 30% of the diet of *ca.* $0.3 \times 3 \times 0.0002 \div 0.4 = 0.00045$ mg/kg, less than the relevant international MRLs.

It is anticipated that animal product residues will be below typical method LOQs.

Pyridaben

- is an acaricide used for the control of two spotted mites in apples. The application rate is up to 12.5 g ai/hL.

The harvest WHP is 1 day.

There are US but no Australian or Codex for pyridaben in animal commodities. The US residue definition for animal tissues includes two metabolite and is pyridaben and (2-tert-butyl-5-(4-(1-carboxy-1-methylethyl)benzylthio)-4-chloropyridazin-3(2H)-one) and (2-tert-butyl-5-[4-(1,1-dimethyl-2-hydroxyethyl)benzylthio]-4-chloropyridazin-3(2H)-one). The MRLs for animal tissues have all been set at 0.05 mg/kg while the milk MRL is 0.01 mg/kg.

⁷⁰ 2002 JMPR. Pesticide Residues in Food - 2002 Evaluations – Part I: Residues Volume 1, FAO Plant Production and Protection Paper 175/1. FAO and WHO 2003

There is an Australian MRL of 0.5 mg/kg for apples (pome fruit) (same residue definition as US for plants, i.e. parent compound).

The US MRL for apples is 0.5 mg/kg and for apple pomace (wet) 0.75 ppm.

NOTE: US MRLs have been established for animal feed items (almond hulls, apple pomace (wet) and citrus pulp (dry)) as well as for animal commodities. If the US MRLs are used to estimate the dietary burden using the US EPA Guideline, a dietary burden of 1.5 ppm is estimated. An anticipated TF is the 0.05 ppm (animal commodity tolerances) (1.5 ppm (dietary burden) = 0.03 (crude estimate).

Anticipated residues are $0.3 \times 0.75 \times 0.03 \div 0.4 = 0.02$ mg/kg for tissues and 0.0025 mg/kg for milk.

EFSA reported a feeding study where lactating Holstein cows were administered pridaben for 29 days at doses equivalent to 2.5, 7.5 and 25 ppm in the diet. Cows were sacrificed 5 hours after the last dose. No residues of pyridaben, PB-7 or PB-9 were detected in whole milk (<0.01 mg/kg) or in kidney and muscle (<0.05 mg/kg). Maximum residues (mg/kg) in liver and fat were:

Dose (ppm)	Liver			Fat		
	Pyridaben	PB-7	PB-9	Pyridaben	PB-7	PB-9
2.5	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
7.5	<0.05	0.05	<0.05	<0.05	<0.05	<0.05
25	<0.05	0.15	<0.05	0.07	<0.05	<0.05

Livestock residues are not anticipated to exceed international and/or domestic market standards.

Pyrethrins

-is a natural pyrethroid insecticide used for the control various insect pests in apples and other fruit crops. The application rate is up to 8 g ai/hL.

The harvest WHP is 1 days.

There are US but no Australian or Codex MRLs for pyrethrins in animal commodities. The MRLs applicable to cattle fat (target tissue) have all been set at 1 mg/kg. The MRL for milk fat is 0.05 mg/kg reflecting negligible residues in whole milk. There is an Australian MRL of 1 mg/kg for apples (fruits) while the US MRL is also 1 mg/kg (post-harvest).

In a feeding study with lactating cows, residues in tissues of animals dosed orally at a level equivalent to 5 ppm in the feed had residues in tissues that were <LOQ (0.038 mg/kg) for muscle, liver and kidney and 0.048-0.075 mg/kg in fat⁷¹. Feeding apple pomace with residues of 1 ppm should not result in tissues residues above typical LOQs for pyrethrins.

It is anticipated that animal product residues will be below typical method LOQs.

Pyrimethanil

-is a fungicide used for the control of powdery mildew and black spot in apples. It is applied as a foliar spray at an application rate of 15 g ai/hL.

No harvest WHP required.

Do not graze any treated area or cut for stock food

There are Australian, Codex and US MRLs for pyrimethanil in animal commodities. The Australian MRLs for animal commodities are *0.05 mg/kg for tissues and *0.01 mg/kg for milks. The Codex MRLs for edible offal and milk are set at 0.1 and meat at *0.05 mg/kg. The US MRLs for cattle kidney are 2.5 and other tissues 0.01 mg/kg. The Australian MRL for apples is 0.05 mg/kg (pome fruit) and for pome fruit pomace (dry) 0.3 ppm. [MRLs for residues in pomace may be from an expired permit use].

