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Pesticide risk profile for the feeding of almond hulls 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
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
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 pesticide residues in cattle and sheep fed almond hulls

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, offal and milk 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, edible offal and milk posed by the presence of pesticide residues in almond hulls fed to cattle and sheep.

Assessment of currently registered chemicals that may be used on almond 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.

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/oppref/rereg/status.cfm?show=rereg>

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 “FAO manual on the submission and evaluation of pesticide residues data for the estimation of maximum residue levels in food and feed” (Rome 2002, 2nd edition) lists the maximum proportion of almond hulls included in animal feed as 10% and this was used in the current evaluation. Estimates of residues in almond hulls were obtained from scaling of literature studies, maximum residue levels (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. However as almond hulls are reported to typically contain 90% dry matter this was not considered necessary.

The estimated residue in animal commodities is:

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

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

- The almonds are harvested at maturity and that the hulls are derived at this time.
- The crop has been treated at the maximum rate and with the shortest interval between application and harvest permitted by the product label³
- The maximum rate of incorporation in the ration/diet is 10%
- 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 2010⁴. 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 almond hulls 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 almonds.

Most of the compounds registered for use on almonds 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.*).

The conclusion of the analysis is the risk of residue violations in milk, meat and edible offal posed by the feeding of almond hulls derived from almond crops treated with currently registered products is low for the majority of chemicals.

³ 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.

⁴ 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..

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
Dicofol	Fat	0.5-2.5	0.01	Yes but limited decline	No
Tetradifon	Fat	0.9	0.01	No	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)

The current assessment has only identified pesticides of concern and 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

Azoxystrobin

-is a strobilurin fungicide used for control of anthracnose on almonds. Application is at 275 g ai/ha. The harvest WHP is 28 days.

The Australian MRLs for animal tissues have been set at *0.01 mg/kg while the milk MRL is 0.005 mg/kg. The US MRLs for animal commodities are set at 0.03, 0.01 and 0.07 mg/kg for cattle fat, meat and meat by-products respectively and 0.006 mg/kg for milk. Australian MRLs have been set for tree nuts at T0.02 mg/kg and almond hulls at T5 ppm. Codex MRLs for milk and mammalian meat is 0.10 and 0.05 mg/kg, respectively, and Almond hulls is 7 mg/kg.

Residues in tissues of lactating cows were ≤ 0.01 mg/kg after feeding at levels up to 25 ppm in the diet for 28 days. It is not considered likely that residues from feeding almond hulls will exceed 0.01 mg/kg in tissues or milk⁵.

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 almonds for control of anthracnose. The application rate is up to 160 g ai/hL. The harvest WHP is 30 days

There are Australian and USA but no Codex MRLs for captan in animal tissues. The relevant MRLs for meat in Australia and the US are set at *0.05 mg/kg and 0.20 mg/kg, respectively. The Australian MRL for milk is *0.01 mg/kg. The Australian MRL for tree nuts (almonds) is T0.3 mg/kg and for almond hulls T60 ppm.

JMPR has reported that feeding at rates of up to 100 ppm in the diet did not lead to detectable residues of captan *per se* in tissues or milk⁶.

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

Carfentrazone-ethyl

-is a selective aryl triazolinone herbicide used for the control of certain broad-leafed weeds in pre-flowering almond crops. The maximum application rate is 18 g ai/ha. No harvest WHP is required. Do not allow stock to graze treated areas for 14 days after application.

There are Australian and US but no Codex MRLs for carfentrazone ethyl in animal commodities. The Australian residue definition is parent compound while the US residue definition is carfentrazone-ethyl and its metabolite carfentrazone-chloropropionic acid (alpha, 2-dichloro-5-[-4-difluoromethyl]-4,5-dihydro-3-methyl-5-oxo-1H-1,2,4-triazol-1-yl]-4-fluorobenzenepropanoic acid). The Australian animal tissue MRLs have all been set at *0.05 mg/kg and milk at *0.025 mg/kg. The US MRLs are 0.1 for meat and meat by-products and 0.05 mg/kg for milk. The Australian MRL for tree nuts is *0.05 mg/kg.

