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Dosages, withholding periods and export slaughter intervals of parasiticides registered for use in goats in Australia

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Abstract

Compared to cattle and sheep, producers have fewer registered veterinary chemicals available to control parasites in goats and goat producers are concerned that only a limited number of these may have effective dose rates or withholding periods (WHPs) and export slaughter intervals (ESIs) established. Using desktop research, this project has revealed that all of the thirty eight parasiticide products registered for use in goats have a WHP established and included on the product label. WHPs are mandatory and must be included on the label of every registered product. Only one product has an ESI established, the only new active to be registered for use in goats in the 10 years since the APVMA was given responsibility for establishing ESIs. Review of the published scientific literature revealed that the label dose rate for goats was the same as that demonstrated as being effective in published efficacy studies for all but one of the actives for which published information was available.

Executive summary

Compared to cattle and sheep, producers have fewer registered veterinary chemicals available to control parasites in goats. Goat producers are also concerned that only a limited number of these may have effective dose rates or withholding periods (WHPs) and export slaughter intervals (ESIs) established for goats.

The objective of this project was to investigate dosages, WHPs and ESIs for all parasiticides registered for use on goats in Australia and the extent to which these are supported by data, to promote efficacy and satisfy importing country residue limit requirements.

This objective has been met.

Of the thirty eight parasiticide products registered for use in goats, all have a WHP established for goats. WHPs are mandatory and must be included on the label of every registered product; therefore, all products registered for use in goats have a WHP established for goats.

The 38 parasiticide products registered for use in goats in Australia represents only 14 actives. Australian MRLs have been established for all of these chemicals/drugs in goats and are published in the MRL standard on the APVMA website.

Only one new parasiticide active (abamectin) has been registered for use in goats since the APVMA was given responsibility for establishing ESIs approximately 10 years ago. An ESI has been established for this product, based on a residues trial that demonstrated that abamectin residues declined to the level of quantification by 28 days after treatment. This is the only registered parasiticide product that has an ESI established for goats.

To enable ESIs to be established for the other registered parasiticide products it is likely that similar studies will be required. This is because at least one important export market does not have an MRL established for the drugs/chemicals in these products. When important export markets have not established an MRL for a veterinary drug/chemical, the APVMA requires data showing tissue residue depletion to the level of quantification and does not accept extrapolation beyond sampling points when establishing an ESI. Generating these data will be a costly undertaking and is unlikely to be a priority for the various product registrants because the actives are older compounds with generic competition and are also registered for use in cattle and/or sheep, with use in these species likely to be the major product uses.

Review of the published veterinary literature revealed that for most of the actives for which published information was available, the label dose rate for goats was the same as that demonstrated as being effective in published efficacy studies. The exception was albendazole, for which it would appear the label dose rate may be lower than the ideal in terms of efficacy, particularly for the liver fluke *Fasciola hepatica.*

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Background

The Australian goat industry is made up of the rangeland goat meat production sector, the farmed goat meat sector and the fibre and dairy sectors. The number of rangeland goats is estimated to be between three and four million, with an additional 400,000 goats farmed for meat, dairy and fibre. Approximately 1.7 million goats were slaughtered in 2011.The major export markets for Australian goat meat are the USA (56.7%), Taiwan (13.6%), Trinidad & Tobago (9.8%), Canada (9.2%), Jamaica (2.8%), Vietnam (2.2%), Korea (1.5%), Japan (1.5%), Puerto Rico (1.4%) and Reunion (0.4%).

While rangeland goats in their natural environment are relatively disease and parasite free, goats confined to a farming environment or run in high densities are susceptible to internal and external parasites.

Compared to cattle and sheep, producers have fewer registered veterinary chemicals available to treat goats to manage parasites. Goat producers are also concerned that only a limited number of these may have effective dose rates or withholding periods (WHPs) and export slaughter intervals (ESIs) established for goats.

Meat & Livestock Australia (MLA) would like to enhance the availability of veterinary chemical treatments to goat producers by establishing effective dose rates, WHPs and ESIs for the products currently registered for use on goats to control internal and external parasites.

The Australian Pesticides and Veterinary Medicines Authority (APVMA) provides the following description of the WHP.[1]

> *The Withholding Period (WHP) is minimum period which must elapse between last administration or application of a veterinary chemical product, including treated feed, and the slaughter, collection, harvesting or use of the animal commodity for human consumption. WHPs are mandatory for domestic slaughter and are on the label of very registered product.*
>
> *The purpose of the WHP is to ensure that edible commodities from treated animals contain residue levels that are below the MRL.*
>
> *Compliance with the WHP should provide a high degree of assurance both to the producers and the consumers that the concentrations of residues in foods derived from treated animals are below MRL.*
>
> *The WHPs for animal slaughter as well as for the production of milk, eggs and honey for human consumption are determined from the results of suitable residue depletion studies using:*
>
> - *the formulation intended for marketing in Australia*
> - *the critical use-pattern administered to the target animal species.*

As described by the APVMA website[2] *an ESI is the minimum time that must elapse between administration of a veterinary chemical to animals and their slaughter for export. ESIs*

[1] http://.apvma.gov.au accessed 28 February 2013

manage differences between Maximum Residue Limits (MRLs) allowed for chemicals in Australia and MRLs of trading partners. ESI advice is particularly important for quality assurance schemes, and especially for producers filling out the National Vendor Declaration (NVD) forms as part of the whole-of-chain management of exported product. ESIs are agreed to by the relevant industry and the registrant of the veterinary chemical.

ESIs were an initiative of the red meat industry as a response to managing residue risks in major export markets and were initially set and managed by the Meat Research Corporation (MRC) and then by MLA (N. Blackman, pers. comm.). At the request of the red meat industry, the setting of ESIs was transferred to the APVMA, which has managed the setting of ESIs for the past 10 years.

The APVMA's current approach to setting Export Intervals (EIs, referred to as ESIs for food commodities derived from livestock that are slaughtered) is described in the Vet MORAG[3]:

> *"EIs are important tools in the management of potential risks to trade arising from the use of a registered product. EIs are advisory periods which the applicant proposes, and are agreed to or amended by the APVMA in consultation with the affected producer industries.*
>
> *EIs are an important component of the APVMA being satisfied that use of the product would not result in undue prejudice to trade, however EIs are non statutory in that the Agvet Code does not specifically require that they be set.*
>
> *EIs assist producers, processors and exporters to comply with MRLs or import residue tolerances of trading partners when the MRLs or import tolerances are more stringent than the respective Australian MRLs.*
>
> *EIs are set to ensure that exported food commodities meet the lower of either the CXL[4] or the most sensitive MRL or import tolerance set by a major trading partner. Applicants must conduct residue depletion trials for determining an EI for veterinary chemicals, using the product formulation that is to be marketed in Australia, and animals must be treated in accordance with the **critical** use pattern specified on the label of the product.*
>
> *The critical use pattern refers to the maximum dose rate to which animals may be exposed. Some major trading partners have not set an MRL for a particular veterinary chemical. In this case, EIs will be based on the time required for residues to deplete to the limit of quantification (LOQ).*
>
> *Adequate residues data are required for the establishment of an EI. The data must show depletion of the chemical down to the lowest MRL or import tolerance of the major trading partners for the relevant food commodity. The APVMA does not accept the use of extrapolation of residues data beyond the sampling points when determining an EI.*
>
> *Applicants are advised to consult with users and affected industries to determine EIs that are practical and manageable for all relevant parties. The APVMA will independently seek advice from user groups and peak industry bodies on whether the proposed EIs are practicable."*

[2] http://.apvma.gov.au accessed 28 February 2013
[3] http://www.apvma.gov.au/morag_vet/vol_3/part_05b_trade.php#gen19 accessed 28 February 2013
[4] Codex MRL

It is usual for generic products to adopt the ESI of the reference product[5].

In September 2011 the APVMA released a discussion paper that indicated in the future it may accept statistical determination of the ESI[6].

[5] http://.apvma.gov.au/ accessed 28 February 2013
[6] http://www.apvma.gov.au/consultation/public/closed/2011/esi_policy.php accessed February 2013

Project objectives

The objective of the project was to investigate dosages, WHPs and ESIs for all parasiticides registered for use on goats in Australia and the extent to which these are supported by data, to promote efficacy and satisfy importing country residue limit requirements.

Methodology

The methodology used to achieve the project objectives was as follows:

1. The APVMA PUBCRIS database was used to compile a list of all chemicals and products currently registered for use in treating goats in Australia to manage internal and external parasites, and if available the label dose rate, WHP and ESI. The search terms used were product type = parasiticide and host animal/crop = goat, and product type = parasiticide + nutritional and host/animal = goat. The Maximum Residues Standard (MRL) Standard on the APVMA website was also searched to determine if MRLs for the chemicals have been established in goats.
2. Internet searches were conducted to determine if these chemicals and products are registered internationally for use in goats, with a particular emphasis on the major export markets for Australian goat meat that account for 90% of goat meat exports (USA, Taiwan, Trinidad & Tobago, Canada, and Jamaica). Internet searches were also conducted to determine relevant international and CODEX MRLs in goats.
3. The veterinary scientific literature was searched using the EBSCOhost veterinary databases for publications that described the use of these chemicals to manage internal and external parasites in goats, with an emphasis on publications that described dose rates, pharmacokinetics and residue depletion. Search terms included the chemical/drug name, goats, efficacy, metabolism and pharmacokinetics
4. Where possible, consulted with the pioneer registrant of each of the chemicals/products to determine if they have unpublished information they would be prepared to make available. The consolidation within the pharmaceutical sector over the past 20 years and the fact that most of the actives registered for use in goats are older drugs meant that most of the pioneer registrants no longer exist; therefore, this would have been possible for only one active (triclabendazole) and so was not undertaken.