⁷¹ 2000 JMPR. Pesticide Residues in Food - 2000 Evaluations – Part I, FAO Plant Production and Protection Paper 165. FAO and WHO 2001

Do NOT apply later than 4 weeks after petal fall.

The UK PSD reported⁷² a lactating dairy cow metabolism study, a cow received 7 daily doses of ¹⁴C-pyrimethanil at a dose rate equivalent to 10 ppm. The cow was sacrificed with 24 hours of the last dose. Total radioactive residues (TRR) in milk (as parent) reached a plateau after 2 days of 0.05-0.06 mg/L (highest 0.069 mg/L at day 5). The metabolite SN 614276 represented 64% of the TRR in milk. TRR in tissues were 0.017 for muscle, 0.036 for fat, 0.25 for kidney and 0.36 mg equiv/kg for liver. Two major metabolites were identified in kidney: SN614276 (46% TRR) and SN 614800 (7% TRR). For liver 73% of the TRR remained un-extracted.

From the above the TF for pyrimethanil (as parent compound) appears to be *ca.* 0.01 for tissues. Anticipated residues from feeding pomace dry are $0.3 \times 0.3 \times 0.01 = 0.0009$ mg/kg.

It is anticipated that animal product residues will be below typical method LOQs.

Quintozene

-is a fungicide used to prevent collar rot in plants. It is applied at planting at a rate of 0.375 g ai/tree.

No WHP required.

Do not graze treated area or cut for stock food.

No Australian, Codex or US MRLs have been established for animal tissues or pome fruit. A nil residue situation due to the long interval between application and harvest.

It is anticipated that animal product residues will be below typical method LOQs.

Simazine

- is a triazine herbicide and is used for the control of grass and broadleaf weeds in crops including apples. It is applied to bare ground as a directed spray at 110 g ai/hL

No harvest or grazing/feeding WHPs required.

There are Australian and US but no Codex MRLs for animal commodities. The Australian MRLs have all been set at *0.05 mg/kg and milk at *0.02 mg/kg. The US MRLs are 0.03 mg/kg for animal commodity MRLs. The Australian MRL for apples is *0.1 mg/kg while the US MRL is 0.2 mg/kg.

As no residues are anticipated in apples there is no concern over the feeding of apple pomace.

It is anticipated that animal product residues will be below typical method LOQs.

Spinetoram

- is an antibiotic insecticide used for the control of various pests in apples. The application rate is up to 3.8 g ai/hL.

The harvest WHP is 7 days.

DO NOT graze any treated area or cut for stockfood.

There are Australian, Codex and USA MRLs for spinetoram in animal commodities. The Australian MRLs are all *0.01 mg/lg (meat, offal, milk). The respective milk MRLs are T0.1 and 7 (85 mg/kg for whole milk fat) mg/kg. The Codex MRL is 0.2 mg/kg for meat (fat) and *0.01 mg/kg for edible offal and milk. The US MRL is 5.5 mg/kg for fat, 0.2 for meat, 0.85 for liver, 0.6 for offal other than liver and 0.3 for milk (0.75 milk fat). There are Australian MRLs of 0.5 mg/kg for apples and 1 mg/kg for apple pomace (dry). The US MRL for apples is 0.2 mg/kg while the US MRL for apple pomace is 0.5 mg/kg.

⁷² UK PSD Evaluation of fully approved or provisionally approved products: Issue No. 138 pyrimethanil September 1995

The 2008 JMPR reported: Lactating dairy cows were dosed daily for 29 consecutive days via gelatin capsules containing a mixture of spinetoram and N-demethyl and N-formyl metabolites of XDE-175-J (1.2–38.6 ppm in diet) or spinetoram only (37.6 ppm). Residues in the milk in 1.2 ppm (equivalent to 0.4 mg XDE-175-J and -L) dose group were generally between the LOD (0.003 mg/kg) and LOQ (0.01 mg/kg) throughout the dosing period. No or low concentration residues were detected in skim milk; even in 11.5 and 38.6 ppm (total) doses groups, mean total residues of the four compounds in skim milk ranged from just below the LOQ to 0.075 mg/kg. In all of the dose groups on day 14 and 28, total residues in cream were much higher than the residues in skim milk at 0.187 and 0.237 mg/kg in the 1.2 ppm doses groups. The mean total residues in cream from the 11.5 and 38.6 ppm doses groups ranged from 0.64 to 5.84 mg/kg. The average ratio of residues in cream to those in whole milk is 6:6. All tissues from treated cows contained residues and they increased from the lowest to highest dose groups. Residue concentrations were lowest in the muscle followed by kidney, liver, and fat. Residues in fat were significantly higher than residues in the other tissues. These results indicate that residues of spinetoram tend to accumulate in fatty tissue. With one exception, residues were not detectable in milk by the fourth day after the last dose was administered. Concentrations just above the LOD were detected in one cow through day nine after the final dose. No further residue was detected beyond that point. Residues in tissues continuously declined through 28-day depletion period after the last dose. No residue was detected in kidney, liver or muscle from any cow by 28 days after the final dose or in fat 56 days following the final dose.

