

Going into Goats

Module 9

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Parasite control



What to do?

Controlling parasites is about managing and reducing the risk of infestation and is an essential consideration for many goat enterprises, particularly those operating in more high risk regions with more intensive operations. Factors to consider in managing internal parasites include:

- responsible and sustainable chemical use
- faecal worm egg counting (WEC)
- grazing management
- visual assessment of animals
- animal selection.

How to do it?

This module describes various goat parasites and presents options for producers to minimise the production risks associated with internal and external parasites.

Guidelines for controlling internal parasites of goats

Worms, or parasitic nematodes of the gastrointestinal tract (GIT or the ‘gut’), are a major constraint to efficient, intensive goat production in pasture-based systems worldwide.

The widespread reliance on **anthelmintics** (worm treatments or ‘**drenches**’) in livestock enterprises has led to significant resistance among worm populations. As resistance increases, so too does the potential impact on animal health and production as a greater proportion of worms survive treatments.

The sustainable control of worms involves careful anthelmintic use as part of an integrated plan that should include a range of both chemical and non-chemical strategies. Diligence in monitoring worm burdens, testing drenches for efficacy and incorporating browse and nutritional supplementation in the diet are useful tools that can support effective and sustainable worm control.

Less reliance on chemical use is important in preserving those active ingredients in current drenches that continue to provide good worm control. Sustainable control is as much about the management of drench resistance as it is about managing the worms themselves. If drenches are not used wisely, there is a risk that the products that are currently effective may not be in a few years time.

Key nematodes (‘worms’)

The major gastrointestinal (GI) nematode parasites (worms) of concern in Australian goats are the barber’s pole worm (*Haemonchus contortus*), the brown stomach worm (*Teladorsagia* [previously known as *Ostertagia*] *circumcincta*) and the black scour worm (*Trichostrongylus* spp.). Adult barber’s pole and brown stomach worms both inhabit the abomasum (fourth stomach), whereas adult black scour worms are found in the small intestine.

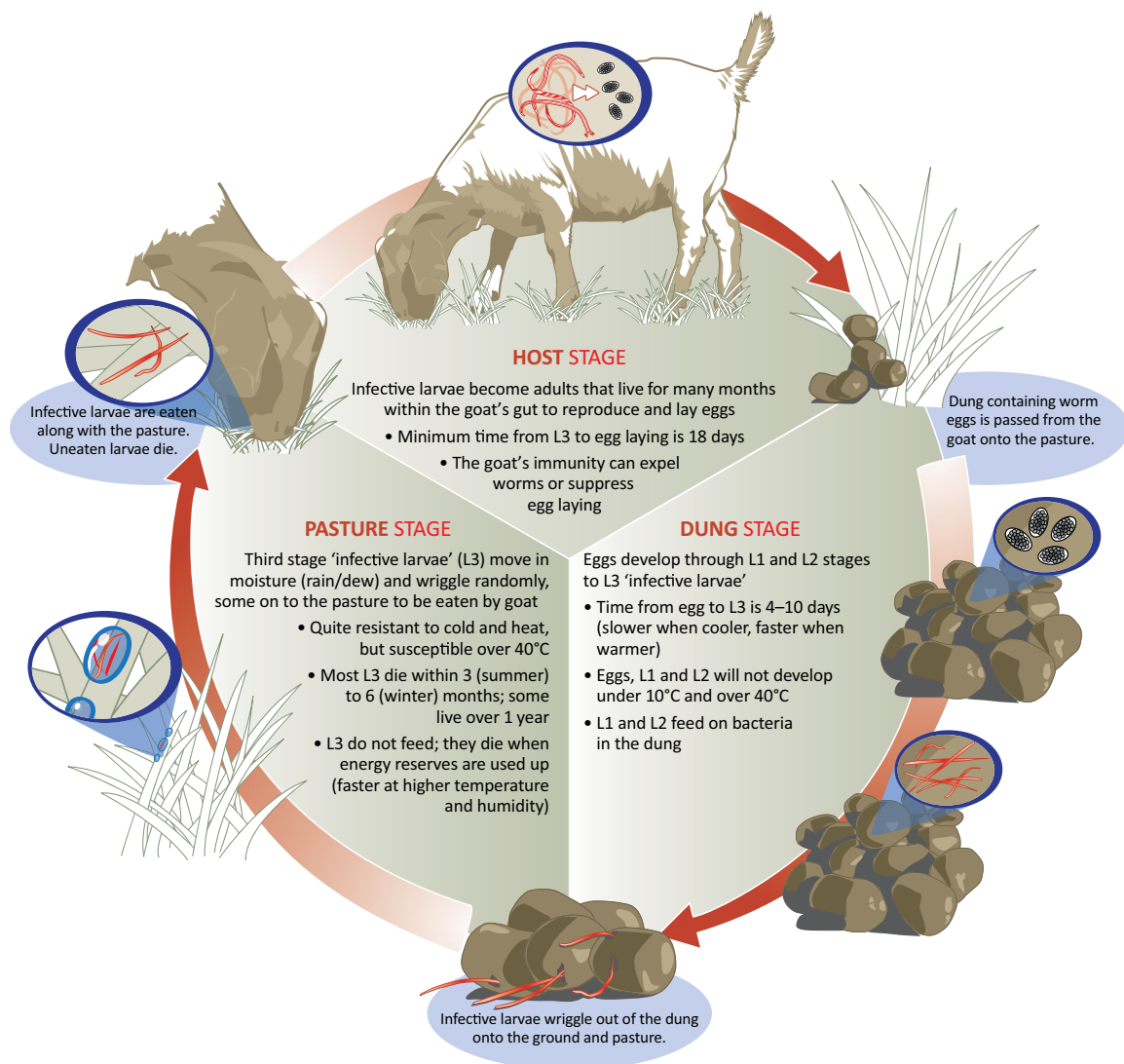
Other worms that can be found in goats include large intestinal worms, such as the nodule worm (*Oesophagostomum columbianum*), the small bowel worm (*Oesophagostomum venulosum*) and the large-mouthed bowel worm (*Chabertia ovina*). Threadworms (*Strongyloides papillosus*) and the thin-necked intestinal worm (*Nematodirus spp.*) can also be found in the small intestine, but are rarely a problem in Australia.