Results

Currently registered products for use goats in Australia

Thirty eight products registered for use in goats in Australia were found on the APVMA PUBCRIS database (Table 1). While 38 products are registered for use in goats in Australia, this represents only 13 actives (Although piperonyl butoxide is included in the tables below, it is not an active ingredient *per se*. Its use is restricted to that of a synergist in products containing pyrethrins or synthetic pyrethroids). The majority of the actives were discovered

and registered for use in animals prior to the APVMA being established in 1993[7] (Bowman, 1999; Cole, 1986).

The registered claims and dose rates for the 38 products are shown in Table 2, and the WHPs in Table 3. Because WHPs are mandatory and must be included on the label of every registered product, all products registered for use in goats have a WHP established for goats.

Most of the actives registered for use in goats were registered prior to the APVMA assuming responsibility for establishing ESIs approximately 10 years ago. Prior to the APVMA assuming responsibility for establishing ESIs, MLA/MRC did not establish any ESIs for goats (N. Blackman, *pers. comm.*).

Over the past 10 years only one new active has been registered for use in goats (abamectin - CAPRIMEC BROAD SPECTRUM ORAL ANTHELMINTIC SOLUTION FOR GOATS). This product is the only registered product for goats in which an ESI has been established for goats. The ESI was established based on a residues trial that demonstrated that abamectin residues declined to the level of quantification by 28 days after treatment[8].

[7] http://www.apvma.gov.au/ accessed 4th February 2013
[8] http://www.apvma.gov.au/advice_summaries/38169.pdf accessed 14 September 2012

Table 1. Parasiticide products registered for use in goats in Australia (Source: http://.apvma.gov.au accessed 4th February 2013)

APVMA Product Number	Product name	Recorded first date of registration[9]	Actives	Registrant
36340	COOPERS CLOUT-S BACKLINE LICE TREATMENT	May 1985	Deltamethrin	Intervet Australia Pty Ltd
37097	COOPERS PANACUR 25 ORAL ANTHELMINTIC FOR SHEEP CATTLE AND GOATS	Nov 1996	Fenbendazole	Intervet Australia Pty Ltd
37202	INCA PESTENE INSECT POWDER	Feb 1991	Rotenone / Sulfur-Sublimed	Inca (Flight) Co Pty Ltd
38791	ORALJECT GOAT AND SHEEP WORMER BROADSPECTRUM ANTHELMINTIC PASTE FOR GOATS AND SHEEP	Nov 1996	Morantel citrate	Virbac (Australia) Pty Ltd
39068	WSD FENBENDAZOLE ORAL ANTHELMINTIC FOR SHEEP, GOATS AND CATTLE	Nov 1991	Fenbendazole	Rebop Holding Pty Ltd T/A Western Stock Distributors
39572	WSD DIAZINON FOR SHEEP, CATTLE, GOATS AND PIGS	Jun 1990	Diazinon	Rebop Holding Pty Ltd T/A Western Stock Distributors
39573	WSD FLY STRIKE POWDER TO CONTROL FLYSTRIKE AND FOR WOUND DRESSING FOR ANIMALS	Nov 1996	Diazinon / Piperonyl butoxide / Pyrethrins	Rebop Holding Pty Ltd T/A Western Stock Distributors
39574	WSD MULESING POWDER WOUND DRESSING FOLLOWING MULES OPERATION GENERAL WOUND DRESSING FOR SHEEP, CATTLE AND GOATS	Nov 1996	Diazinon / Piperonyl butoxide / Pyrethrins	Rebop Holding Pty Ltd T/A Western Stock Distributors
39817	VIRBAC OXFEN ANTHELMINTIC FOR SHEEP AND GOATS	Nov 1996	Oxfendazole	Virbac (Australia) Pty Ltd
39823	TAKTIC EC ACARICIDAL SPRAY FOR CATTLE AND PIGS	Jun 1988	Amitraz	Intervet Australia Pty Ltd
40267	OXFEN LV ANTHELMINTIC FOR SHEEP CATTLE AND GOATS	May 1993	Oxfendazole	Virbac (Australia) Pty Ltd
40645	ALBEN BROAD SPECTRUM ANTHELMINTIC FOR SHEEP, LAMBS AND GOATS	Oct 1994	Albendazole	Virbac (Australia) Pty Ltd
41044	COOPERS AMITIK CATTLE DIP AND SPRAY	Aug 1997	Amitraz	Intervet Australia Pty Ltd
41278	TAKTIC WP CATTLE DIP AND SPRAY	Nov 1996	Amitraz	Intervet Australia Pty Ltd
45044	COOPERS AMITIK EC CATTLE AND PIG SPRAY	Jun 1993	Amitraz	Intervet Australia Pty Ltd
45211	BARRICADE 'S' CATTLE DIP AND SPRAY	Dec 1987	Chlorfenvinphos / Cypermethrin	Pfizer Animal Health Australia Pty Ltd

[9] First registered date in any state of Australia

Table 1. Parasiticide products registered for use in goats in Australia (Source: http://.apvma.gov.au accessed 4th February 2013)

APVMA Product Number	Product name	Recorded first date of registration[9]	Actives	Registrant
45788	VALBAZEN BROAD SPECTRUM SHEEP LAMB AND GOAT DRENCH	Not stated	Albendazole	Intervet Australia Pty Ltd
46231	COOPERS FLY STRIKE POWDER INSECTICIDE	Nov 1996	Diazinon / Piperonyl butoxide / Pyrethrins	Intervet Australia Pty Ltd
46815	COOPERS BLOCKADE 'S' CATTLE DIP AND SPRAY	Nov 1996	Chlorfenvinphos / Cypermethrin	Intervet Australia Pty Ltd
47676	FASINEX 50 FLUKICIDE FOR SHEEP CATTLE AND GOATS	Apr 1995	Triclabendazole	Novartis Animal Health Australasia Pty Ltd
48360	WSD ALBENDAZOLE BROAD SPECTRUM SHEEP, LAMB AND GOAT DRENCH	Jul 2001	Albendazole	Rebop Holding Pty Ltd T/A Western Stock Distributors
49876	NUCIDOL 200 EC INSECTICIDE AND ACARICIDE	May 1997	Diazinon	Zagro Animal Health Pte Ltd
51149	TICKOFF WP CATTLE TICKICIDE	May 1999	Amitraz	Jurox Pty Ltd
51309	FLUKARE S FLUKICIDE FOR SHEEP, CATTLE AND GOATS	Sep 1998	Triclabendazole	Virbac (Australia) Pty Ltd
51466	OXAZOLE LV WORMING DRENCH FOR SHEEP, CATTLE AND GOATS	May 1999	Oxfendazole	Jurox Pty Ltd
52185	FASINEX 100 ORAL FLUKICIDE FOR SHEEP, CATTLE AND GOATS	Nov 1999	Triclabendazole	Novartis Animal Health Australasia Pty Ltd
54369	4FARMERS FENBENDAZOLE ORAL ANTHELMINTIC FOR SHEEP, GOATS AND CATTLE	Aug 2001	Fenbendazole	4 Farmers Pty Ltd
55587	FLUKARE S PLUS SELENIUM FLUKICIDE FOR CATTLE, SHEEP AND GOATS	May 2002	Selenium as sodium selenate / Triclabendazole	Virbac (Australia) Pty Ltd
56725	FLUKARE C PLUS SELENIUM FLUKICIDE FOR CATTLE, SHEEP AND GOATS	Jul 2003	Selenium as sodium selenate / Triclabendazole	Virbac (Australia) Pty Ltd
58264	VIRBAC COMBAT WHITE ANTHELMINTIC FOR SHEEP, CATTLE AND GOATS	Feb 2004	Oxfendazole	Virbac (Australia) Pty Ltd
58982	YOUNG'S TRICLA 50 FLUKICIDE FOR SHEEP, CATTLE AND GOATS	Sep 2005	Triclabendazole	Novartis Animal Health Australasia Pty Ltd
60420	CAPRIMEC BROAD SPECTRUM ORAL ANTHELMINTIC SOLUTION FOR GOATS	Jul 2007	Abamectin	Virbac (Australia) Pty Ltd

Table 1. Parasiticide products registered for use in goats in Australia (Source: http://.apvma.gov.au accessed 4th February 2013)

APVMA Product Number	Product name	Recorded first date of registration[9]	Actives	Registrant
60489	EXIFLUKE ORAL FLUKICIDE FOR SHEEP, CATTLE AND GOATS	Oct 2006	Triclabendazole	Bayer Australia Ltd (Animal Health)
60617	WSD LV TRICLABENDAZOLE ORAL FLUKICIDE FOR SHEEP, CATTLE AND GOATS	Jan 2007	Triclabendazole	Rebop Holding Pty Ltd T/A Western Stock Distributors
62353	COOPERS DIAZINON SHEEP BLOWFLY DRESSING AND CATTLE, GOAT AND PIG SPRAY	Dec 2007	Diazinon	Intervet Australia Pty Ltd
64458	SAICOM ANTIC WP CATTLE DIP AND SPRAY	Feb 2011	Amitraz	Saicom Pty Ltd
65721	TIKDIP CATTLE DIP AND SPRAY	Mar 2011	Amitraz	Agvantage Pty Ltd
66730	BOVITRAZ WP CATTLE DIP AND SPRAY	Oct 2011	Amitraz	Bayer Australia Ltd (Animal Health)

Table 2. Registered dose rate of parasiticide products registered for use in goats in Australia (Source: http://.apvma.gov.au accessed 4th February 2013)