Livestock residues are not anticipated to exceed international and/or domestic market standards.

Spinosad

- is an antibiotic insecticide used for the control of various pests in apples. The application rate is up to 4.8 g ai/hL.

The harvest WHP is 3 days.

There are Australian, Codex and USA MRLs for spinosad in animal commodities. The Australian and US MRLs applicable to cattle meat (fat) are 2 and 50 mg/kg respectively. The respective milk MRLs are T0.1 and 7 (85 mg/kg for whole milk fat) mg/kg. The Codex MRL is 3 mg/kg for cattle fat and 2 mg/kg for fat of other mammals and 1 mg/kg for cattle milk (5 mg/kg for milk fat). There are Australian MRLs of 0.5 mg/kg for apples and 1 mg/kg for apple pomace (dry). The US MRL for apples is 0.2 mg/kg while the MRL for apple pomace is 0.5 mg/kg.

The TF for cattle fat is 0.5-0.6⁷³ giving an anticipated maximum residue in cattle fat from feeding of apple pomace at 30% of the diet of $0.3 \times 1 \times 0.6 = 0.18$ mg/kg.

The TF for milk is 0.05 giving an anticipated maximum residue in cattle fat from feeding of apple pomace at 30% of the diet of $0.3 \times 1 \times 0.05 = 0.015$ mg/kg.

Livestock residues are not anticipated to exceed international and/or domestic market standards.

Tau-fluvalinate

-is a synthetic pyrethroid insecticide used on apples for the control of apple dimpling moth and plague thrips. Application is at 4.8 g ai/hL.

No WHP required when used as directed.

There are no Australian, US or Codex MRLs for animal tissues. The Australian MRL for apples is 0.1 mg/kg.

The mean TF for fluvalinate in fat is 0.05 (feeding at 4.8 ppm in the diet)⁷⁴ resulting in an anticipated maximum residue from feeding apple pomace at 30% of the diet of $0.3 \times 0.1 \times 0.05 \div 0.4 = 0.00375$ mg/kg, less

⁷³ 2001 JMPR Pesticide Residues in Food - 2001 Evaluations – Part I, FAO Plant Production and Protection Paper 171. FAO and WHO 2002

⁷⁴ Evaluation of fully approved or provisionally approved products. Issue 162: Evaluation on Tau-fluvalinate, March 1997, Department of Environment Food and Rural Affairs, Pesticide Safety Directorate. UK

than the relevant Australian, proposed Codex and US MRLs and likely regulatory method LOQ (assumed 0.01 mg/kg).

The mean TF for fluvalinate in milk is 0.02 (feeding at 4.8 ppm in the diet) resulting in an anticipated maximum residue from feeding apple pomace at 30% of the diet of $0.3 \times 0.1 \times 0.02 \div 0.4 = 0.0015$ mg/kg, less than the relevant Australian, proposed Codex and US MRLs and likely regulatory method LOQ (assumed 0.01 mg/kg).

It is anticipated that animal product residues will be below typical method LOQs.

Tebufenozide

- is an insecticide. Application to apples is for control of codling moth and light brown apple moth and is at an application rate of 6 g ai/hL.

The harvest WHP is 21 days.

Do not graze any treated area or cut for stock food

There are Australian, US MRLs and Codex MRL for tebufenozide in animal tissues. The Australian residue definition is parent compound. The animal tissue MRLs have all been set at *0.02 mg/kg while the milk MRL is *0.01 mg/kg. The Codex MRLs for edible offal are *0.02, meat (fat) 0.05 and milk *0.01 mg/kg.