The small lungworm (*Muellerius capillaris*) can be common in higher rainfall areas and the lungworm (*Dictyocaulus filaria*) is occasionally found in goats pastured in cooler climates.

All of these parasites can also infect sheep. Therefore the transfer of worms between goats and sheep and vice versa should always be considered and mitigating actions put in place.

The worm lifecycle

An understanding of the general lifecycle of the significant gastrointestinal worms of goats can greatly assist in the development of an effective and sustainable worm control program. This lifecycle is illustrated in Figure 1.



The worm lifecycle. Source: paraboss.com.au

Adult worms, inside the gastrointestinal tract of the goat mate and the female worms produce eggs that are passed out in the faeces.

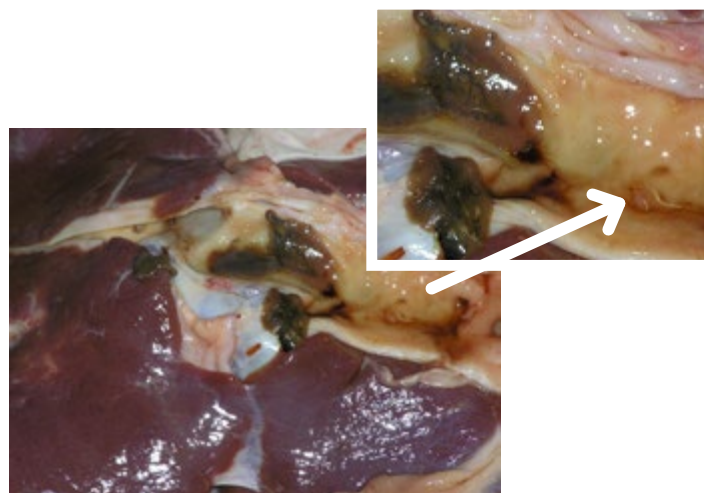
Barber's pole worms produce a very large numbers of eggs, with each female worm laying up to 10,000 eggs per day.

Most of the other significant gastrointestinal worms typically lay only 100–200 eggs per day. Given sufficient moisture and suitable temperatures, the eggs hatch on the pasture and a first-stage larvae, or L1, emerges. The L1 and subsequent L2 (second-stage larvae after growth and moulting of the L1) feed off bacteria and other micro-organisms in the goat faeces. If conditions remain favourable, the L2 develops into an L3, or third-stage larvae, capable of infecting other goats.

The L3 retain the outer cuticle of the L2 to provide them with more protection against the environment, but this also means they cannot feed and will perish if they exhaust their energy reserves before being eaten by a goat. This is the reason why 'spelling' pasture (the removal of suitable hosts for the parasite) can reduce the worm larvae population and hence the risk for subsequent grazing livestock. The time taken for L3 to perish will vary depending on moisture and temperatures. In hot, dry conditions, many of the L3 on pasture can perish within a month or two. During milder conditions in winter or spring, L3 might survive many months in the environment.

The nature of the worm lifecycle means there can be two sub-populations of worms on a farm at any one time. One sub-population lives in the goat as, developing immature, and then mature adult worms and the other sub-population lives in the environment as eggs, larvae and free-living infective larvae. During hot, dry conditions, the numbers of free-living stages on pasture may be very low with most of the parasite population being in the host. The reverse is true of wet summers, especially for barber's pole worm, with most of the parasite population as larvae on pasture. During wetter, warmer times of the year, the vast majority of the worm population will be found on the pasture rather than in the livestock.

Distribution of key worms



Liver fluke infestation, right image showing close up

Source: Berwyn Squire, Goat Health Veterinary Officer, DEDJTR Agriculture Victoria

Barber's pole worm is most significant in summer rainfall zones, where nodule worm can also be important.