Actives	APVMA Product Number	Product name	Label claims for goats	Label dose rate
Abamectin 0.8 g/L	60420	CAPRIMEC BROAD SPECTRUM ORAL ANTHELMINTIC SOLUTION FOR GOATS	Treatment and control of abamectin-sensitive strains of internal parasites of goats (including benzimidazole, levamisole and morantel resistant strains); adult and immature gastrointestinal roundworms and lungworms	1 mL per 4 kg bodyweight (0.2 mg abamectin per kg bodyweight)
Albendazole 19 mg/mL	45788	VALBAZEN BROAD SPECTRUM SHEEP LAMB AND GOAT DRENCH	Control of susceptible gastrointestinal roundworms (except whipworms), large lungworms, and tapeworm and to aid in the control of adult liver fluke. Also to reduce the output of viable worm and fluke eggs	Roundworms, lungworms & tapeworms - 1 mL per 5 kg bodyweight (3.8 mg albendazole per kg bodyweight) Roundworms, lungworms, tapeworms & adult liver fluke -1 mL per 4 kg bodyweight (4.75 mg albendazole per kg bodyweight)
Albendazole 19 g/L	40645	ALBEN BROAD SPECTRUM ANTHELMINTIC FOR SHEEP, LAMBS AND GOATS	Control of benzimidazole-sensitive mature and immature gastrointestinal roundworms, large lungworms, tapeworms and aids in control of adult liver fluke	Roundworms, lungworms & tapeworms - 1 mL per 5 kg bodyweight (3.8 mg albendazole per kg bodyweight) Adult liver fluke -1 mL per 4 kg bodyweight (4.75 mg albendazole per kg bodyweight)
Albendazole 19 g/L	48360	WSD ALBENDAZOLE BROAD SPECTRUM SHEEP, LAMB AND GOAT DRENCH	Control of benzimidazole-sensitive mature and immature gastrointestinal roundworms (except whipworm), as an aid in the control and adult liver fluke and to reduce the output of viable worm and fluke eggs	Roundworms, lungworms & tapeworms - 1 mL per 5 kg bodyweight (3.8 mg albendazole per kg bodyweight) Roundworms, lungworms, tapeworms & adult liver fluke -1 mL per 4 kg bodyweight (4.75 mg albendazole per kg bodyweight)
Amitraz 125 g/L	39823	TAKTIC EC ACARICIDAL SPRAY FOR CATTLE AND PIGS	Cattle tick (NSW only)	400 mL per 200 mL water; treat at 14-21 day intervals or 3-7 day intervals if animals being moved

Table 2. Registered dose rate of parasiticide products registered for use in goats in Australia (Source: http://.apvma.gov.au accessed 4th February 2013)

Actives	APVMA Product Number	Product name	Label claims for goats	Label dose rate
Amitraz 500 g/kg	41044	COOPERS AMITIK CATTLE DIP AND SPRAY	Cattle tick (NSW only)	500 g per 1000 L water; use on goats on quarantined properties only; apply at 14-21 day intervals or as directed by NSW Department of Primary Industries
Amitraz 500 g/kg	41278	TAKTIC WP CATTLE DIP AND SPRAY	Cattle tick (NSW only)	500 g per 1000 L water; use on goats on quarantined properties only; apply at 14-21 day intervals or as directed by NSW Board of Tick Control
Amitraz 125 g/L	45044	COOPERS AMITIK EC CATTLE AND PIG SPRAY	Cattle tick (NSW only)	400 mL per 200 mL water; treat at 14-21 day intervals or 3-7 day intervals if animals being moved
Amitraz 500 g/kg	51149	TICKOFF WP CATTLE TICKICIDE	Cattle tick (NSW only)	Full label not available on APVMA website
Amitraz 500 g/kg	64458	SAICOM ANTIC WP CATTLE DIP AND SPRAY	Cattle tick	500 g per 1000 L water or 100 g per 200 L water; in animals being moved apply at 3-7 day intervals or as directed by relevant State Department of Agriculture
Amitraz 500 g/kg	65721	TIKDIP CATTLE DIP AND SPRAY	Cattle tick (NSW only)	500 g per 1000 L water; use on goats on quarantined properties only; apply at 14-21 day intervals or as directed by NSW Department of Primary Industries
Amitraz 500 g/kg	66730	BOVITRAZ WP CATTLE DIP AND SPRAY	Cattle tick	Full label not available on APVMA website
Chlorfenvinphos 138 g/L / Cypermethrin 25 g/L	45211	BARRICADE 'S' CATTLE DIP AND SPRAY	Cattle tick, New Zealand bush tick, paralysis ticks and buffalo fly	Dilute 1:250 in water; treat at 10-21 day intervals depending on the parasite
Chlorfenvinphos 138 g/L / Cypermethrin 25 g/L	46815	COOPERS BLOCKADE 'S' CATTLE DIP AND SPRAY	Cattle tick, New Zealand bush tick, paralysis ticks and buffalo fly	Dilute 1:250 in water; treat at 10-21 day intervals depending on the parasite

Table 2. Registered dose rate of parasiticide products registered for use in goats in Australia (Source: http://.apvma.gov.au accessed 4th February 2013)

Actives	APVMA Product Number	Product name	Label claims for goats	Label dose rate
Deltamethrin 10 g/L	36340	COOPERS CLOUT-S BACKLINE LICE TREATMENT	Pyrethroid susceptible lice (*Bovicola caprae, Lingnathus stenopsis*)	2 mL per 10 kg bodyweight (2 mg deltamethrin per k bodyweight)
Diazinon 200 g/L	39572	WSD DIAZINON FOR SHEEP, CATTLE, GOATS AND PIGS	Lice (*Bovicola caprae*)	100 mL per 40 L water (0.5 g diazinon per L); spray goats and repeat 15 days later
Diazinon 200 g/L	49876	NUCIDOL 200 EC INSECTICIDE AND ACARICIDE	Lice	Full label not available on APVMA website
Diazinon 200 g/L	62353	COOPERS DIAZINON SHEEP BLOWFLY DRESSING AND CATTLE, GOAT AND PIG SPRAY	Lice (*Bovicola caprae*)	50 mL per 20 L water (0.5 g diazinon per L); use as hand spray and repeat 16-17 days later if required
Diazinon 15 g/kg / Piperonyl butoxide 0.8 g/kg / Pyrethrins 1 g/kg	39573	WSD FLY STRIKE POWDER TO CONTROL FLYSTRIKE AND FOR WOUND DRESSING FOR ANIMALS	To control flystrike; wound dressing	Dust wound with powder in ample quantities
Diazinon 15 g/kg / Piperonyl butoxide 0.8 g/kg / Pyrethrins 1 g/kg	39574	WSD MULESING POWDER WOUND DRESSING FOLLOWING MULES OPERATION GENERAL WOUND DRESSING FOR SHEEP, CATTLE AND GOATS	General wound dressing	Dust wound lightly with powder
Diazinon 15 g/kg / Piperonyl butoxide 0.8 g/kg / Pyrethrins 1 g/kg	46231	COOPERS FLY STRIKE POWDER INSECTICIDE	General wound dressing	Dust wound lightly with powder
Fenbendazole 25 g/L	37097	COOPERS PANACUR 25 ORAL ANTHELMINTIC FOR SHEEP CATTLE AND GOATS	Control of benzimidazole-sensitive mature and immature roundworms and lungworm and to aid in the control of tapeworm	1 mL per 5 kg bodyweight (5 mg fenbendazole per kg bodyweight)
Fenbendazole 25 g/L	39068	WSD FENBENDAZOLE ORAL ANTHELMINTIC FOR SHEEP, GOATS AND CATTLE	Control of benzimidazole-sensitive roundworms and lungworm; aids in the control of tapeworm and whipworm	1 mL per 5 kg bodyweight (5 mg fenbendazole per kg bodyweight)

Table 2. Registered dose rate of parasiticide products registered for use in goats in Australia (Source: http://.apvma.gov.au accessed 4th February 2013)

Actives	APVMA Product Number	Product name	Label claims for goats	Label dose rate
Fenbendazole 25 g/L	54369	4FARMERS FENBENDAZOLE ORAL ANTHELMINTIC FOR SHEEP, GOATS AND CATTLE	Control of benzimidazole-sensitive roundworms and lungworm; aids in the control of tapeworm and whipworm	1 mL per 5 kg bodyweight (5 mg fenbendazole per kg bodyweight)
Morantel citrate 30 mg/mL	38791	ORALJECT GOAT AND SHEEP WORMER BROADSPECTRUM ANTHELMINTIC PASTE FOR GOATS AND SHEEP	Control of morantel-susceptible mature and immature roundworms, including benzimidazole resistant strains	1 mL per 3 kg bodyweight (10 mg morantel per kg bodyweight)
Oxfendazole 45.3 g/L	58264	VIRBAC COMBAT WHITE ANTHELMINTIC FOR SHEEP, CATTLE AND GOATS	Control of benzimidazole-sensitive mature and immature roundworms, lungworms and tapeworms	Full label not available on APVMA website
Oxfendazole 22.6 g/L	39817	VIRBAC OXFEN ANTHELMINTIC FOR SHEEP AND GOATS	Control of benzimidazole-sensitive mature and immature roundworms, lungworms and tapeworms	Full label not available on APVMA website
Oxfendazole 45.3 g/L	51466	OXAZOLE LV WORMING DRENCH FOR SHEEP, CATTLE AND GOATS	Treatment and control of benzimidazole-sensitive mature and immature roundworms, lungworms and tapeworms. Also kills roundworm eggs except *Nematodirus* spp.)	Full label not available on APVMA website
Oxfendazole 45.3 g/L	40267	OXFEN LV ANTHELMINTIC FOR SHEEP CATTLE AND GOATS	Control of benzimidazole-sensitive mature and immature roundworms, lungworms and tapeworms	1 mL per 10 kg bodyweight (4.53 mg oxfendazole per kg bodyweight)
Rotenone 10 g/kg / Sulfur-sublimed 50 g/kg	37202	INCA PESTENE INSECT POWDER	Control of lice, mites and fleas	Sprinkle lightly over the body; repeat weekly
Triclabendazole 50 g/L	47676	FASINEX 50 FLUKICIDE FOR SHEEP CATTLE AND GOATS	Treatment of susceptible early immature, immature and mature liver fluke	Full label not available on APVMA website
Triclabendazole 50 g/L	51309	FLUKARE S FLUKICIDE FOR SHEEP, CATTLE AND GOATS	Treatment of susceptible early immature, immature and mature liver fluke	Full label not available on APVMA website
Triclabendazole 100 g/L	52185	FASINEX 100 ORAL FLUKICIDE FOR SHEEP, CATTLE AND GOATS	Treatment of triclabendazole-susceptible early immature, immature and mature liver fluke	1 mL per 10 kg bodyweight (10 mg triclabendazole per kg bodyweight)