The US residue definition for animal commodities is the sum of tebufenozide and its metabolites benzoic acid, 3,5-di-methyl-1-(1,1-dimethylethyl)-2-((4-carboxymethyl)benzoyl)hydrazide, benzoic acid, 3-hydroxymethyl,5-methyl-1-(1,1-dimethylethyl)-2-(4-ethylbenzoyl)hydrazide, the stearic acid conjugate of benzoic acid, 3-hydroxymethyl,5-methyl-1-(1,1-dimethylethyl)-2-(4-ethylbenzoyl)hydrazide and benzoic acid, 3-hydroxymethyl-5-methyl-1-(1,1-dimethylethyl)-2-(4-(1-hydroxy-ethyl)benzoyl)hydrazide.

The US MRLs are 0.1 mg/kg for fat, 0.08 mg/kg for meat and meat by-products and 0.04 mg/kg for milk.

The Australian MRL for apples is 1 mg/kg and 10 ppm for apple (pome fruit) pomace (dry) while the USA MRL for apples is 1 mg/kg and for apple pomace 3 ppm.

In a lactating cow feeding study, animals were dosed at levels equivalent to 6, 18 or 60 ppm in the feed for 28 consecutive days⁷⁵. The TFs for fat are 0.003 and 0.005 for the Australian and US residue definitions respectively (18 ppm feeding level). Using the TF for the US residue definition and assuming feeding of pomace at no more than 30% of the diet, anticipated residues in fat are $0.3 \times 10 \times 0.005 = 0.015$ mg/kg, less than typical regulatory method LOQs for animal tissues.

The TFs for milk are 0.0003 and 0.001 for the Australian and US residue definitions respectively (18 ppm feeding level). Using the TF for the US residue definition and assuming feeding of pomace at no more than 30% of the diet, anticipated residues in fat are $0.3 \times 10 \times 0.001 = 0.003$ mg/kg, less than typical regulatory method LOQs for milk (0.01 mg/kg).

It is anticipated that animal product residues will be below typical method LOQs.

Tebufenpyrad

- is an acaricide used for the control of two spotted mites in apples. The application rate is up to 10 g ai/hL.

The harvest WHP is 14 days.

Do not graze any treated areas. Do not feed produce from treated areas to animals including poultry.

There are no Australian, Codex or US MRLs for tebufenpyrad in animal commodities. There is an Australian MRL of 1 mg/kg for apples (pome fruit).

The log P_{ow} for tebufenpyrad is 4.93 suggesting residues may accumulate in fat.

⁷⁵ 2001 JMPR Pesticide Residues in Food - 2001 Evaluations – Part I, FAO Plant Production and Protection Paper 171. FAO and WHO 2002

EFSA reported a feeding study where lactating dairy cows were dosed at levels equivalent to 0.3, 0.8 and 2.8 ppm in the diet for 28 days. Animals were sacrificed about 4 hours after the last dose. Residues of tebufenpyrad, CL810720 (M-OH) and CL810721 (M-COOH) were <0.01 mg/kg in milk for all dose groups. Residues were detected in kidney and fat but not in other tissues. Maximum residues (mg/kg) in kidney for the highest dose group were <0.01 mg/kg for tebufenpyrad, <0.01 mg/kg for M-OH and 0.02 mg/kg for M-COOH. Residues in fat were 0.02 mg/kg for tebufenpyrad and <0.01 mg/kg for the two metabolites.

It is anticipated that animal product residues will be below typical method LOQs.

Terbacil

- is a herbicide and is used for the control of grass and broadleaf weeds in crops including apples. It is applied to bare ground as a directed spray at 3.6 g ai/ha

No harvest or grazing/feeding WHPs required.

There are no Australian, Codex or US MRLs for animal tissues. The Australian MRL for pome fruit is *0.04 mg/kg. The US MRL for apples is 0.3 mg/kg (parent compound as Australian definition). As no residues are expected in apples or pomace, in residues are expected in animal commodities.

It is anticipated that animal product residues will be below typical method LOQs.

Tetradifon

- is a non-systemic acaricide that is used for the control of various species of mites in apples. The application rate is 200 g a.i./ha (20 g a.i./hL). The harvest WHP is 7 days.

There are Australian but no Codex or US MRLs for tetradifon in apples. There are no Australian, Codex or US MRLs for tetradifon residues in animal commodities. The Australian MRL for apples is 5 mg/kg. There are no MRLs for apple pomace.