⁵ Animal Residue Data Sheet – Azoxystrobin (October 2002) <http://www.apvma.gov.au/residues/stockfeed.shtml>

⁶ 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>

In an animal transfer study⁷, lactating cows were fed at levels equivalent to 1, 3 and 10 ppm in the diet for 28 consecutive days. No detectable residues (<0.005 ppm) of carfentrazone-ethyl, carfentrazone or F8426-propionic acid were found in any of the milk samples taken, except for low concentrations of carfentrazone (0.005 – 0.008 ppm) in three isolated samples from the 10 ppm dose group. No detectable residues (<0.01 ppm) of carfentrazone-ethyl, carfentrazone or F8426-propionic acid were found in any of the tissue or cream samples with the exception of kidney samples where trace amounts of carfentrazone (0.012 – 0.013 ppm) were found in samples from the 10 ppm dose group. There were no detectable residues of carfentrazone in kidney from cows fed clean feed for 7 days after dosing for 28 days, indicating that this residue was readily cleared from the kidney and excreted from the animal over a relatively short period of time.

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

Chlorothalonil

-is registered for use on almonds for control of shot hole and stone fruit rust at rates of up to 2.3 kg ai/ha.

Do not graze treated crops (NB: this restriction only applies to beans, peanuts & peas).

There are Australian and US but no Codex MRLs for chlorothalonil. The Australian residue definition is the sum of chlorothalonil and 4-hydroxy-2,5,6-trichloroisophthalonitrile metabolite expressed as chlorothalonil. The Australian MRLs are 7 mg/kg for edible offal, 2 mg/kg for meat in the fat and 0.05 mg/kg for milk. The US residue definition for animal commodities is 4-hydroxy-2,5,6-trichloroisophthalonitrile. The relevant MRLs for cattle commodities are 0.1, 0.5, 0.05 and 0.03 mg/kg for fat, kidney, meat by-products (except kidney) and meat respectively. The MRL for milk is 0.1 mg/kg. The Australian MRL for almonds is 0.1 mg/kg. The US MRL for almonds is 0.05 mg/kg and for almond hulls 1 ppm.

The TF for kidney (target tissue, US residue definition) is 0.09⁸. Assuming residues of chlorothalonil in hulls are 1 ppm, anticipated residues in kidney would be $0.1 \times 1 \times 0.09 = 0.009$ mg/kg if fed at 10% of the diet. Residues were not detected in tissues after a period of 32 days on clean feed (earliest clean-feed slaughter period; feed level 250 ppm chlorothalonil + 2 ppm metabolite).

The TF for milk is 0.03 giving rise to anticipated residues in milk of be $0.1 \times 1 \times 0.03 = 0.003$ mg/kg if fed at 10% of the diet. Other countries would be expected to utilise parent compound in any monitoring and no residues of parent compound are expected in animal tissues from feeding almond hulls.

Chlorothalonil can contain up to 100 mg/kg hexachlorobenzene (HCB)⁹, an application rate of 2.3 kg ai/ha corresponds to a potential application of HCB at 0.23 g/ha. Estimates of the potential for transfer of HCB residues are given below:

(a) Uptake from soil. Noting the half-life for HCB in soil is 3-6 years. Uptake of HCB by various crops was such that the ratio of soil to crop residues ranges from 0.03 – 2.4 for aerial parts. The contribution from previous years applications (assumed 12 years of additions 1 spray per year at the

⁷ APVMA Public Release Summary on evaluation of the new active Carfentrazone-ethyl in the product Affinity 400 DF Herbicide <http://www.apvma.gov.au/publications/prscar.pdf>

⁸ 1997 JMPR Pesticide Residues in Food - 1997 evaluations, FAO Plant Production and Protection Paper 146. FAO and WHO 1998 <http://www.fao.org/ag/AGP/AGPP/Pesticid/Default.htm>

⁹ 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>

maximum rate = 0.23 g HCB/ha = 2.76 g HCB/ha), distributed in the top 20 cm soil with density 1 g/mL would be 2760 mg/2000000 kg = 0.0014 ppm. Assuming a ratio of 0.1 for crop to soil, residues in aerial plant parts would account for no more than 0.00014 mg/kg.