In predominantly winter rainfall or non-seasonal rainfall areas, including regions with a Mediterranean climate, the scour worms are generally the most important species. Barber's pole worm infection can also be significant in these areas in years characterised by wetter summers.

Worms are a less common problem in pastoral areas due to the combination of low rainfall, the availability of browse fodder and generally lower stocking rates.

Detecting infections

The clinical signs during worm infections are due to the effects of the worms on the goat host.

Barber's pole worms suck blood and heavy infestations can quickly lead to anaemia (visible as pale mucous membranes, such as the gums and inner eyelids), submandibular oedema (also known as bottle jaw; an accumulation of fluid under the skin beneath the animal's jaw) and sudden deaths. Importantly, barber's pole worm infection does not generally lead to the typically expected 'worm signs' of weight loss and scouring.

In smaller herds in prone areas, individual animals can be examined for anaemia by weekly checking of the lower inner eyelids during warm and moist weather conditions. The international FAMACHA© system allows users to be trained to regularly assess the anaemia scores of their stock. Affected individual animals can be identified and treated, and possibly removed from the herd if shown to be prone to worm problems. For more information on the FAMACHA© system, visit mla.com.au/famacha

Liver fluke (*Fasciola hepatica*) and the bacterium *Mycoplasma ovis* can also cause anaemia, so their presence needs to be considered in areas where these may be found. Liver fluke can be an important internal parasite of goats in some parts of Australia. More information about liver fluke and its treatment and control can be found at wormboss.com.au

Black scour worms and brown stomach worms affect the structure and function of the goat's gut. Signs of infection include inappetence, weight loss, illthrift and scouring. Nodule worms can also lead to goats exhibiting a hunched back with scours which may contain mucus.

It is important to remember that by the time signs of disease caused by worms are obvious, it is likely that production losses will have already occurred. High worm egg output from infected animals can also lead to the contamination of pastures with significant numbers of infective larvae which pose a risk for subsequent grazing. It is always better to predict and avoid worm problems, rather than try to fix them after they have caused obvious signs.

**By the time signs of worms become obvious in goats,
productivity losses will have already occurred.**

Faecal worm egg counting

Faecal worm egg counting (WEC) provides a method to monitor worm burdens in live goats. Several laboratories around Australia offer a WEC service including advice on results (see wormboss.com.au for an up-to-date listing). It is also possible to purchase your own equipment and become trained to do WEC on-farm. This test can help to identify and predict worm problems and also helps in decision making regarding the need to drench. Avoiding unnecessary drenching saves money and time and can help minimise the development of worm resistance to drenches.

The WEC gives a guide to the size of the adult worm burden inside the sampled animal. It does not measure the number of larvae or immature worms present, the species of worms or any drench resistance that may exist. To identify the worm species present, eggs from the faeces need to be incubated by the WEC laboratory and the hatching larvae identified. This process is called a **larval culture and differentiation** and generally takes between 7-10 days.

A larval culture and differentiation is particularly important in regions where significant levels of barber's pole worm are found. This test can help confirm if barber's pole worm is present on a property and therefore help determine which strategic monitoring and control measures are appropriate. Barber's pole worm levels can increase very rapidly during periods of warm temperatures and rainfall, especially if followed by a few overcast days. Rapid hatching of worm eggs in faeces and increased survival of infective larvae on pasture can lead to deaths within weeks in susceptible goats, so it is important to know if this worm is present on-farm.

In some parts of Australia, WEC on weaners and pregnant and lactating does are recommended 3-6 weeks after rain to assess worm activity. The WEC can then be repeated at 2-6 weekly intervals, depending on location and weather conditions, to help to monitor the risk until the season becomes dry again.

Drench resistance testing

A **faecal worm egg count reduction test (FECRT)** is the most efficient way to determine drench effectiveness in killing worms on an individual property. There are many goat and sheep worms in Australia that can survive some or most of the currently available worm treatments. Therefore, drench effectiveness information for an individual property is extremely important in planning effective worm treatments and an overall sustainable worm control program. Drenches used should be checked regularly to ensure ongoing effectiveness.

The FECRT is an on-property trial involving 15 goats per treatment group and an undrenched control group. It is possible to evaluate several treatments during one test by having more than one treatment group. The WEC in treated goats is compared to the WEC of goats in the untreated control group between 10 and 14 days after treatment. The comparative reduction in WEC caused by the respective treatments provides a guide to their current effectiveness. More details about FECRT can be found at wormboss.com.au. Your local veterinarian or state government veterinary laboratory should be able to assist with FECRT design and procedures.

Another, simpler alternative is a DrenchCheck - Day10 (see wormboss.com.au). A group of goats, identified as 'wormy' by a pre-treatment WEC, are treated individually with the product of choice and then the WEC of at least 10 to 15 goats are re-checked between 10 and 14 days after treatment. This approach only evaluates the effectiveness of the single product used.

Controlling worms

A key step in being able to control worms in goats is understanding the worm lifecycle.