On feeding cattle apple pomace with tetradifon residues in the range 0.07-0.53 ppm, residues after 160 days of feeding were 0.17 mg/kg in fat⁷⁶. Assuming a TF for fat of 0.3 and residue of tetradifon at the same level as the MRL would give an estimated residue in fat from apple pomace at 30% of the diet of $0.3 \times 5 \times 0.3 = 0.45$ mg/kg.

Livestock residues may exceed international and/or domestic market standards.

Thiabendazole

- is a systemic fungicide used for the post-harvest control of blue and green moulds and stem rot in apples. It is registered on apples as a post-harvest dip at 100 g ai/100L. No harvest WHP required when used as directed.

There are Australian, Codex and US MRLs for thiabendazole in cattle tissues. The Australian MRL for animal tissues have been set at 0.2 mg/kg while the milk MRL is 0.05 mg/kg. There is an Australian MRL for apples at 10 mg/kg. The Codex MRL for cattle kidney is 1 mg/kg while the MRL for cattle milk is 0.2 mg/kg. The US MRL for cattle meat is 0.1, meat byproducts is 0.4 mg/kg while the milk MRL is 0.1 mg/kg. The US MRL for apples (pome) is 5 and apple wet pomace is 12 mg/kg.

Processing factors reported in JMPR 2000 for apples to pomace (dry) were 3.4 to 4.9⁷⁷.

⁷⁶ Rumsey, T.S., Bovarel, K.P., Fontenot, J.P., Oltjen, R.R., & Priode, B.M. (1977) Supplementation of apple pomace with non-protein nitrogen for gestating beef cows. IV. Pesticide accumulation in cows. *J. Anim. Sci.*, 46: 543-550.

⁷⁷ 2000 JMPR. Pesticide Residues in Food - 2000 Evaluations – Part I, FAO Plant Production and Protection Paper 165. FAO and WHO 2001

The TF for kidney (target tissue) is 0.004^{78} giving anticipated residues of $0.3 \times 10 \times 4.9 \times 0.004 = 0.06$ mg/kg if fed at 30% diet.

The TF for milk is 0.001 giving anticipated residues of $0.3 \times 10 \times 4.9 \times 0.001 = 0.015$ mg/kg if fed at 30% diet.

Livestock residues are not anticipated to exceed international and/or domestic market standards.

Thiacloprid

- is a chloronicotinyl (pyridylmethylamine) insecticide used for the control of codling moth on pome fruit.

The application concentration is 18 g ai/100L (ca. 270 g ai/ha).

Do not harvest for 21 days after application

Do not graze any plants that were present in the sprayed area at the time of application

There are Australian, US and Codex MRLs for thiacloprid in animal tissues. The relevant Australian MRLs (residue definition thiacloprid) are *0.02 mg/kg for animal commodities except milk which has an MRL of *0.01 mg/kg. The Australian MRL for pome fruit is 1 mg/kg .. The US residue definition is the sum of thiacloprid and metabolites retaining the thiazolidine ring intact, measured and expressed in terms of thiacloprid, *per se*. The US tolerances are for meat is 0.03, meat byproducts and kidney 0.05 at 0.2 mg/kg and milk at 0.03 mg/kg. The USA MRL for apples is 0.3 mg/kg (Pome fruit) and apple wet pomace 0.6 mg/kg. The Codex MRL for edible offal is 0.5, meat 0.1 and milk 0.05 mg/kg.

Thiacloprid has a log P_{ow} of 1.3. Klein (2001) reported⁷⁹ a metabolism study where a lactating goat was dosed orally with thiacloprid at 10 mg/kg bw (ca. 340 ppm in the diet). Residues of thiacloprid in tissues and milk collected 6 hours after sacrifice were 1.6 mg/kg in fat, 7.0 mg/kg in kidney, 14 mg/kg in liver, 3.5 mg/kg in muscle and 1.5 mg/kg in milk. There was little difference in the residues of parent compound and measured using the US residue definition for liver and milk. The TF for liver and milk are estimated to be 0.04 and 0.004 respectively.

JMPR (2006) reported a feeding study on cow was carried out at three dosing levels equivalent to 2.1, 6.2 and 20.6 ppm thiacloprid in the diet for 28 consecutive days. On average, of the three cows treated per dose group, liver contained the highest thiacloprid residue levels (0.10 mg/kg) followed by kidney (0.03 mg/kg), milk and muscle (0.02 mg/kg) and fat (0.01 mg/kg) at the 2.1 ppm level. Maximum levels for tissues were 0.02 mg/kg for fat, 0.02 mg/kg for muscle, 0.04 mg/kg for kidney and 0.11 mg/kg for liver.