The TF for fat and milk fat are assumed to be 8 and 8.4 respectively. Feeding almond hulls with HCB residues of 0.00014 ppm at 10% of the diet would give rise to residues of $0.1 \times 0.00014 \times 8 = 0.00011$ mg/kg in fat and 0.00012 mg/kg in milk fat.

(b) Foliar residues. If assume residues in fruit at day 0 from application of a pesticide at 1 kg ai/ha are 10 ppm and scale for application rate, residues are expected to be $0.00023 \times 10 = 0.0023$ ppm for HCB in almond hulls. Residues in cattle fat and milk would be $0.1 \times 0.0023 \times 8 = 0.0018$ mg/kg for fat and $0.1 \times 0.0023 \times 8.4 = 0.0019$ mg/kg in milk fat.

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 brown almond mites on almonds. The application rate is up to 15 g ai/hL.

The harvest WHP is 35 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, milk and edible offal 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 almonds of $T0.5$ mg/kg .

The TF for liver is 0.026^{10} . No detectable residues are expected from feeding clofentezine contaminated almond hulls ($0.1 \times 5 \times 0.026 = 0.013$ mg/kg).

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 almonds it is used for the control of mites. The application rate is up to 480 g ai/ha.

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 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 almonds has been set at 5 mg/kg.

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

¹⁰ Using 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>

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 definition¹¹. 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 at more than 10× in hulls the anticipated residues in fat are $0.1 \times 10 \times 5 \times 0.5 = 2.5$ mg/kg for the Codex and $0.1 \times 10 \times 5 \times 0.1 = 0.5$ for the Australian residue definition. Anticipated residues in milk are $0.1 \times 10 \times 5 \times 0.04 = 0.2$ mg/kg for the Codex and $0.1 \times 10 \times 5 \times 0.006 = 0.03$ for the Australian residue definition. Residues above LOQ are expected if hulls derived from dicofol treated almonds are fed to animals.

Dicofol can contain up to 1000 mg/kg DDT and related compounds¹², an application rate of 0.48 kg ai/ha corresponds to application of DDT at 0.48 g/ha. 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 hulls, the anticipated residues are $0.1 \times (10 \times 5 / 1000) \times 1.8 = 0.009$ mg/kg in subcutaneous fat and $0.1 \times (10 \times 5 / 1000) \times 2.1 = 0.01$ mg/kg in milk fat.

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

Diquat

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

No harvest WHP required

Grazing WHP is 1 day

The Australian and Codex MRLs for diquat in meat (mammalian) are the same at *0.05 mg/kg. The US MRL for meat 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 tree nuts 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). Residues in almond hulls would be expected to be less than 100 ppm. This suggests that no residues would be detected in animal tissues if fed almond hulls.

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 tree nuts. The application rate is up to 1 kg ai/ha.

The harvest WHP is not required.

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

The relevant Australian MRLs are the same at 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 and milk 0.15 mg/kg. There is an MRL for mixed pasture of 15 mg/kg while the tree nut MRL is 0.1 mg/kg. The US MRL for almonds hulls is 0.5 mg/kg.

¹¹ 1994 JMPR - Pesticide Residues in Food - 1994 Evaluations, Part I Residues FAO Plant Production and Protection Paper 78. FAO and WHO 1995

¹² 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>

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 diet¹³.

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

Glyphosate

-is a non-selective foliar herbicide used for the control of broadleaf weeds and grasses in crops such as sugarcane, maize, sorghum and winter cereals as well as tree nuts. It is applied at application rates up to 3.2 kg ai/ha.

No harvest or grazing WHPs are required.

The relevant Australian and Codex MRLs are at 2 mg/kg and 5 for offal, respectively. The relevant USA MRL is 5 mg/kg for cattle meat byproducts. The Australian and Codex milk MRLs are *0.1 mg/kg and *0.05 mg/kg respectively. The tree nut MRL is 0.2 mg/kg while there is also a primary animal feed commodity MRL for glyphosate of 150 mg/kg. The US has a tolerance for almond hulls at 25 ppm.