Table 2. Registered dose rate of parasiticide products registered for use in goats in Australia (Source: http://.apvma.gov.au accessed 4th February 2013)

Actives	APVMA Product Number	Product name	Label claims for goats	Label dose rate
Triclabendazole 50 g/L	58982	YOUNG'S TRICLA 50 FLUKICIDE FOR SHEEP, CATTLE AND GOATS	Treatment of susceptible early immature, immature and mature liver fluke	1 mL per 5 kg bodyweight (10 mg triclabendazole per kg bodyweight)
Triclabendazole 100 g/L	60489	EXIFLUKE ORAL FLUKICIDE FOR SHEEP, CATTLE AND GOATS	Treatment of susceptible early immature, immature and mature liver fluke	1 mL per 10 kg bodyweight (10 mg triclabendazole per kg bodyweight)
Triclabendazole 100 g/L	60617	WSD LV TRICLABENDAZOLE ORAL FLUKICIDE FOR SHEEP, CATTLE AND GOATS	Treatment of triclabendazole-susceptible early immature, immature and mature liver fluke	Full label not available on APVMA website
Selenium as sodium selenate / Triclabendazole 50 g/L	55587	FLUKARE S PLUS SELENIUM FLUKICIDE FOR CATTLE, SHEEP AND GOATS	Treatment of susceptible early immature, immature and mature liver fluke	1 mL per 10 kg bodyweight (10 mg triclabendazole per kg bodyweight)
Selenium as sodium selenate / Triclabendazole 120 g/L	56725	FLUKARE C PLUS SELENIUM FLUKICIDE FOR CATTLE, SHEEP AND GOATS	Treatment of susceptible early immature, immature and mature liver fluke	1 mL per 12 kg bodyweight (10 mg triclabendazole per kg bodyweight)

Table 3. Registered WHPs for goats of parasiticide products registered for use in goats in Australia (Source: http://.apvma.gov.au accessed 4th February 2013)

Actives	APVMA Product Number	Product name	WHP Meat	WHP Milk
Abamectin 0.8 g/L	60420	CAPRIMEC BROAD SPECTRUM ORAL ANTHELMINTIC SOLUTION FOR GOATS	14 days	4 days (8 milkings)
Albendazole 18 mg/mL	45788	VALBAZEN BROAD SPECTRUM SHEEP LAMB AND GOAT DRENCH	10 days	Not to be used in female goats producing or that will produce milk for human consumption
Albendazole 19 g/L	40645	ALBEN BROAD SPECTRUM ANTHELMINTIC FOR SHEEP, LAMBS AND GOATS	10 days	Not to be used in female goats producing or that will produce milk for human consumption
Albendazole 19 g/L	48360	WSD ALBENDAZOLE BROAD SPECTRUM SHEEP, LAMB AND GOAT DRENCH	10 days	Not to be used in female goats producing or that will produce milk for human consumption
Amitraz 125 g/L	39823	TAKTIC EC ACARICIDAL SPRAY FOR CATTLE AND PIGS	Nil	Nil
Amitraz 500 g/kg	41044	COOPERS AMITIK CATTLE DIP AND SPRAY	Nil	Nil
Amitraz 500 g/kg	41278	TAKTIC WP CATTLE DIP AND SPRAY	Nil	Nil
Amitraz 125 g/L	45044	COOPERS AMITIK EC CATTLE AND PIG SPRAY	Nil	Nil
Amitraz500 g/kg	51149	TICKOFF WP CATTLE TICKICIDE	Nil	Nil
Amitraz 500 g/kg	64458	SAICOM ANTIC WP CATTLE DIP AND SPRAY	Nil	Nil
Amitraz500 g/kg	65721	TIKDIP CATTLE DIP AND SPRAY	Nil	Nil
Amitraz500 g/kg	66730	BOVITRAZ WP CATTLE DIP AND SPRAY	Nil	Nil
Chlorfenvinphos 138 g/L/ Cypermethrin 25 g/L	45211	BARRICADE 'S' CATTLE DIP AND SPRAY	8 days	Not to be used in female goats producing or that will produce milk for human consumption
Chlorfenvinphos 138 g/L/ Cypermethrin 25 g/L	46815	COOPERS BLOCKADE 'S' CATTLE DIP AND SPRAY	8 days	Not to be used in female goats producing or that will produce milk for human consumption
Deltamethrin 10 g/L	36340	COOPERS CLOUT-S BACKLINE LICE TREATMENT	3 days	Not to be used in female goats producing or that will produce milk for human consumption
Diazinon 200 g/L	39572	WSD DIAZINON FOR SHEEP, CATTLE, GOATS AND PIGS	14 days	48 hours

Table 3. Registered WHPs for goats of parasiticide products registered for use in goats in Australia (Source: http://.apvma.gov.au accessed 4th February 2013)

Actives	APVMA Product Number	Product name	WHP Meat	WHP Milk
Diazinon 200 g/L	49876	NUCIDOL 200 EC INSECTICIDE AND ACARICIDE	14 days	Not to be used in female goats producing or that will produce milk for human consumption
Diazinon 200 g/L	62353	COOPERS DIAZINON SHEEP BLOWFLY DRESSING AND CATTLE, GOAT AND PIG SPRAY	14 days	48 hours
Diazinon 15 g/kg / Piperonyl butoxide 0.8 g/kg / Pyrethrins 1 g/kg	39573	WSD FLY STRIKE POWDER TO CONTROL FLYSTRIKE AND FOR WOUND DRESSING FOR ANIMALS	14 days	Not to be used in female goats producing or that will produce milk for human consumption
Diazinon 15 g/kg / Piperonyl butoxide 0.8 g/kg / Pyrethrins 1 g/kg	39574	WSD MULESING POWDER WOUND DRESSING FOLLOWING MULES OPERATION GENERAL WOUND DRESSING FOR SHEEP, CATTLE AND GOATS	14 days	Not to be used in female goats producing or that will produce milk for human consumption
Diazinon 15 g/kg / Piperonyl butoxide 0.8 g/kg / Pyrethrins 1 g/kg	46231	COOPERS FLY STRIKE POWDER INSECTICIDE	14 days	Not provided on label
Fenbendazole 25 g/L	37097	COOPERS PANACUR 25 ORAL ANTHELMINTIC FOR SHEEP CATTLE AND GOATS	14 days	24 hours (2 milkings)
Fenbendazole 25 g/L	39068	WSD FENBENDAZOLE ORAL ANTHELMINTIC FOR SHEEP, GOATS AND CATTLE	14 days	24 hours (2 milkings)
Fenbendazole 25 g/L	54369	4FARMERS FENBENDAZOLE ORAL ANTHELMINTIC FOR SHEEP, GOATS AND CATTLE	14 days	24 hours (2 milkings)
Morantel citrate 30 mg/mL	38791	ORALJECT GOAT AND SHEEP WORMER BROADSPECTRUM ANTHELMINTIC PASTE FOR GOATS AND SHEEP	7 days	Not to be used in female goats producing or that will produce milk for human consumption
Oxfendazole 45.3 g/L	58264	VIRBAC COMBAT WHITE ANTHELMINTIC FOR SHEEP, CATTLE AND GOATS	10 days	Not to be used in female goats producing or that will produce milk for human consumption
Oxfendazole 22.6 g/L	39817	VIRBAC OXFEN ANTHELMINTIC FOR SHEEP AND GOATS	10 days	Not to be used in female goats producing or that will produce milk for human consumption

Table 3. Registered WHPs for goats of parasiticide products registered for use in goats in Australia (Source: http://.apvma.gov.au accessed 4th February 2013)

Actives	APVMA Product Number	Product name	WHP Meat	WHP Milk
Oxfendazole 45.3 g/L	51466	OXAZOLE LV WORMING DRENCH FOR SHEEP, CATTLE AND GOATS	10 days	Not to be used in female goats producing or that will produce milk for human consumption
Oxfendazole 45.3 g/L	40267	OXFEN LV ANTHELMINTIC FOR SHEEP CATTLE AND GOATS	10 days	Not to be used in female goats producing or that will produce milk for human consumption
Rotenone / Sulfur-sublimed	37202	INCA PESTENE INSECT POWDER	1 day	Not to be used in lactating does where milk or milk products may be used for human consumption
Triclabendazole 50 g/L	47676	FASINEX 50 FLUKICIDE FOR SHEEP CATTLE AND GOATS	21 days Kids fed milk from animals treated within the past 21 days – 7 days.	Not to be used in lactating animals where milk or milk products may be used milk for human consumption
Triclabendazole 50 g/L	51309	FLUKARE S FLUKICIDE FOR SHEEP, CATTLE AND GOATS	21 days Kids fed milk from animals treated within the past 21 days – 7 days.	Not to be used in lactating animals where milk or milk products may be used milk for human consumption
Triclabendazole 100 g/L	52185	FASINEX 100 ORAL FLUKICIDE FOR SHEEP, CATTLE AND GOATS	21 days Kids fed milk from animals treated within the past 21 days – 7 days.	Not to be used in lactating animals where milk or milk products may be used milk for human consumption
Triclabendazole 50 g/L	58982	YOUNG'S TRICLA 50 FLUKICIDE FOR SHEEP, CATTLE AND GOATS	21 days Kids fed milk from animals treated within the past 21 days – 7 days.	Not to be used in lactating animals where milk or milk products may be used milk for human consumption

Table 3. Registered WHPs for goats of parasiticide products registered for use in goats in Australia (Source: http://.apvma.gov.au accessed 4th February 2013)