In the second dose group thiacloprid residue increased to average values of 0.04 mg/kg in milk and fat (highest value 0.04 mg/kg) 0.05 mg/kg in muscle (highest value 0.06 mg/kg), 0.1 mg/kg in kidney (highest value 0.11 mg/kg) and 0.29 mg/kg in liver (highest value 0.32 mg/kg). In the high dose group the findings were 0.17 mg/kg in milk, 0.12 mg/kg in fat (highest value 0.16 mg/kg), 0.16 mg/kg in muscle (highest value 0.18 mg/kg), 0.27 mg/kg in kidney (highest value 0.32 mg/kg) and 0.94 mg/kg in liver (highest value 1.1 mg/kg).

The TF for liver and milk are estimated to be $1.1/20.6 = 0.053$ and $0.17/20.6 = 0.008$ respectively.

The US EPA reported⁸⁰ a total of 18 field trials (12 apple and 6 pear) that were conducted in 6 different regions. Applications were made as ground-based foliar sprays at 0.28 kg ai/ha with 6- to 8-day intervals. The highest residue at 30-day PHI was 0.28 ppm, in apples. The highest residue at a 45-day PHI was 0.26 ppm, occurring in pears. Although residues in pome fruit did not consistently decline in relation to sampling intervals, residues were generally lower at the longer PHI (45 days) in harvest experiments. In the apple processing study, residues concentrated in the wet pomace (1.8×).

⁷⁸ 2000 JMPR. Pesticide Residues in Food - 2000 Evaluations – Part I, FAO Plant Production and Protection Paper 165. FAO and WHO 2001

⁷⁹ Klein, O (2001) Behaviour of thiacloprid (YRC 2894) in plants and animals. *Pflanzenschutz-Nachrichte Bayer* **54** 209-240.

⁸⁰ [Federal Register: May 7, 2003 (Volume 68, Number 88)] [Notices][Page 24458-24463] From the Federal Register Online via GPO Access [wais.access.gpo.gov] [DOCID:fr07my03-74] ENVIRONMENTAL PROTECTION AGENCY [OPP-2003-0139; FRL-7303-7] Thiacloprid; Notice of Filing a Pesticide Petition to Establish a Tolerance for a Certain Pesticide Chemical in or on Food AGENCY: Environmental Protection Agency (EPA).

Feeding apple pomace (dry) with residues 3 ppm at 30% of the diet would give rise to residues in liver of $0.3 \times 3 \times 0.053 = 0.048$ mg/kg, higher than the Australian tolerance.

The TF for milk is 0.004. Feeding apple pomace with residues 3 ppm at 30% of the diet would give rise to residues in milk of $0.3 \times 3 \times 0.008 = 0.0072$ mg/kg.

Livestock residues may exceed international and/or domestic market standards.

Thiram

- is a dithiocarbamate fungicide used on a variety of crops. It is used on apples for the control of black spot, target spot and ripe spot at an application rate of 120 g ai/hl.

The harvest WHP is 7 days

Do not feed grass clipping from treated areas or treated seed to poultry or animals

There are Australian and Codex but no US MRLs for thiram in animal commodities. The Australian MRL for edible offal is 2 mg/kg while the Codex MRL is 0.1 mg/kg, both as CS₂.

The Australian PAFC MRL is 50 ppm and the apple MRL 3 mg/kg. The US MRL for apples is 7 mg/kg (as tetramethyl thiram disulfide) Residues in apple pomace (dry) would be expected to be much less than 50 ppm. The target tissue is liver. The TF for liver (45 ppm feeding study for mancozeb)⁸¹ was 0.003 giving an anticipated maximum residue from the feeding of apple pomace (dry) at 30% at the diet of $0.3 \times <50 \times 0.003 = <0.05$ mg/kg, less than the relevant international MRLs.

It is anticipated that animal product residues will be below typical method LOQs.

Trichlorfon

- is an organophosphate insecticide used for the control of various insects in crops. It is registered on apples for the control of fruit fly and so involves application late in the crop growth. The application rate is up to 250 g ai/hL.

The harvest WHP is 2 days.

The grazing WHP is 2 days.