Residues in cattle, pig and poultry meat, eggs and milk were negligible after the animals were fed with a diet containing 100 mg/kg glyphosate and aminoglyphosate acid¹⁴. The highest residues were in pig liver and kidney (up to 0.16 and 0.91 mg/kg, respectively) and cattle kidney (up to 1.4 mg/kg).

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

Haloxyfop

-is an aryloxyphenoxypropionate (fop) herbicide used for the control of certain grasses in various crops. It is registered for weed control in tree nuts at an application rate of up to 516 g ai/ha.

A harvest WHP is not required.

Do not graze or cut for stock food for 28 days after application (this restriction applies to field crops & pastures only).

There are Australian but no USA or Codex animal tissue MRLs for haloxyfop. 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. There are Australian MRLs of *0.05 mg/kg for tree nuts.

The TF for cattle fat is 0.05, cattle kidney 0.19 cattle milk 0.016 and cattle cream 0.17¹⁵. If it is assumed residues are present at the same level as the MRL residues in cattle tissues would be $0.1 \times 0.05 \times 0.05 = 0.00025$ mg/kg in fat and $0.1 \times 0.05 \times 0.19 = 0.00095$ mg/kg in kidney, $0.1 \times 0.05 \times 0.016 = 0.00008$ mg/kg in milk and $0.1 \times 0.05 \times 0.17 = 0.00085$ mg/kg in cream if hulls were included at 10% of the diet. Maximum residues of haloxyfop in fat of cows dosed at the equivalent of 10 ppm in the diet were 0.53 mg/kg at the end of the 28 day feeding period and 0.21 mg/kg after 7 days on clean feed and 0.22 mg/kg after 14 days on clean feed.

¹³ 1998 JMPR - Pesticide Residues in Food - 1998 Evaluations, Part I Residues FAO Plant Production and Protection Paper 152/1. FAO and WHO 1999

¹⁴ FAO/WHO (1986a) Pesticide residues in food - Evaluations 1986. Part I - Residues. Joint Meeting of the FAO Panel of Experts Residues in Food and the Environment and the WHO Expert Group on Pesticide Residues, Rome, 29 September-8 October 1986. Rome, Food and Agriculture Organization of the United Nations (FAO Plant Production and Protection Paper 78/1).

¹⁵ 1995 JMPR - Pesticide Residues in Food - 1995 Evaluations, Part I Residues FAO Plant Production and Protection Paper 137. FAO and WHO 1996

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 blossom blight and brown rot in almonds at a rate of up to 500 g ai/ha.

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 including milk. 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 almonds at *0.02 mg/kg. The US MRL for almonds is 0.3 mg/kg and for hulls at 2 ppm.

The TF for fat (US residue definition) is 0.03 and for milk 0.007 (both at 15 ppm feeding level)¹⁶. Assuming residues in almond hulls are the same as the US tolerance (conservative) and feeding hulls at 10% of the diet the anticipated residues in fat and milk are $0.1 \times 2 \times 0.03 = 0.006$ mg/kg and $0.1 \times 2 \times 0.007 = 0.0014$ mg/kg, below the US tolerance. If parent compound is monitored in tissues in other countries, as in Australia, residues in tissues are expected to be below the method LOQ.

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

Mancozeb

-is registered for use on almonds for the control of brown rot at a maximum rate of 4.32 kg ai/ha. The harvest WHP is 14 days.

There are Australian and Codex but no US MRLs for mancozeb in animal commodities. The Australian and Codex MRLs for edible offal set at *0.05 mg/kg and milk at *0.05 mg/kg

The almond MRL is 3 mg/kg. The Australian PAFC MRL is 50 ppm.

Residues in almond hulls would be expected to be less than 30 ppm (10× the almond MRL). The target tissue is liver. The TF for liver (45 ppm feeding study¹⁷) was 0.003 giving an anticipated maximum residue from the feeding of hulls of $0.1 \times 30 \times 0.003 = 0.009$ mg/kg, less than the relevant international MRLs. The TF for milk was <0.008. No detectable residues are expected in milk from feeding almond hulls to dairy cattle.

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

Napropamide

-is a herbicide used for control of weeds in almond orchards. The maximum application rate is 3.35 kg ai/ha.

No WHP required.

Do not graze treated areas.