Actives	APVMA Product Number	Product name	WHP Meat	WHP Milk
Triclabendazole 100 g/L	60489	EXIFLUKE ORAL FLUKICIDE FOR SHEEP, CATTLE AND GOATS	21 days Kids fed milk from animals treated within the past 21 days – 7 days.	Not to be used in lactating animals where milk or milk products may be used milk for human consumption
Triclabendazole 100 g/L	60617	WSD LV TRICLABENDAZOLE ORAL FLUKICIDE FOR SHEEP, CATTLE AND GOATS	21 days Kids fed milk from animals treated within the past 21 days – 7 days.	Not to be used in lactating animals where milk or milk products may be used milk for human consumption
Selenium as sodium selenate / Triclabendazole 50 g/L	55587	FLUKARE S PLUS SELENIUM FLUKICIDE FOR CATTLE, SHEEP AND GOATS	21 days Kids fed milk from animals treated within the past 21 days – 7 days.	Not to be used in lactating animals where milk or milk products may be used milk for human consumption
Selenium as sodium selenate / Triclabendazole 120 g/L	56725	FLUKARE C PLUS SELENIUM FLUKICIDE FOR CATTLE, SHEEP AND GOATS	21 days Kids fed milk from animals treated within the past 21 days – 7 days.	Not to be used in lactating animals where milk or milk products may be used milk for human consumption

Maximum Residue Limits

The Maximum Residue Limits (MRLS) for the 13 parasiticide actives and one synergist registered for use in goats in Australia adopted by Australia, CODEX and the export markets that account for 90% of Australia's goat meat exports (USA, Taiwan, Trinidad and Tobago, Canada and Jamaica) are shown in Table 4 (The sources of the information provided in Table 4 are as follows, all accessed during February 2013:

- http://www.apvma.gov.au
- http://www.codexalimentarius.net
- http://www.fao.org
- http://www.mrldatabase.com/
- http://iaspub.epa.gov/apex/pesticides/f?p=CHEMICALSEARCH:1:11722036122860::NO:1::
- http://consumer.fda.gov.tw/Law/Detail.aspx?nodeID=518&lang=1&lawid=125
- http://consumer.fda.gov.tw/Law/Detail.aspx?nodeID=518&lang=1&lawid=132&k=%u79BD%u755C%u7522%u54C1%25u4
- http://pr-rp.hc-sc.gc.ca/mrl-lrm/index-eng.php
- http://webprod5.hc-sc.gc.ca/dpd-bdpp/start-debuter.do?lang=eng

Trinidad and Tobago and Jamaica do not maintain MRL standards and defer to CODEX[10].

Rotenone was not included in the MRLs standards of any of the major export markets for Australian goat meat or in the CODEX or Australian MRL standards.

Table 4 shows that for all active ingredients except deltamethrin or piperonyl butoxide, at least one major export market for Australian goat meat does not have a MRL established for the parasiticide actives registered for use in goats in Australia. This means, that for these actives, data that demonstrate residue levels declining to the level of quantification will be required to allow caprine ESIs to be established for the products that contain these actives.

Japan and Korea are smaller, but still important export markets for Australian goat meat and together account for 3.7% of goat meat exports. Japan has MRLs established for deltamethrin and piperonyl butoxide in goats[11], but Korea does not[12]. Vietnam, another significant export market for Australian goat meat (2.2% of export) also does not have MRLs established for either deltamethrin or piperonyl butoxide[13].

Therefore, for all the 14 parasiticide actives registered for use in goats in Australia data that show residue levels declining to the level of quantification will be required if ESIs are to be established.

[10] http://www.mrldatabase.com/ accessed February 2013
[11] http://www.m5.ws001.squarestart.ne.jp/foundation/search.html accessed February 2013
[12] http://www.kfda.go.kr/eng/index.do?nMenuCode=63 accessed February 2013 http://www.kfda.go.kr/eng/eng/download.do;jsessionid=Fu6iauYcVfckIvrftXTWazijUMrETpfN1UZiuGvCRliH9J1csi3xaf4ovckuEscT?boardCode=16771&boardSeq=67852&fileSeq=5 accessed February 2013
[13] http://www.nafiqad.gov.vn/b-legal-documents/promulgating-the-lists-of-food-safety-criteria-and-maximum-levels-thereof-in-certain-domestically-produced-or-imported-foodstuffs-of-animal-origin-under-the-management-of-the-ministry-of-agriculture-and-rural-development/ accessed February 2013

International Registrations

Albendazole and fenbendazole are registered for use in goats in the USA. None of the 13 parasiticide actives are registered for use in goats in Canada. None of the other major export markets for Australian goat meat maintain a database of products registered for use in goats in a readily accessible form.

Table 4. Australian, CODEX and some international MRLs (mg/kg) for the actives included in parasiticide products registered for use in goats in Australia

Active	Food	Australia	Codex	USA	Taiwan	Canada
Abamectin	Goat meat	0.01	0.01	0.02	-	-
	Goat, edible offal of	-	0.1	-	-	-
	Goat meat by-products	-	-	0.02	-	-
	Goat fat	0.1	-	-	-	-
	Goat kidney	0.01	-	-	-	-
	Goat liver	0.05	-	-	-	-
	Goat muscle	-	-	-	-	-
	Goat milk	0.005	0.005	0.005	-	-
	Milk	-	-	-	-	-
Albendazole	Goat, Edible offal of	*0.1	-	-	-	-
	Goat meat	*0.1	-	-	-	-
	Muscle (species not specified)	-	0.1	-	-	-
	Liver (species not specified)	-	5.0	-	-	-
	Kidney (species not specified)	-	5.0	-	-	-
	Fat (species not specified)	-	0.1	-	-	-
	Milks (species not specified)	-	0.1	-	-	-
	Goat liver	-	-	0.0025	-	-
Amitraz	Edible offal (mammalian)	0.5	-	-	-	-
	Meat (mammalian)	0.1	-	-	-	-

Table 4. Australian, CODEX and some international MRLs (mg/kg) for the actives included in parasiticide products registered for use in goats in Australia

Active	Food	Australia	Codex	USA	Taiwan	Canada
	Milks	0.1	0.01	-	-	-
Chlorfenvinphos	Goat, Edible offal of	T*0.1	-	-	-	-
	Goat meat [in the fat]	T0.2	-	-	-	-
	Muscle (livestock) [in the fat]	-	-	-	0.2	-
	Milks	-	-	-	0.008	-
Cypermethrin	Goat, Edible offal of	0.05	-	-	-	-
	Goat meat [in the fat]	0.5	-	-	-	-
	Edible offal (mammalian)	-	0.05	-	-	-
	Meat [in the fat] (mammals other than marine mammals)	-	2	-	-	-
	Milk fats	-	0.5	-	-	-
	Milks	-	0.05	-	0.05	-
	Goat fat	-	-	1	-	-
	Goat meat	-	-	0.2	-	-
	Goat meat by-products	-	-	0.05	-	-
	Muscle (livestock) [in the fat]	-	-	-	0.2	-
	Edible offal (livestock)	-	-	-	0.05	-
Deltamethrin	Goat, Edible offal of	0.1	-	-	-	-
	Goat meat [in the fat]	0.2	-	-	-	-

Table 4. Australian, CODEX and some international MRLs (mg/kg) for the actives included in parasiticide products registered for use in goats in Australia

Active	Food	Australia	Codex	USA	Taiwan	Canada
	Kidney of cattle, goats, pigs and sheep	-	0.03	-	-	-
	Liver of cattle, goats, pigs and sheep	-	0.03	-	-	-
	Meat [in the fat] (mammals other than marine mammals)	-	0.5	-	-	-
	Milks [in the fat]	-	0.05	-	-	0.05
	Goat fat	-	-	0.05	-	
	Goat meat	-	-	0.02	-	0.02
	Goat meat by-products	-	-	0.05		0.02
	Muscle (livestock) [in the fat]	-	-	-	0.5	-
	Edible offal (livestock)	-	-	-	0.05	-
Diazinon	Edible offal (mammalian)	0.7	-	-	-	-
	Meat [mammalian] [in the fat]	0.7	-	-	-	-
	Milks [in the fat]	0.5	0.02	-	0.02	-
	Goat meat [in the fat]	-	2	-	-	-
	Kidney of cattle, goats, pigs and sheep	-	0.03	-	-	-
	Liver of cattle, goats, pigs and sheep	-	0.03	-	-	-
Fenbendazole	Goat, Edible offal of	0.5	-	-	-	-
	Goat meat	0.5	-	-	-	-
	Milks	0.1	-	-	-	-
	Goat muscle	-	0.1	0.4	0.1	-

Table 4. Australian, CODEX and some international MRLs (mg/kg) for the actives included in parasiticide products registered for use in goats in Australia

Active	Food	Australia	Codex	USA	Taiwan	Canada
	Goat liver	-	0.5	0.8	0.5	-
	Goat kidney	-	0.1	-	0.1	-
	Goat fat	-	0.1	-	0.1	-
Morantel	Goat, Edible offal of	2	-	-	-	-
	Meat [mammalian]	0.3	-	-	-	-
	Milks	*0.1	-	-	-	-
	Muscle (Cattle, pigs, sheep, goats)	-	-	-	0.3	-
	Fat (Cattle, pigs, sheep, goats)	-	-	-	0.3	-
	Liver (Cattle, sheep, goats)	-	-	-	2	-
	Kidney (Cattle, sheep, goats)	-	-	-	2	-
Oxfendazole	Edible offal (mammalian)	3		-	-	-
	Meat [mammalian]	*0.1	0.1	-	-	-
	Milks	0.1		-	-	-
	Goat muscle	-	0.1	--	0.1	-
	Goat liver	-	0.5	-	0.5	-
	Goat kidney	-	0.1	-	0.1	-
	Goat fat	-	0.1	-	0.1	-
Piperonyl butoxide (pyrethrin/pyrethroid synergist)	Edible offal (mammalian)	0.1	-	-	-	-
	Meat [mammalian]	0.1	-	-	-	-

Table 4. Australian, CODEX and some international MRLs (mg/kg) for the actives included in parasiticide products registered for use in goats in Australia

Active	Food	Australia	Codex	USA	Taiwan	Canada
	Milk	-	0.05	-	-	-
	Kidney of cattle, goats, pigs and sheep	-	0.2	-	0.1	-
	Liver of cattle, goats, pigs and sheep	-	1	-	0.1	-
	Meat [in the fat] (mammals other than marine mammals)	-	2	-	0.1	-
	Milks [in the fat]	-	0.05	-	-	-
	Goat fat	-	-	0.1	-	0.1
	Goat meat	-	-	0.1	-	0.1
	Goat meat by-products	-	-	0.1	-	0.1
Pyrethrins	Goat fat	-	-	1.0	-	-
	Goat meat	-	-	0.05	-	0.05
	Goat meat by-products	-	-	0.05	-	0.05
	Milk fat	-	-	-	-	0.05
Triclabendazole	Cattle milk	T*0.05	-	-	-	-
	Fat (mammalian)	1	-	-	-	-
	Kidney (mammalian)	1	-	-	-	-
	Liver (mammalian)	2	-	-	-	-
	Meat (mammalian)	0.5	-	-	-	-

Literature review

References were found that describe the pharmacokinetics, metabolism and/or efficacy of abamectin, albendazole, deltamethrin, fenbendazole, oxfendazole and triclabendazole in goats.