There are no Codex MRLs for trichlorfon in animal tissues. The Australian and US MRL for cattle fat is 0.1 and 0.5 mg/kg, respectively. The Australian MRL for milks is *0.05 mg/kg while no milk MRL has been set in the US. The Australian MRL for apples (fruits) is 0.1 mg/kg. Residues decline in soil and foliage with typical half-lives of 10 and 3 days respectively.

Following peroral uptake of the trichlorfon (12.5 and 20 ppm in feed), no trichlorfon residues were detected (<0.1 ppm) in any of the examined tissues and organs (brain, heart, kidney, steak, fat) after a four week feeding period⁸². Residues in apple pomace are expected to be less than 20 ppm. No detectable residues are expected in tissues of grazing animals.

It is anticipated that animal product residues will be below typical method LOQs.

Trifloxystrobin

-is a fungicide used for the control of powdery mildew and black spot in apples. It is applied as a foliar spray at an application rate of 5 g ai/hL.

The harvest WHP is 5 weeks (35 days). NOTE there is an export harvest interval of 10 weeks (70 days).

Do not allow stock to graze in any treated area

There are Australian, US and Codex MRLs for trifloxystrobin. The Australian and US MRLs for animal tissues have all been set at *0.05 and 0.05 mg/kg, respectively. The Australian and US milk MRLs are *0.02 and 0.02 mg/kg respectively. The Codex MRL for cattle liver & meat is 0.05, kidney *0.04 and milk is *0.02

⁸¹ 1993 JMPR - Pesticide Residues in Food - 1993 Evaluations, Part I Residues FAO Plant Production and Protection Paper 124. FAO and WHO 1994

⁸² 1971 JMPR. Evaluations of some pesticide residues in food. AGP/1971/M/9/1; WHO Pesticide Residues Series No. 1, 1972

mg/kg. The Australian MRL for apples is 0.3 mg/kg (Pome fruit) and for apple pomace (dry) 15 mg/kg (Pome fruit pomace). The US MRL for apples is 0.5 mg/kg (pome fruit) and for apple pomace (wet) is 5 ppm.

Lactating cows dosed orally for 28 consecutive days with trifloxystrobin at levels equivalent to 2, 6 and 20 ppm in the diet had residues in tissues and milk that were <0.02 mg/kg⁸³. The exception was fat of cows fed at 20 ppm in the diet which had residues on 0.06 mg/kg. Anticipated residues in fat from feeding apple pomace at 30% of the diet are $0.3 \times 15 \times 0.003 = 0.0135$ mg/kg.

It is anticipated that animal product residues will be below typical method LOQs.

Trifluralin

- is a selective herbicide of the dinitroaniline class and is used for the control of grass and broadleaf weeds in crops including apples. It is applied to apples as a shielded or directed spray to bare ground. The application rate is up to 1.1 kg ai/ha.

No harvest or grazing/feeding WHPs required.

There are no Codex or US MRLs for trifluralin in animal tissues. The Australian MRL for meat (mammalian) and milk are *0.05 mg/kg. The Australian MRL for apples is *0.05 mg/kg.

The US EPA evaluation of trifluralin states that based on a goat metabolism study where animals were fed at exaggerated rates there is no expectation of finite residues of trifluralin in animal tissues⁸⁴. Therefore no residues are expected to result from the feeding of apple pomace to animals. Residues decline in soil and foliage with typical half-lives of 60 and 3 days respectively.

It is anticipated that animal product residues will be below typical method LOQs.

Triforine

- is a systemic fungicide of the DMI group that is used on apples for the control of powdery mildew and fungal black spot. The application rate is up to 22.8 g ai/hL.

The harvest WHP is 1 day

There are no Australian, Codex or US MRLs for triforine in animal tissues. The Australian MRL for apples is 1 mg/kg.

No processing data or animal transfer studies were located for triforine. The log P_{ow} for triforine is 2.2. Using empirical relationships between tissue residues and log P_{ow} the following maximum TF are estimated: 0.17 for fat, 0.06 for offal and 0.02 for milk.