¹⁶ 1994 JMPR - Pesticide Residues in Food - 1994 Evaluations, Part I Residues FAO Plant Production and Protection Paper 78. FAO and WHO 1995

¹⁷ 1993 JMPR - Pesticide Residues in Food - 1993 Evaluations, Part I Residues FAO Plant Production and Protection Paper 124. FAO and WHO 1994

Do not apply when nuts are on the ground

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

As no residues are expected in almonds, or feed products derived from treated almonds, no residues are expected in animal tissues from feeding hulls.

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

Norflurazon

-is a fluorinated pyridazinone herbicide used for the control of annual grasses and broadleaf weeds in almond orchards. It is applied to almonds at an application rate of up to 4 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 0.50 mg/kg for cattle liver and 0.1 mg/kg for other tissues. There are no Australian MRLs for animal commodities, the MRL for almonds (tree nuts) is *0.2 mg/kg. The US MRL for almonds is 0.1 mg/kg and for hulls 1 ppm.

The US EPA noted¹⁸ that “*metabolism of norflurazon in livestock has been studied and tolerances for livestock commodities have been established. 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.

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 tree nuts is 0.1 mg/kg and the US one for hulls 0.05 m/kg.

¹⁸ Reregistration Eligibility Decision Norflurazon List A Case 0229, Environmental Protection Agency, Office of Pesticide Programs, Special Review and Reregistration Division.
<http://cfpub.epa.gov/oppref/rereg/status.cfm?show=rereg>

The US EPA reported in their assessment on oryzalin¹⁹ 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 when trees are in foliage or 960 g ai/ha if applied when the trees are dormant.

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 MRL for tree nuts is 0.05 mg/kg and the US MRL for almond hulls is 0.1 mg/kg.

The TF for fat is 0.035 while the TF for milk is 0.003²⁰. There is no expectation of residues in animal tissues including fat or milk.

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 after application.

Remove stock from treated areas 3 days before slaughter.

The Australian for paraquat in edible offal, meat and milk are set at *0.5, *0.05 and *0.01 mg/kg respectively. Codex MRL for edible offal is 0.05 and meat and milk are the same at 0.005 mg/kg .. The US MRLs for kidney is 0.5 mg/kg and for milk 0.01 mg/kg. Residues in soil and foliage decline with typical half-lives of *ca.* 1000 and 30 days respectively. The MRL for almonds (tree nuts) is *0.05 mg/kg in Australia.

For residues in kidney to be less than the US MRL of 0.3 mg/kg, cattle would have to fed at less than *ca.* 80 ppm in the diet. Noting the application rates it is considered unlikely that residues in almond hulls would exceed 80 ppm. This suggests that residues in excess of the Australian, Codex and US MRLs would not be expected in animal tissues if fed almond hulls.

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

Pendimethalin

¹⁹ Reregistration Eligibility Decision Oryzalin List A Case 0186, Environmental Protection Agency, Office of Pesticide Programs, Special Review and Reregistration Division. <http://cfpub.epa.gov/oppref/rereg/status.cfm?show=rereg>

²⁰ Reregistration Eligibility Decision (RED) Oxyfluorfen List A Case 2490, Environmental Protection Agency, Office of Pesticide Programs, Special Review and Reregistration Division. <http://cfpub.epa.gov/oppref/rereg/status.cfm?show=rereg>

-is a selective dinitroaniline herbicide used for the control of annual ryegrass and certain broadleaf weeds in almonds. It is applied at a maximum rate of 3.96 kg ai/ha. A harvest WHP is not required.

There are no Codex or US MRLs for pendimethalin in animal tissues, The Australian MRLs are all *0.01 mg/kg (edible offal, meat & milks). Residues decline in soil and foliage with typical half-lives of 90 and 50 days respectively. US MRL for almond hulls is 0.5 mg/kg. The Australian MRL for tree nuts is *0.05 mg/kg.

The US EPA notes²¹ that animal metabolism studies in goats conducted at exaggerated feeding levels indicate that there is no reasonable expectation for residues of pendimethalin in tissues or milk.

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

Phosphorous acid

-is a systemic fungicide used on almonds for suppression of *Phytophthora* spp. at an application rate of 200 g ai/hL.