It is important to consider the level of environmental (or free-living) stages of the lifecycle when planning treatments and thinking about the risk from worms. Worm eggs contaminating the pasture can hatch and worm larvae can develop and infect livestock.

◆ Preventing new infections

Reducing the incidence of new infection can be accomplished by reducing the intake of infective larvae from the pasture and strengthening the host's ability to prevent establishment of these ingested larvae.

Goats are browsing animals and should have at least 30–50% of their food supplied as browse for optimal nutrition. This can also assist in reducing the intake of infective worm larvae, thereby assisting with worm control. The majority of worm larvae are found within 10cm from ground level due to the moisture levels and temperature. Therefore, goats that are grazing lower than 10cm from the ground are exposed to more worm larvae.



Larvae climbing the walls of a jar having hatched in droppings.
This demonstrates how larvae can climb pasture. Source: paraboss.com.au

Browse does not necessarily mean trees. Browse plants, such as lucerne and other leguminous crops can play an important role in reducing worm larval contamination in pasture-based systems.



Browse is provided here as saltbush.

Grazing cattle alongside goats can contribute strongly to better worm control by reducing pasture contamination with worm eggs and larvae. Goats share many of the same worms with sheep but liver fluke is the only internal parasite of major significance that is commonly shared by cattle and goats. Most goat or sheep worm larvae eaten by cattle will be destroyed rather than being allowed to establish inside the animal and develop into adult worms. Therefore, worm contamination risks for goats can be decreased by having cattle graze common pastures in rotation. Grazing cattle can also lead to improvements in pasture quality by removing long, rank feed.

◆ Immunity and worms

Malnourished or stressed goats are particularly susceptible to worm infection as their immune system may be compromised. Nutritional supplementation for livestock in poor condition can assist overall worm control. Extra protein, energy and minerals may also be required during critical times to help boost immunity. Breeding does are more susceptible to worms between approximately two weeks before and up to eight weeks after kidding, as their immunity is lowered due to the physiological processes they experience during this time. Young growing goats can also have additional nutritional requirements.

Good goat nutrition and body condition help support an effective immune system and thereby assist with worm control.

Variation in natural immunity to worms between different goats can lead to a range in the severity of signs and affects among goats. Some goats will remain unaffected, while others may appear to be severely affected. Identifying and breeding from those goats with lower WEC ('resistant' to worms) or those able to cope better with worm burdens without productivity losses ('resilient' to worms), can help to increase the overall immunity of the herd to worms. Research has shown that resistance to worms is a heritable trait in goats. Consideration should be given to culling or separating from the herd goats that are more susceptible to worms.

Identifying and culling goats that are more susceptible to worms will increase the overall immunity of the herd.

If worm-related traits are incorporated into a breeding index and selection is carried out over a number of years, producers can increase the worm immunity of their herd. KIDPLAN currently includes an estimated breeding value (EBV) for individual WEC (for more information, seesheepgenetics.org.au click on KIDPLAN from the home page).

"At the end of the day it comes down to three critical elements; 1) classing on body condition and taking the tail out of the mob, 2) providing browse as much as is possible and maintaining pasture length and 3) supplying adequate nutrition to allow the goats immune system to fight internal parasites naturally."

David Booth, Cootamundra, NSW

◆ Treating worms

The need to treat existing worm burdens in goats is best determined by WEC and larval cultures. All worm treatments currently registered for goats in Australia will only remove the susceptible worms that are present in the goats at the time of treatment. If goats are not carrying a worm burden that is causing significant production loss or ill-health, it can be a waste of time and money to treat the goats for worms.

Every time an effective worm treatment is required to control worms, a goat owner should consider the four 'R's':

1. the use of **REGISTERED** drenches;
2. chemical **RESIDUES** following treatment;
3. worm **RESISTANCE** to drenches; and
4. the number of parasites in **REFUGIA** (i.e. in refuge).

There are several drenches currently registered for use in goats in Australia (visit or wormboss.com.au or apvma.gov.au for an up-to-date list). Only registered products should be used in goats. The chemical registration process includes the determination of appropriate Withholding Periods (WHP) and Export Slaughter Intervals (ESI) and these must be considered and respected by producers prior to use. Read labels on drench containers and keep accurate records.

The legal use of products not registered for goats requires an off-label recommendation from your veterinarian. A veterinarian should be consulted to recommend the most effective product and dose for goats to avoid serious complications regarding drench effectiveness, safety for goats and potential meat or milk residues.

If worms are not well controlled by registered drenches, your veterinary practitioner may be able to give a recommendation for an unregistered drench. Take care with withholding periods and export slaughter intervals. Keep accurate records.

◆ Worming and drench resistance

Every time a worm treatment is used, there is the potential to increase worm resistance to the active ingredient in the treatment.