JMPR report that Triforine is rapidly metabolized and excreted in rats; unchanged compound accounts for only 0-5 % of the dose (Hawkins et al., 1992). Substantial quantities of unchanged triforine were recovered only from faeces (Boehringer Sohn, 1974a,b). The first metabolite to be identified was N-[2,2,2-trichloro-1-(piperazin-1-yl)ethyl]-formamide, which is formed by the cleavage of an entire side chain (Darda, 1977). In later metabolic studies with ¹⁴C labelling in the piperazine ring and aliphatic side chain (Hawkins et al., 1992), triforine underwent virtually complete metabolism after administration as a single oral dose of 10 mg/kg bw. N-[2,2,2-Trichloro-1-(piperazin-1-yl)ethyl]formamide, the major radiolabelled urinary component in rats receiving [piperazine ¹⁴C]-triforine, accounted for 46-53% of the dose over 0-24; however, in rats receiving side-chain-labelled ¹⁴C-triforine, the proportion was reduced to 24-27% after a single 10 mg/kg bw dose and 21-24% after repeated doses. It was excreted as the glucuronide. The side-chain metabolite trichloroethanol and its glucuronide represented 18-21% of the dose. Another side-chain metabolite occurring in the urine was the N-acetylcysteine conjugate of 2,2,2-trichloroethylamine, which

⁸³ Public Release Summary on Evaluation of the new active TRIFLOXYSTROBIN in the product FLINT FUNGICIDE National Registration Authority for Agricultural and Veterinary Chemicals September 2000 Canberra Australia

⁸⁴ Reregistration Eligibility Decision, Trifluralin, List A Case 0179, Environmental Protection Agency, Office of Pesticide Programs, Special Review and Reregistration Division EPA 738-R-95-040, April 1996

represented 13-15% of the administered dose. In faeces collected from female rats over 0-48 h, 3.6% of the single 10 mg/kg bw dose and 3.4% of the repeated doses was present as N-[2,2,2-trichloro-1-(piperazin-1-yl)ethyl]formamide. This metabolite was not detected in the faeces of rats receiving 1000 mg/kg bw. Very little unchanged triforine (0-1%) was detected in the faeces of rats given the low dose, whereas it represented 70-80% of the dose in rats given 1000 mg/kg bw (Hawkins et al., 1992). This result suggests that absorption of triforine is a saturable process, unless there is extensive biliary excretion at the high dose.

It is anticipated that animal product residues will be below typical method LOQs.

Zineb

- is a dithiocarbamate fungicide used on a variety of crops. It is used on apples for the control of black spot, sooty blotch and bitter rot at an application rate of 120 g ai/hL.

The harvest WHP is 14 days

There are Australian and Codex but no US MRLs for zineb in animal commodities. The Australian MRL for edible offal is *0.05 mg/kg while the Codex MRL is 0.1 mg/kg, both as CS₂. The Australian PAFC MRL is 50 ppm and the apples MRL 3 mg/kg. Residues in apple pomace would be expected to be much less than 50 ppm. The target tissue is liver. The TF for liver (45 ppm feeding study for mancozeb)⁸⁵ was 0.003 giving an anticipated maximum residue from the feeding of apple pomace at 30% of the diet of $0.3 \times < 50 \times 0.003 = < 0.05$ mg/kg, less than the relevant international MRLs.

It is anticipated that animal product residues will be below typical method LOQs.

Ziram

- is a dithiocarbamate fungicide used on a variety of crops. It is used on apples for the control of black spot, sooty blotch and bitter rot at an application rate of 120 g ai/hL

The harvest WHP is 7 days

There are Australian and Codex but no US MRLs for ziram in animal commodities. The Australian MRL for edible offal is *0.05mg/kg while the Codex MRL is 0.1 mg/kg, both as CS₂. The US residue definition is ziram (zinc dimethyldithiocarbamate), calculated as zinc ethylenebisdithiocarbamate. The US MRL for apples is 7 mg/kg. The Australian PAFC MRL is 50 ppm and the apples MRL 3 mg/kg. Residues in apple pomace would be expected to be much less than 50 ppm. The target tissue is liver. The TF for liver (45 ppm feeding study for mancozeb)⁸⁶ was 0.003 giving an anticipated maximum residue from the feeding of apple pomace at 30% of the diet of $0.3 \times < 50 \times 0.003 = < 0.05$ mg/kg, less than the relevant international MRLs.

It is anticipated that animal product residues will be below typical method LOQs.

⁸⁵ 1993 JMPR - Pesticide Residues in Food - 1993 Evaluations, Part I Residues FAO Plant Production and Protection Paper 124. FAO and WHO 1994

⁸⁶ 1993 JMPR - Pesticide Residues in Food - 1993 Evaluations, Part I Residues FAO Plant Production and Protection Paper 124. FAO and WHO 1994