References that describe caprine uses of amitraz, chlorfenvinphos [apart from a comment that this chemical is becoming environmentally unsustainable for tick control in animals (Wilson, 1996)], cypermethrin [apart from a paper that described immunosuppression in goats following daily oral treatment with 41.6 mg per kg bodyweight for 30 days (Tamang et al., 1988)], diazinon, morantel citrate, piperonyl butoxide, pyrethrins or rotenone were not found. Although references were found that described the pharmacokinetics and efficacy of morantel tartrate, these are not considered directly applicable to morantel citrate because the different salts of morantel have different pharmacokinetic properties (McKellar et al., 1993)

Abamectin

Abamectin is a macrocyclic lactone anthelmintic and is highly effective against most species of gastrointestinal nematodes (Shoop and Soll, 2002)

No published papers were found that described the use of abamectin in goats.

The APVMA advice summary for CAPRIMEC BROAD SPECTRUM ORAL ANTHELMINTIC SOLUTION FOR GOATS[14] indicates that, after oral administration of 0.2 mg abamectin per kg bodyweight, the plasma bioavailability of abamectin is similar to the plasma bioavailability of the drug in sheep, justifying the 0.2 mg per kg bodyweight dose rate. Fat was identified as the critical tissue for abamectin residues in treated goats. The results of the residues study supported a 14-day WHP, a 28-day re-treatment interval and a 28-day ESI. One pen efficacy and three field efficacy studies were conducted in Boer goats and demonstrated high levels of efficacy against *Haemonchus contortus, Trichostrongylus* spp., *Teladorsagia* spp. and *Oesophagostomum* spp. No adverse reactions were observed in adult Boer goats treated with 1X, 3X or 5X the 0.2 mg per kg bodyweight dose rate based on clinical examination and clinical pathology (biochemistry and haematology).

Albendazole

Albendazole is a broad spectrum sulphide benzimidazole anthelmintic with activity against gastrointestinal nematodes, lungworms, tapeworms and adult liver fluke (McKellar and Scott, 1990).

After oral or intra-ruminal administration to goats, albendazole undergoes rapid hepatic metabolism to its sulphoxide metabolite (Benchaoui et al., 1993; McKellar and Scott, 1990), with the parent drug not detectable in the systemic circulation (Benchaoui et al., 1993; Capece et al., 2009; Dubey et al., 2008). The sulphoxide metabolite is biologically active (Delatour et al., 1991; McKellar and Scott, 1990) and exists as both positive and negative enantiomers (Delatour et al., 1991). The sulphoxide metabolite is further metabolised to the sulphone metabolite, which is biologically inactive (McKellar and Scott, 1990).

In goats just over half of a radiolabelled [^{14}C] intra-ruminal dose of albendazole is eliminated in urine (approximately 55%) and approximately 20% in the faeces, which is comparable to

[14] http://www.apvma.gov.au/advice_summaries/38169.pdf accessed 14 September 2012

the elimination of the drug in sheep (sheep: urine approximately 60%, faeces approximately 20%) (Hennessy et al., 1993b).

The pharmacokinetics of albendazole sulphoxide and albendazole sulphone has been studied by a number of research groups. Following administration of either albendazole or albendazole sulphoxide to goats at a dose rate of 7.5 mg per kg bodyweight orally, the plasma bioavailability of albendazole sulphoxide and the ratios of the areas under the curve of the sulphone to sulphoxide metabolites are similar (0.51-0.56) (Benchaoui et al., 1993).

The systemic bioavailability of albendazole sulphoxide is higher in goats than in cattle, but lower than in sheep, whereas the systemic bioavailability of the sulphone metabolite is higher in goats then in either cattle or sheep (Delatour et al., 1991; Hennessy et al., 1993b). Goats also have lower ratios of the positive to negative enantiomers of the sulphoxide metabolite than either cattle or sheep (Delatour et al., 1991). The positive enantiomer of the sulphoxide metabolite is thought to be responsible for anthelmintic activity (Delatour et al., 1991). Administering albendazole in repeated doses at a 24 hour interval increases the ratio of the sulphone to sulphoxide metabolite and increases the ratio of the positive to negative sulphoxide enantiomer (Benoit et al., 1992).

The results of the pharmacokinetic studies have lead researchers to suggest that increasing the dose rate of albendazole in goats form 4.75 to 7.5 mg/kg might lead to equivalent efficacy in the two species (Hennessy et al., 1993b). (*Editor's note: Such a recommendation for albendazole-containing drenches registered in Australia would be off-label, could result in violative residues and cannot be supported without supportive residue depletion data*).

Infection with gastrointestinal nematodes reduces the systemic bioavailability of albendazole sulphoxide in goats (Dubey et al., 2008). The bioavailability of the drug is also reduced in young goats (2 months old) compared to adult goats (Capece et al., 2009). Administering albendazole as a divided oral dose rather than as a single dose (i.e. 2.5 mg/kg twice at a 12 hour interval or 5 mg/kg once, or 3.75 mg/kg twice at a 12 hour interval or 7.5 mg/kg once) improves the systemic bioavailability of the sulphoxide metabolite in both goats and sheep, with greater improvement in goats and at the lower dose rate (Goats: divided 5 mg/kg dose rate eightfold increase compared to single dose. Sheep: divided 5 mg/kg dose rate sixfold increase compared to single dose (Sanyal, 1998a).

Following treatment with a single oral dose of albendazole at 10 mg per kg bodyweight (the dose rate approved for control of liver fluke in the USA), liver concentrations of the albendazole 2-aminsulphone, the albendazole marker residue, were as follows:

- Day 5 138.50±24.93 ppb
- Day 10 78.70±16.53 ppb
- Day 15 50.69±15.82 ppb
- Day 20 29.43±2.17 ppb
- Day 25 26.43±8.17 ppb[15].

[15] FD Freedom of Information Summary NADA 110-048; http://www.fda.gov/downloads/AnimalVeterinary/Products/ApprovedAnimalDrugProducts/FOIADrugSummaries/UCM283352.pdf accessed 12 February 2013

Dosages of albendazole used in efficacy studies in goats and cited in the literature vary widely and are summarised in Table 5 below. At dose rates of 5.0, 7.5, 10.0 or 15 mg per kg bodyweight albendazole is 73.3%, 88.2%, 88.3% and 95.9% effective against adult stages of *Fasciola hepatica* in goats, based on the number of flukes at necropsy 3 weeks after treatment (Foreyt, 1988). At a dose rate of 20.0 mg per kg, albendazole is 97.7% effective against adult *Fasciola gigantica* in in goats based on the number for flukes at necropsy at 2 weeks after treatment (Koko et al., 2000).

Against gastrointestinal nematodes, the manufacturer's recommended dose rate of 3.8 mg per kg bodyweight was 100% effective against *Trichostrongylus colubriformis* and *Oesophagostomum columbianum* in Brazilian goats with naturally acquired and experimental worm infections, but only 87.9% effective against *Haemonchus contortus* and 6.7% effective against *Strongyloides* spp. (Charles et al., 1989). The manufacturer's recommended dose rate of 3.8 mg/kg was also found to be 100% effective against *Haemonchus* and *Trichostrongylus* in Malaysian goats with reduced efficacy against *Oesophagostomum* (89%) and an inconclusive result obtained for *Strongyloides* (Shanta et al., 1980)

The efficacy of two 3.8 mg per kg doses of albendazole administered at a 24 hour interval was >99% against naturally acquired infections of *Ostertagia* spp. and *Trichostrongylus* spp. and 96% effective against *Oesophagostomum venulosum* in New Zealand goats (Pomroy et al., 1988). In the same study, albendazole administered at a dose rate of 7.6 mg per kg bodyweight as a single treatment was >99% effective against all three parasites.

At dose rates of 3.8, 5.7 or 7.6 mg per kg bodyweight administered as single treatments to Nigerian goats, albendazole was 42.5%, 54.4% or 72.8% effective, respectively, against *Haemonchus contortus* and 100% effective at all dose rates against *Oesophagostomum columbianum* (Eguale et al., 2009).

At a dose rate of 10 mg/kg administered as a single treatment albendazole was 100% effective against *Haemonchus contortus, Trichostrongylus colubriformis, Bunostomum trigonocephalum, Oesophagostomum columbianum, Oesophagostomum asperum* and *Strongyloides papillosus* in Indian goats, based on either faecal egg count or total worm count (Sathianesan and Sundaram, 1982). Also in India, a total dose of 8.0 mg albendazole per kg bodyweight split over two treatments administered at a 12 hour interval was 100% effective in goats based on faecal egg count (Sanyal, 1998b).