Do not harvest for 28 days after application. Do not apply after hull split.

Residues of phosphorous acid are expected to be converted into phosphate and not represent a residue risk for animal commodities.

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

Pirimicarb

- is a carbamate aphicide used for the control of aphids in various crops. It is registered on almonds for control of green peach aphids (PER 5653). The application rate is up to 25 g ai/hL or 550 g ai/ha.

Do not harvest for 28 days after application.

Do not use treated almond hulls for stock food.

There are Australian and Codex but no USA MRLs for pirimicarb in animal commodities. The Australian MRLs for meat and milk are *0.1 mg/kg while the Codex MRLs are *0.01 mg/kg, both set at the limit of analytical quantitation and are essentially the same. The Australian MRL for tree nuts is *0.05 mg/kg.

No data was located for residues of pirimicarb in almond hulls however in a feeding study reported by JMPR residues of pirimicarb were <0.05 mg/kg for animals dosed at the equivalent of 200 ppm in the diet²², a level of exposure much greater than would be anticipated to arise if almond hulls were fed. The TF for milk is 0.00065 indicating a little likelihood that residues would be detected in milk.

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

²¹ Reregistration Eligibility Decision Pendimethalin List A Case 0187, Environmental Protection Agency, Office of Pesticide Programs, Special Review and Reregistration Division.

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

²² 1978 JMPR - Pesticide Residues in Food - 1978 Evaluations, FAO Plant Production and Protection Paper 15 Suppl. FAO and WHO 1979

Propiconazole

- is a DMI fungicide used for the control of various anthracnose and blossom blight in almonds (PER 5652). Application is at a maximum rate of 12.5 g ai/hL.

The harvest WHP is 42 days (6 weeks).

There are Australian, Codex and US MRLs for propiconazole in animal commodities. The Australian MRLs (propiconazole) are 1 mg/kg for edible offal, 0.1 mg/kg for meat and *0.01 mg/kg for milk. The Codex MRLs are (propiconazole) *0.01 mg/kg for edible offal, milk and meat (mammalian).. The US residue definition is the sum of propiconazole and its metabolites determined as 2,4-dichlorobenzoic acid, expressed as parent compound. The US MRLs are 2 mg/kg for liver and kidney, 0.05 mg/kg for milk, fat and meat by-products (except liver and kidney).. The Australian MRL for almonds (tree nuts) is T0.2 mg/kg and almond T0.2 mg/kg.

Animal transfer studies were reported by the 1987 JMPR at feeding levels of 15-100 ppm for cows and 4.5 ppm for goats resulted in undetectable parent residues in milk and tissues (<0.05 mg/kg)²³. After feeding cows for 14 days at 15 ppm the total residues were undetectable in milk and 0.63 mg/kg in kidney. The TF for kidney is 0.042. Anticipated residues are $0.1 \times 10 \times 0.042 = 0.042$ mg/kg.

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

Pymetrozine

-is an insecticide used to control green peach aphids in almonds. The application rate is up to 200 g ai/ha.

The harvest WHP is 28 days.

Do not feed treated almond hulls to animals.

There are Australian but no Codex or US MRLs for pymetrozine in animal commodities. The Australian MRLs have all been set at *0.01 mg/kg. The Australian MRL for almonds is T*0.01 mg/kg.

The US EPA reported that no detectable residues of pymetrozine or CGA-313124 were observed in samples of liver, kidney, perirenal fat, omental fat, round muscle, or tenderloin muscle from cows dosed with 10 ppm pymetrozine²⁴. The US EPA used these results to establish that there was no need to establish meat and milk tolerances.

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

Simazine

- is a triazine herbicide used for the control of weeds in almond orchards with application rates up to 1.75 kg ai/ha.

A harvest WHP is not required.

²³ 1987 JMPR Pesticide Residues in Food - 1987 Evaluations, Part I Residues FAO Plant Production and Protection Paper 86/1. FAO and WHO 1988

²⁴ Federal Register: June 9, 2004, Volume 69, Number 111, Page 32346-32351, Pymetrozine Pesticide Tolerance Filing 9/98, Federal Register: October 7, 1998, Volume 63, Number 194, Page 53902-53911

There are Australian and US but no Codex MRLS for animal commodities. The Australian MRLs for meat and edible offal are set at *0.05 mg/kg and for milk is *0.2 mg/kg. The US MRLs are 0.03 mg/kg for animal commodity MRLs.