If the chosen product is highly effective (i.e. removes close to 100% of the worms when used) only a very small number of parasites will survive; those being the few worms in a population that are naturally resistant to the chemical used. These surviving worms will usually not directly affect the livestock but resistant worms can breed together and produce 'resistant' eggs. These eggs are passed on to the pasture and can develop into drench resistant larvae which can eventually infect other goats. Increased numbers of drench resistant adult worms develop in this way, which then breed and the cycle continues. This distributes the genes for drench resistance through more and more worms in the overall population and, over time, the drench becomes less and less effective. This is the reason why resistance will eventually develop to every new worm treatment released to the market and therefore why every treatment should be considered carefully.

If the administered treatment is already less than highly effective, this increase in drench resistance can occur much more rapidly. A high frequency of treatments and/or underdosing of goats (thereby exposing worms to sub-optimal levels of the active ingredient) can also speed up selection for resistance. It is also important to understand that goats metabolise many drench ingredients differently to sheep, meaning dose rates for sheep cannot necessarily be applied to goats. Sheep dose rates may translate to underdosing in goats which will have the effect of increasing the rate at which resistance develops.

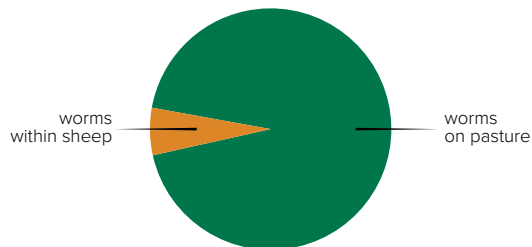
A drench becomes less effective every time it is used.

The rate of decline in the effectiveness of a drench can also be influenced by both the number of parasites and parasite stages on the pasture at the time goats are treated and those within an untreated goat. These stages that avoid exposure to the given treatment, are known as being in **refugia** (in refuge).

Those in refugia are not selected for resistance and become important in diluting resistant worms which survive treatment. That is, the resistant worms and their egg output are mixed with non-resistant worms that were in refugia at the time of treatment. This reduces the risk that resistant worms will breed with other resistant worms and so accelerate the development of resistance.

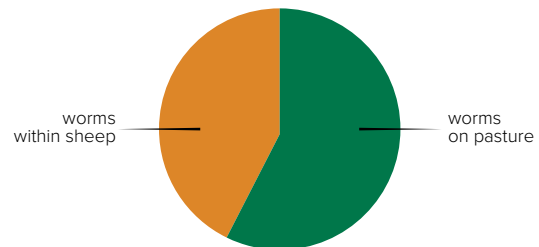
During winter and spring, conditions are favourable for the survival of worm eggs and larvae in the environment and therefore the bulk of the worm population on a farm is 'outside' the goats on the pasture. Therefore, any resistant egg output from adult worms that have survived treatment are mixed into a relatively large and diverse genetic pool of resistant and mainly susceptible individuals. This dilutes the drench resistant worm population.

Green pasture



Likely proportion of worms in sheep on green pasture
(e.g. in winter or spring)
Source: wormboss.com.au

Dry pasture



Likely proportion of worms in sheep on dry pasture
(e.g. in summer)

In hot, dry weather, the harsher, low refugia environmental conditions result in relatively fewer eggs and larvae surviving on the pasture. Any surviving resistant eggs passed by the host may have a relatively larger influence on the genetics of the overall worm population when environmental conditions again turn favourable for worm development. More rapid development of drench resistance can, therefore, take place.

Another example of a 'low refugia' environment is a paddock that has been unstocked for several months causing a large proportion of the eggs and larvae on the pasture to have died over time. This means the untreated parasite population is greatly depleted and thus more rapid drench resistance may develop under such circumstances as there may be a higher percentage of resistant parasites breeding together.

There is an obvious contradiction between maintaining worms in refugia to recontaminate animals and slow the development of worm resistance to drenches and controlling worms in animals; however, this can be managed with careful planning and particular attention to paddock rotation and the timing of treatments.

A more detailed explanation of refugia can be found at wormboss.com.au

◆ Quarantine drenching

Newly purchased goats, or those returning from agistment, can potentially bring resistant worms onto the property. A quarantine drench is important to exclude such resistant worms.

Since the type of resistance is most likely not known, it is wise to treat the goats with more than one active ingredient. Registered drenches should be used but not mixed together prior to dosing. If unregistered drenches are being considered, it is important to obtain veterinary advice regarding the appropriate dose, treatment efficacy, safety and risks of residues.

Goats can be held in a quarantine paddock until a worm egg count between 10-14 days later is negative and then can be moved onto a 'wormy' paddock containing browse. The resident

worm eggs and larvae, already on the farm, can then help to dilute any few remaining resistant eggs put out by the incoming goats.

Once that paddock is vacated, it should be grazed by adult cattle or cropped to ensure any imported resistant worms do not establish on your property.

◆ Managing drench resistance

Other strategies to help to counteract drench resistance include:

» Use feed withdrawal at drenching

Withdrawing feed 24 hours before and 12 hours after drenching can help to extend the useful activity of the benzimidazole and abamectin drenches, by leading to slight increases in effectiveness against some resistant strains of worms. This strategy can be discussed with your veterinarian. Ensure access to water at all times.