In French dairy goats experimentally infected with benzimidazole-susceptible strains of *Haemonchus contortus* and *Trichostrongylus colubriformis*, a slow-release capsule that delivered 36.7 mg albendazole per day for 105 days (for goats ≤70 kg this would deliver a dose rate of at least 0.5 mg per kg bodyweight per day) was 99.9% effective against *Haemonchus contortus* and 92.2% effective against *Trichostrongylus colubriformis* present at the time of capsule administration (Chartier et al., 1996). It also prevented infection against the same strains for 85-91 post-treatment. Albendazole capsules are registered for use in sheep in Australia (Extender 100 100 Day Controlled Release Capsules for 40-80 kg Sheep; APVMA Product Number 49713), but are not registered for use in goats.

Table 5. Summary of published efficacy studies with albendazole in goats

Species	Dose rate (mg/kg)	Efficacy (%)	Reference
Fasciola hepatica	5; 7.5; 10; 15	73.3; 88.2; 88.3; 95.9	(Foreyt, 1988)
Trichostrongylus colubriformis, Oesophagostomum columbianum	3.8	100	(Charles et al., 1989)
Haemonchus contortus	3.8	87.9	(Charles et al., 1989)
Strongyloides	3.8	6.7	(Charles et al., 1989)
Haemonchus, Trichostrongylus	3.8	100	(Shanta et al., 1980)
Oesophagostomum	3.8	89	(Shanta et al., 1980)
Ostertagia, Trichostrongylus	2 x 3.8 (24h)	>99	(Pomroy et al., 1988)
Oesophagostomum venulosum	2 x 3.8 (24h)	96	(Pomroy et al., 1988)
Ostertagia, Trichostrongylus, Oesophagostomum venulosum	7.6	>99	(Pomroy et al., 1988)
Haemonchus contortus	3.8; 5.7; 7.6	42.5; 54.4; 72.8	(Eguale et al., 2009)
Oesophagostomum columbianum	3.8; 5.7; 7.6	100	Eguale et al., 2009)
Haemonchus contortus, Trichostrongylus colubriformis, Bunostomum trigonocephalum, Oesophagostomum columbianum, Oesophagostomum asperum, Strongyloides papillosus	10	100	(Sathianesan and Sundaram, 1982)
Not provided	8 (1/2, 12h)	100	(Sanyal, 1998b)

Deltamethrin

No references were found that describe the pharmacokinetics, metabolism or residue depletion of deltamethrin after cutaneous application to goats.

One paper was found that described the pharmacokinetics and residue depletion of deltamethrin after single intravenous (0.2 mg deltamethrin per kg bodyweight) or oral (15 mg per kg bodyweight) administration (Juliet et al., 2001). After administration of the intravenous dose the goats developed signs of toxicity that persisted for 2 hours. Deltamethrin was detectable in the systemic circulation 0.5-6 hours after treatment and was retained in liver, fat and bone for at least one hour after treatment (the last sample time point). Following oral treatment blood levels of deltamethrin were highly variable, but below the level of detection in all goats by 72 hours post-treatment. Recovery of deltamethrin from tissues 3 or 5 days after oral treatment ranged from 0.02-3.60% or 0.2-0.3%, respectively.

Two papers were found that described the efficacy of a 1% (10 g/L) deltamethrin pour-on in goats, one that described efficacy against the tick *Ixodes rubicundus* (Kok et al., 1996) and one that described efficacy against lice (*Damalinia limbata*) (Brown et al., 2005). In the first study, the efficacy of 1% deltamethrin pour-on against *Ixodes rubicundus*, applied at a dose rate of 1 mL/5 kg bodyweight to Angora goats in four equal parts to the axillae and groin, was 95.3% at 7 days post-treatment, 88.6% at 14 days post-treatment and 54.8% at 21 days

post-treatment. The product was much more effective in Dorper and Merino sheep (efficacy 97.9% and 100% at 21 days post-treatment, respectively) than in goats and the researchers attributed the differences to the amount of sebum and suint in the epidermis of the different goats and sheep. In the second study, 20 mL of the 1% deltamethrin pour-on, applied to between-shears louse-infested Mohair goats along the dorsal midline from the neck to the tail, achieved 98.3% efficacy at 28 days post-treatment and 100% efficacy at 56 days post-treatment.

Fenbendazole/oxfendazole

Fenbendazole and its sulphoxide metabolite oxfendazole are considered metabolically interchangeable (McKellar and Scott, 1990) and for the purposed of this review will be considered together. Oxfendazole undergoes further metabolism to its sulphone derivative, a process which is irreversible (McKellar and Scott, 1990).

Fenbendazole/oxfendazole are a broad-spectrum sulphide benzimidazole anthelmintic with activity against gastrointestinal nematodes, lungworms and tapeworms (McKellar and Scott, 1990). Similar to albendazole, the sulphoxide metabolite (oxfendazole) is considered to be the most active form of the drug (McKellar and Scott, 1990).

The metabolism of fenbendazole has been studied in hepatic fractions from bovine, caprine and ovine livers (Short et al., 1988b). Compared to bovine and ovine hepatic fractions, the caprine hepatic fractions produced similar levels of the sulphoxide metabolite oxfendazole, but significantly more fenbendazole sulphone and *p*-hydroxyfenbendazole, the major excretory metabolite in goats (Short et al., 1987). In contrast, ovine hepatic fractions did not produce any *p*-hydroxyfenbendazole.

The metabolism of fenbendazole has also been studied in goats compared to cattle (Short et al., 1988a). Goats and cattle were treated both orally and intravenously with a dose of 5 mg fenbendazole per kg bodyweight and sample of faeces, urine and plasma collected for analysis. In both species, the sulphoxide metabolite (oxfendazole) is the major metabolite in plasma and the sulphone metabolite appears later and takes longer to be cleared. Following oral administration, the peak concentration of the sulphone metabolite in goats is double that of cattle. In goats, but not cattle, two additional metabolites were also detected following both oral and intravenous administration, fenbendazole-amine and *p*-hydroxyfenbendazole. Elimination of the drug was largely via the faeces, regardless of the route of administration, with very little of the drug or its metabolites found in the urine of either species.

In goats approximately 70% of a radiolabelled [^{14}C] dose of oxfendazole is excreted in the faeces and approximately 20% in the urine, which is comparable to the elimination of the drug in sheep (sheep: faeces approximately 80%; urine approximately 20%) (Hennessy et al., 1993a).

The pharmacokinetics of fenbendazole/oxfendazole in goats has been studied by several research groups.

Researchers in the United Kingdom and France observed a dose-related increase in the area under the curve of oxfendazole and fenbendazole sulphone in goats following oral administration of the drug [Area under the curve: 5 mg oxfendazole per kg bodyweight 10.5 µg/mL h; 10 mg/kg 19.9 µg/mL h; 20 mg/kg 43.4 µg/mL h; n=5 for each dose rate (Bogan et al., 1987)]. Increasing bioavailability with increasing dose rate was also observed by

researchers in Australia following either intra-ruminal or intra-abomasal treatment [Area under the curve: intra-ruminal 5 mg oxfendazole per kg bodyweight 12.7 µg/mL h, 10 mg/kg 26.7 µg/mL h. Intra-abomasal 10 mg/kg 18.3 µg/mL h; 20 mg/kg 35.8 µg/mL h; n=4 for each dose rate and method of administration (Sangster et al., 1991)].

There also appears to be a dose-related increase in bioavailability of fenbendazole/ oxfendazole in goats, for example three daily oral doses of oxfendazole at a dose rate of 1.7 mg per kg bodyweight resulted in an area under the curve of 19.0 µg/mL h compared to an area under the curve of 47.8 µg/mL h following three daily doses of 5.0 mg/kg bodyweight (Bogan et al., 1987).

Pre-treating goats with cytochrome P45 inhibitor piperonyl butoxide increases the bioavailability of fenbendazole/oxfendazole in goats, most likely by blocking the metabolism of the drug into inactive metabolites (Benchaoui and McKellar, 1996)

The pharmacokinetics of oxfendazole in sheep and goats treated intravenously with 7.5 mg oxfendazole per kg bodyweight are similar, but a 10 mg/kg dose administered orally to both species results in approximately 40-60% lower bioavailability in goats than sheep (Bogan et al., 1987).

The time to maximum plasma concentration following an oral dose of 5 mg/kg bodyweight occurs approximately 24 hours sooner in goats than cattle, goats eliminate fenbendazole faster than cattle and the volume of distribution is smaller (Davis et al., 1988; Short et al., 1988a).

Parasitism with the *Ostertagia ostertagi* or *Haemonchus contortus* and *Trichostrongylus colubriformis*, reduces the systemic bioavailability of oxfendazole in both goats (Area under the curve approximately 75% that of non-parasitised goats) and sheep (Area under the curve approximately 70% that of non-parasitised sheep) (Bogan et al., 1987; Hennessy et al., 1993a), whereas abomasal concentrations remained unchanged and were similar in both sheep and goats (Hennessy et al., 1993a). Similar levels of efficacy against benzimidazole-resistant *Haemonchus contortus* have been observed in goats and sheep given the same dose rate of oxfendazole (20 mg per kg bodyweight) (Sangster et al., 1991), which suggests that abomasal concentrations of the drug are more important for efficacy against this parasite than plasma concentrations, even though it is a blood-feeder (Hennessy et al., 1993a).

Slightly higher, although statistically significant, levels of efficacy against benzimidazole-resistant *Trichostrongylus colubriformis* were observed in sheep compared to goats when given the same oral dose rate of oxfendazole (20 mg per kg bodyweight; sheep per cent reduction 98.7%; goats per cent reduction 94.5%). Although not significant, the mean proportion of the [^{14}C] dose of oxfendazole leaving the abomasum of goats was approximately half that of sheep, which may affect efficacy against an intestinal parasite such as *Trichostrongylus colubriformis*, although plasma bioavailability cannot be ruled out as important for efficacy (Hennessy et al., 1993a).