The Australian MRL for almonds is *0.1 mg/kg (tree nuts) while the US one is 0.25 mg/kg for both almonds and almond hulls.

The US EPA reported²⁵ a ruminant feeding study where dairy cows were dosed with simazine at levels equivalent to 0.5, 2.5, and 5 ppm in the diet for 28 consecutive days. The combined residues of simazine, G-28279, and G-28273 in milk throughout the dosing period were <0.03 mg/kg (<0.01 mg/kg for each analyte) in milk from cows dosed at 0.5 ppm; 0.03 mg/kg (G-28273 was detected at 0.01 mg/kg) from cows dosed at 2.5 ppm; and 0.03-0.05 mg/kg (G-28273 detected at 0.01-0.04 mg/kg) from cows dosed at 5 ppm. The combined residues of simazine, G-28279 and G-28273 were <0.03 mg/kg (each at <0.01 mg/kg) in samples of meat, kidney, liver, and fat from cows in each dose group, with the exception of one cow dosed at 5 ppm and sacrificed on Day 21 which had residues of G-28273 at 0.01 mg/kg in tenderloin and kidney samples.

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

Spinosad

- is an antibiotic insecticide used for the control of heliothis and various other pests in vegetable crops. It is used as a bait application for fruit fly control in almonds at a maximum rate of 0.24 g ai/ha.

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 0.1 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). The MRL for tree nuts is T*0.01 mg/kg.

The TF for cattle fat is 0.5-0.6²⁶. The TF for milk is 0.05. As no residues are expected in almond hulls, no 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 almonds. The application rate is 200 g a.i./ha.

The harvest WHP is 7 days.

There are no Australian MRLs for tetradifon residues in animal commodities. The USA has set nil tolerances for tetradifon residues in meat and milk. There are no Codex or US MRLs for tetradifon in almonds. Presumably the Australian use is covered by the MRL of 5 mg/kg for fruits.

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 fat²⁷. Assuming residues in almond hulls incorporated at 1/3

²⁵ MEMORANDUM. DATE: 26 May 2005 SUBJECT: SIMAZINE: Residue Chemistry Chapter for the RED, Revised for Errors; PC Code 080807; DP Barcode D316474 FROM: David Soderberg TO: Diane Sherman,

²⁶ 2001 JMPR Pesticide Residues in Food - 2001 Evaluations – Part I, FAO Plant Production and Protection Paper 171. FAO and WHO 2002

the rate of pomace are at the same level as the Australian MRL of 5 ppm, and the average residue in pomace in the feeding study was 0.3 ppm (range 0.07-0.53 ppm), gives an estimated residue in fat from almond hulls in the diet of 0.9 mg/kg ($\frac{1}{3} \times 5 \text{ ppm} \times 0.17 \text{ mg/kg} \div 0.3 \text{ ppm} = 0.9 \text{ mg/kg}$). Estimated range = 0.5 – 4 mg/kg in fat). Note used apple MRL as a proxy for almond hulls.

Livestock residues may exceed international and/or domestic market standards. Insufficient data were located to provide confident opinion on livestock residue risks.

Trifluralin

-is a selective dinitroaniline herbicide used to prevent root intrusion into irrigation lines. Application is at a maximum rate of 1.88 g ai/ha applied to the irrigation submain pipes. No grazing WHP is required.

There are no Codex or US MRLs for trifluralin in animal tissues although there are registrations in the US including on vegetables (except carrot) MRL 0.05 mg/kg and carrot (MRL 1 mg/kg), and almond hulls is 0.05 mg/kg. The Australian MRL for meat (mammalian) and for milk is *0.05 mg/kg. There is an Australian MRL for fruits of *0.05 mg/kg.

The US EPA evaluation of trifluralin²⁸ 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 tissues. Therefore no residues are expected to result from the feeding of almond hulls 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.

²⁷ 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.

²⁸ 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