» Use grazing strategies to stabilise drench resistance

Goats should be treated with registered drenches and left on a low-worm long pasture or a browse paddock. As reinfection may occur very quickly, a move to the low-worm long pasture or browse paddock a few days prior to drenching is advocated. This will ensure the resistant population which will continue to shed eggs after drenching will be diluted with nonresistant worms. The time interval in the new paddock before treatment can be varied in relation to the estimated levels of infection carried by the animals at the time of the move. Again, this strategy is best discussed with your veterinarian.

» Follow with paddock rotations

Paddock rotation of goats, either at short intervals for barber's pole worm or at longer intervals for black scour worm, has been successful in supporting effective worm control on many properties.

In the tropic and subtropical zones, infective larvae of barber's pole worm are present on pasture about four days after egg deposition and fall to barely detectable levels within four to six weeks. A grazing system utilising 10 paddocks, each one grazed for 3.5 days and then spelled for 31.5 days, reduced worm egg count of goats to less than half those of similar goats set-stocked on an adjacent area. The rotation cycle was 35 days. For black scour worm, longer rotation intervals of up to 60 days are recommended to compensate for the longer survival times on paddock; however, these need to be tailored for the location.

If drenches are inefficient due to drench resistance or because the larval challenge from the pasture is high, stock rotations through browse paddocks become particularly important. It can also be important to avoid highly worm contaminated areas such as wetter areas in paddocks or areas where goats are locked up overnight.

◆ Hints for effective drenching

- Know the effectiveness of registered drenches on your property.
- Use drenches at the correct dose rate.

- Check the accuracy of the drenching gun regularly. Set the gun at the required dose rate (e.g. 5ml), make five squirts into a measuring cylinder and the level should be five times the dose rate.
- Dose to the heaviest animal in the group. If bodyweights vary widely within a single group then draft the goats into more uniform weight groups and dose to the heaviest in each group. Liveweight estimation 'weigh tapes' can help with more accurate dosing if scales are not available.
- Administer drugs effectively. Make sure that the dose is given at the back of the mouth as a firm squirt. If the dose is placed at the front of the mouth it could find its way into the abomasum and not to the rumen. This could affect drench absorption by the goat and drench effectiveness.
- Always drench in a race. Goats should be standing so that the dose can be swallowed quickly. Ensure the tube to the gun does not suck in air from the pack. This occurs when the operator's head is down and the pack is inverted. Don't miss any animals.
- Check contraindications of products to be used. Check labels for advice.

Guidelines for controlling lice and other external parasites on goats

The most common external parasites of goats in Australia are lice, a number of species of mites and, in some areas, ticks. Biting flies can cause problems from time to time, sheep nasal bots may also infest goats and occasionally goats can become flystruck.

Lice

Four species of lice, including both chewing and sucking species, can infest goats in Australia. Lice numbers are typically low in summer and increase through autumn and winter to a peak in spring. Heavy rain can reduce lice numbers as prolonged saturation can cause drowning of adult and immature lice and inhibit the hatching of lice eggs.

The chewing lice, *Bovicola caprae* and *Bovicola limbatus*, feed mainly on skin scurf, superficial skin cells and bacteria. *B. caprae* will infest all breeds of goats whereas *B. limbatus*, the Angora goat chewing louse, is restricted mainly to Angora and crossbred fibre goats. Chewing lice irritate goats, causing them to itch and rub against trees, fences and other structures. This is particularly damaging in fibre goats where lice can decrease the amount of mohair or cashmere produced and significantly reduce the quality and market value of the fibre. Goat skins can also be damaged.

The common goat sucking louse (*Linognathus stenopsis*) feeds by penetrating capillaries in the skin of the goat with finely adapted mouthparts and sucking blood. This louse is found on most goat species and often occurs in mixed infestations with chewing lice. The African blue louse (*Linognathus africanus*) is another sucking louse that was identified in Australia in 1988 but is not widespread.

Sucking lice can reduce weight gains and cause anaemia when present in high numbers. The formation of scabby bleeding areas, stunting of weaned goats and occasionally death in heavily infested kids has been reported; however, heavy infestations generally only develop when goats are in poor condition or under other stress.

◆ Detecting lice infestations

The most common indication of lice is the observation of goats rubbing, scratching or biting themselves, as well as restlessness and hair loss. Many other conditions can also cause goats to itch, so it is important to actually see lice to diagnose an infestation. When goats are examined in good light, lice can be seen on the coat. Lice can be found on most parts of the body, although largest numbers are generally found in areas with long fibre.

Chewing lice and sucking lice look quite different. Chewing lice have a broad brown head and a pale brown body with dark bands. The young lice (nymphs) are smaller with a cream coloured body and a brown head, but no bands. Sucking lice tend to be larger than chewing lice with a narrow head and much wider dark brown body. They sometimes appear almost bluish in colour because of the blood ingested during feeding and are most commonly found on the sides of the neck, around the udder and along the midline of the chest and belly.