Based on the results of the comparative pharmacokinetic studies of oxfendazole in goats and sheep, some researchers have suggested a higher dose rate of oxfendazole/fenbendazole is required for efficacy in goats compared to sheep (McKellar and Scott, 1990; Sangster et al., 1991). However, in New Zealand, when feral goats were

artificially infected with known benzimidazole-susceptible strains of *Haemonchus contortus*, *Ostertagia circumcincta* and *Trichostrongylus* spp,. the manufacturer's recommended dose rate of 5 mg/kg was found to be highly effective (>98.5%) against all three nematodes based on total worm counts (Elliott, 1987).

Also in New Zealand, similar levels of efficacy in goats and sheep were observed when the animals were artificially infected with the same strains of *Haemonchus contortus*, *Ostertagia* spp., *Cooperia curticeri* and *Trichostrongylus colubriformis* and then treated once with the manufacturers recommended dose rate of oxfendazole (Per cent reductions based on geometric mean total worm count compared to untreated control *Haemonchus contortus*: goats 93.0%, sheep 93.2%; *Ostertagia* spp. goats 99.9% sheep 99.6%; *Cooperia curticeri* goats >99.9%, sheep >99.9%; *Trichostrongylus colubriformis* goats >99.9%, sheep >99.9%) (McKenna and Watson, 1987).

In South Africa, the manufacturer's recommended dose rate of fenbendazole (5 mg/kg bodyweight) was found to be 89.1% effective in goats experimentally infected with *Strongyloides papillosus* (Grimbeek and Terblanche, 1980).

In a French dairy goat herd without known benzimidazole resistance, selective treatment of only the goats in first lactation or high producers, or treatment of all goats, produced similar results as determined by worm egg excretion, pathophysiological parameters (pepsinogen and phosphate concentrations) and milk production (Hoste et al., 2002).

Against known benzimidazole-resistant strains of gastrointestinal nematodes, increasing the dose rate (Garg et al., 2004), withdrawing feed for 24 hours pre-treatment (Barrett et al., 1998) or giving divided doses at 12 or 24 hours intervals (Sangster et al., 1991) increases the efficacy of fenbendazole and oxfendazole in goats, although increasing the dose rate is not always effective (Godara et al., 2011; Uhlinger et al., 1988). Increasing the dose rate (25 -30 mg/kg) is also ineffective against the large lungworm *Muellerius capillaris* (Bliss and Greiner, 1985; Helle, 1986).

Triclabendazole

Triclabendazole is a sulphide benzimidazole anthelmintic with high activity against the liver fluke *Fasciola hepatica*, but with only limited activity against parasitic nematodes (McKellar and Scott, 1990). Similar to the other sulphide benzimidazole anthelmintics, triclabendazole is rapidly metabolised to its sulphoxide and sulphone metabolites after oral administration to goats (Kinabo and Bogan, 1988) and other animals species including rats, rabbits, dogs, sheep, cattle and humans[16]. In goats, triclabendazole is not detected in plasma at any time post-treatment (Kinabo and Bogan, 1988).

Most of an oral dose of triclabendazole administered to goats, sheep, rats and rabbits is eliminated in the faeces within 6-10 days, with about half as unabsorbed drug and half as a result of biliary excretion[17]. At 10 days after treatment, tissue residues in goats and sheep were generally less than 1-2% of an oral dose, with the highest tissue levels found in liver

16 http://www.ema.europa.eu/ema/index.jsp?curl=pages/includes/document/document_detail.jsp?webContentId=WC500015670&mid=WC0b01ac058009a3dc accessed February 2013

17 http://www.ema.europa.eu/ema/index.jsp?curl=pages/includes/document/document_detail.jsp?webContentId=WC500015666&mid=WC0b01ac058009a3dc accessed February 2013

and thyroid[18]. In both goats and sheep triclabendazole and its 4-hydroxy-derivatives are the major components found in faeces[19].

The pharmacokinetics of triclabendazole in goats was determined in goats following a single oral dose of 12 mg triclabendazole per kg bodyweight as a 5% w/v suspension administered to clinically healthy, non-parasitised goats (n=6) (Kinabo and Bogan 254-59. The time to maximum plasma concentration of the sulphoxide and sulphone metabolites was similar to that of rats, rabbits, dogs, sheep, cattle and humans (Goats: triclabendazole sulphoxide 17.60±2.99 hours [mean ± standard deviation]; triclabendazole sulphone 34.80±5.49 hours. Other species except cattle: triclabendazole sulphoxide 6-12 hours; triclabendazole sulphone 12-30 hours. Cattle: triclabendazole sulphoxide 22 hours; triclabendazole sulphone 72 hours[20].) The sulphoxide metabolite was not detected in milk after 3 days post-treatment and the sulphone metabolite after 6 days.

Based on the similar metabolism of triclabendazole in laboratory animals and food-producing ruminants (cattle, sheep and goats) the European Medicines Agency has established triclabendazole tissue and milk MRLs for ruminants as a group[21].

Infection with *Fasciola hepatica* does not change the plasma pharmacokinetic profile of triclabendazole, suggesting that dose adjustment is not needed in cased of fasciolosis (Kinabo and Bogan, 1988).

Fasting goats for 24 hours prior to treatment and for 6 hours after treatment significantly increases the plasma bioavailability of triclabendazole sulphoxide and sulphone (Area under the curve: 1.7 fold increase) (Gokbulut et al., 2010). The nature of the diet also affects the bioavailability of triclabendazole sulphoxide, with area under the curve in housed goats fed hay plus concentrates 1.5 times that of grazing goats (Gokbulut et al., 2006; Gokbulut et al., 2007).

A validated method to detect triclabendazole and its metabolites, including the marker residue ketotriclabendazole, in goat tissues is available (Cai et al., 2010).

A dose rate of 5 mg triclabendazole per kg bodyweight is 100% effective against naturally acquired adult infections of *Fasciola hepatica* in goats (n=10) (Wolff et al., 1983). At the label dose rate (10 mg triclabendazole per kg bodyweight) triclabendazole is highly effective against adult (100%) and late immature (8 weeks post-infection; 99.2%) *Fasciola hepatica* and effective against early immature flukes (4 weeks post-infection; 94.9%) in goats (Martínez-Moreno et al., 1997), similar to the efficacy reported in sheep (Fairweather and Boray, 1999) and cattle (Richards et al., 1990; Shi et al., 1983).

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18 http://www.ema.europa.eu/ema/index.jsp?curl=pages/includes/document/document_detail.jsp?webContentId=WC500015666&mid=WC0b01ac058009a3dc accessed February 2013

19 http://www.ema.europa.eu/ema/index.jsp?curl=pages/includes/document/document_detail.jsp?webContentId=WC500015670&mid=WC0b01ac058009a3dc accessed February 2013

20 http://www.ema.europa.eu/ema/index.jsp?curl=pages/includes/document/document_detail.jsp?webContentId=WC500015670&mid=WC0b01ac058009a3dc accessed February 2013

21 http://www.ema.europa.eu/ema/index.jsp?curl=pages/includes/document/document_detail.jsp?webContentId=WC500124511&mid=WC0b01ac058009a3dc accessed February 2013

Discussion and conclusions

The objective of the project was to investigate WHPs, ESIs and dose rates for all parasiticides registered for use on goats in Australia and the extent to which these are supported by data.

This objective has been met.

Of the thirty eight parasiticide products registered for use in goats, all have a WHP established for goats. WHPs are mandatory and must be included on the label of every registered product; therefore, all products registered for use in goats have a WHP established for goats.

The 38 parasiticide products registered for use in goats in Australia represents only 13 active ingredients and one synergist. Australian MRLs have been established for all of these chemicals/drugs in goats and are published in the MRL standard on the APVMA website.

Only one new parasiticide active (abamectin) has been registered for use in goats since the APVMA was given responsibility for establishing ESIs approximately 10 years ago. An ESI has been established for this product, based on a residues trial that demonstrated that abamectin residues declined to the level of quantification by 28 days after treatment. This is the only registered parasiticide product that has an ESI established for goats.

To enable ESIs to be established for the other registered parasiticide products it is likely that similar studies will be required. This is because at least one important export market does not have a MRL established for the drugs/chemicals in these products. When important export markets have not established an MRL for a veterinary drug/chemical, the APVMA requires data showing tissue residue depletion to the level of quantification and does not accept extrapolation beyond sampling points when establishing an ESI. Generating this information will be a costly undertaking and is unlikely to be a priority for the various product registrants because the actives are older compounds with generic competition and are also registered for use in cattle and/or sheep, with use in these species likely to be the major product uses.

Review of the published veterinary literature revealed that for most of the actives for which published information was available, the label dose rate for goats was the same as that demonstrated as being effective in published efficacy studies. The exception was albendazole, for which it would appear the label dose rate may be lower than the ideal in terms of efficacy, particularly for the liver fluke *Fasciola hepatica.*

Recommendations

1. DAFF, through the National Residue Survey, maintains on its website bulletins/tables of international maximum residue limits for cattle, sheep and pigs. The purpose of these bulletins is to inform producers, processors and marketers of the export requirements with regard to chemical residues. It is recommended that MLA and the Goat Industry Council of Australia ask the National Residue Survey to expand the list of these bulletins to include goats.
2. The APVMA maintains lists of WHPs and ESIs for cattle and sheep on its website. It is recommended that MLA and the Goat Industry Council of Australia ask the APVMA to publish a similar list of WHPs and ESIs for goats, to include all the products currently registered for use in goats, not just parasiticide products.
3. The majority of the parasiticide products registered for use in goats in Australia do not currently have an ESI established. Although beyond the scope of this project, it is likely that many of the other non-parasiticide products registered for use in goats in Australia also do not have ESIs established. Establishing ESIs for all these products is likely to be an expensive undertaking. It is recommended that MLA survey the owners/managers of depots that accumulate goats for export and slaughter to determine the animal health products commonly used in these facilities, thereby allowing a list of priority products for ESI determination to be established.
4. During this project, it was very difficult to find information on parasite control in goats consolidated in one convenient location. It is recommended that MLA consider establishing a website of information on parasite control in goats, using the Wormboss, Flyboss and Liceboss websites as examples.

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