◆ Controlling lice

There are two main elements of good lice control in goats – preventing new infestations and effective treatment when infestations occur.

Goat lice appear to be specific to goats and do not generally breed on other animals or birds. Therefore new infestations usually result from direct contact between infested and non-infested goats. Newly introduced animals, stray or feral goats and the mixing of goats at field days, shows and sales are all potential causes of lice spread. Lice could also be transferred between animals on grooming equipment.

Although goat lice have been collected off sheep overseas, studies in Australia showed that goat chewing lice did not transfer from goats to sheep held in close contact for eight weeks. Sucking lice have been seen to transfer from goats onto lambs running with them, but the lice did not persist on the lambs for longer than 12 days and did not appear to breed while on the sheep. Similarly, the sheep louse *Bovicola ovis*, does not tend to become established on goats if infested sheep are run with goats.

Therefore it is unlikely that other breeds of livestock will be a major source of new infestations. However, other animals paddocked in close contact with goats could carry goat lice for short periods and should be removed from the goat herd when lice treatments are applied or treated at the same time.

In intensively managed or housed goats there is also the chance of reinfestation from contaminated facilities if animals are treated with a non-residual treatment and returned to areas where lice or lice eggs have been dislodged. Although the likelihood of infestation from contaminated facilities is very low, excluding treated livestock for a period of three weeks will further reduce this risk.

◆ Treatment for lice

Sometimes goats only carry low numbers of lice that cause few problems. This is particularly so with short-haired breeds. In addition, lice numbers tend to increase during autumn and winter but then fall away in summer. As needless treatment increases the selection for resistance to lice products and can leave residues in fibre and meat, it is important to consider whether the lice are causing any distress to goats or are likely to cause economic loss before deciding to treat. If you cannot detect an infestation, treatment is not warranted.

Methods of pesticide application available for goats include backline application, spraying and dusts. Products currently registered for treating lice in goats can be found on apvma.gov.au. If a lice treatment is warranted, it is important that all goats on the property are treated at the same time. Animals that miss treatment or receive inadequate treatment can be a source of re-infestation for the rest of the herd.

Clout-S (containing a synthetic pyrethroid chemical called deltamethrin) is a backliner product that is registered for the control of lice in goats in Australia. In contrast to sheep, it is not necessary to shear goats before the application of Clout-S; however, greater effectiveness may be achieved in Angora goats if they are shorn before treatment.

To promote good effect from a backline treatment, it is important to correctly apply the appropriate dose for the heaviest animal in the group, using the applicator gun supplied with the product. Read the product label carefully to ensure the product is applied in the appropriate location and all safety instructions are followed.

Lice treatments can also be applied to goats by spraying or dusting. Details of products currently registered for these uses can be found on apvma.gov.au. To obtain good lice control from spraying goats, it is important to ensure the hair is thoroughly wet to the skin and that good coverage of the whole body is achieved. A coarse spray is most effective for wetting goats and reduces the likelihood of inhalation. Care should also be taken so that goats do not remain wet and cold for too long. Dusts should be sprinkled lightly over the whole body and worked into the skin. As rotenone and sulphur are the active ingredients in the only registered dusts for goats and have little residual effect, repeat treatments will be required to achieve eradication.

Rules for effective and safe use of lice control products

- Apply treatments thoroughly and strictly according to label instructions. To eradicate lice, all lice on each animal must come into contact with the lousicide applied. Lice can occur on most parts of the body.
- All animals on the property must be treated at a similar time. Even animals without lice clearly visible should be treated. If this is not done, once the protective effect of treatment has worn off, undetected lice on the untreated goats can spread back to the treated animals. If different groups of goats are treated at different times this can set up a cycle of reinfestation. Remember that bucks and kids can be a source of lice and should also be treated.

- Remember lice eggs. Most lousicides do not kill eggs. Eggs can take up to 10 days to hatch and the hatching nymphs can start a new infestation. It is important to establish if the treatment you are using provides residual effect for this period and, if not, to apply a second treatment approximately two weeks after the first.

Ticks

A number of species of ticks are found on goats in Australia, although they are seldom a major problem. The main species include the paralysis tick (*Ixodes holocyclus*), the 'Australian' cattle tick (*Rhipicephalus australis*) and *Haemaphysalis longicornis*. The brown dog tick (*Rhipicephalus sanguineus*) and various other species of native ticks are also occasionally recovered from goats.

The paralysis tick (*Ixodes holocyclus*) is the main tick of concern as it may cause weakness and paralysis of the hind limbs in young goats. Affected goats usually recover but treatment is also possible with paralysis tick anti-serum, available from a veterinarian. Purified Anti-tick Serum (Summerland Serums Pty Ltd, Alstonville NSW) is registered for treating tick paralysis in goats in Australia.

Products registered for controlling ticks can be found on apvma.gov.au. These include mixtures of cypermethrin and chlorfenvinphos and formulations of amitraz. It is important to check the product label and local legislation regarding the use of these products in the different states of Australia. When treating goats for ticks, it is especially important to ensure thorough wetting of all parts of the animal, including the belly, inside legs and ears.

Mites

A number of mite species are known to infest goats in Australia but seldom cause significant problems. The main species are ear mites (*Psoroptes cuniculi* and *Raillietia caprae*), the follicle mite (*Demodex caprae*) and the mange mite (*Chorioptes bovis*).

In most cases mite infestations cause little obvious effect but sometimes, in young, old, diseased or stressed individuals, lesions can spread and become more debilitating. Ear twitching, scratching of the ears and head shaking are common signs of ear mites. Sometimes, with close inspection, the mites (about 1mm long) can be seen in the ear canal. Breeds with hanging ears (such as Anglo Nubian goats) appear more susceptible to ear mites than goats with erect ears.

Choriotic mange mites are found most commonly on the coronet, udder, scrotum and limbs of goats and may cause crusts or 'scabs' of yellowish exudate that can range in thickness from a few millimetres to several centimetres in thickness.

Demodex mites are highly specialised mites that live in the follicles and sebaceous glands and sometimes form papules or nodules on the head, neck, shoulders and flanks of goats.

No products are registered for treating mites in goats and, where lesions have become extensive or infestations are thought to be causing distress to goats, advice should be sought from your veterinarian.

Flies and fleas

Stable flies, bush flies, mosquitoes, biting midges, March flies, sand flies, black flies and buffalo flies can all affect goats and may cause problems in very high numbers. Biting flies can produce large sores on the legs, face, ears, udder and scrotum of goats and can cause reductions in weight gains. Barricade S and Blockade S are registered for the control of buffalo fly in goats.

Goats can also occasionally become flystruck in wounds (e.g. fighting wounds in bucks) and where goats have become fouled with urine or faeces. There are a number of products containing diazinon and synergised pyrethrins that are registered for treating flystrike in goats in Australia.

Bush flies (*Musca vetustissima*) can annoy goats by feeding around the eyes and are known to transmit eye diseases such as pink eye in other species.

Fleas can also infest housed goats but are unlikely to be a problem in paddock run animals.

Nasal bots

Nasal bot flies lay eggs that hatch and develop into small larvae (about 1mm long) in the nostrils of the goat. The larvae then move into the nasal passages and frontal sinuses where they complete their development. When sneezed out by the goat the developed larvae may be up to 2cm in length.

These flies are most active in the warmer months and may disturb goats in their efforts to deposit their larvae. This can interfere with grazing and animals can be seen bunched together with their heads pushed into the flanks of other animals or close to the ground. Nasal bots often cause mucus discharge from the nostrils of goats and can cause frequent sneezing.

There is only limited information available on the extent of nasal bot infestation of goats in Australia and in most cases there appears to be little economic impact. Treatment is rarely necessary and, as there are no products registered for use in goats, should only be carried out after seeking advice from your veterinarian.

Toolkit 9 – Parasite control

Tool 9.1 - Finding further information

Tool 9.2 - Glossary of terms

Tool 9.3 - Information on commercially available chemicals registered for parasite control in Australian goats

Case studies

- Management and breeding to support chemical worm control
- The integrated package to effective and sustainable goat worm control
- Organic worm control

Tool 9.1 - Finding further information

Publications

- *MLA Tips and Tools – Controlling nematode parasite of goats in pasture-based systems:* mla.com.au/publications and search 'nematode'.
- Lyndal-Murphy M, James P, Bowles P, Watts R and Baxendell S (2007). MLA Research Report Project B.GOA.0014 - *Options for the control of parasites in the Australian Goat Industry*.
- Going into Goats Module 6 – Husbandry, Toolkit 6, page 3 - Common health problems
- Going into Goats Module 7 - Nutrition

Websites

- apvma.gov.au is the website for the Australian Pesticides and Veterinary Medicines Authority (APVMA) - the Australian government authority responsible for the assessment and registration of pesticides and veterinary medicines. This site includes a list of commercially available anthelmintics registered for nematode control in Australian goats.
- paraboss.com.au is an online parasite control resource primarily aimed at Australian sheep producers. Much of the information about the different parasites and their lifecycles and control is also applicable for goats.
- wormboss.com.au is Australia's leading sheep and goat worm control resource and is part of the ParaBoss group of products incorporating WormBoss, FlyBoss and LiceBoss.
- sheepgenetics.org.au is the site for practical information on the genetic potential of goats including EBV for worm egg count. Select KIDPLAN from the homepage..
- Information on parasite control in Australian goats is also available from the following State Department websites:
 - dpi.nsw.gov.au
 - agric.wa.gov.au
 - daf.qld.gov.au
 - dpipwe.tas.gov.au
 - agriculture.vic.gov.au

Tool 9.2 - Glossary of terms

Anaemia

A sign of disease where there is a reduction in the size or number of red blood cells in the blood. This may be detected visually as paleness of the mucous membranes (such as the gums, inner eyelid and vulval mucosa), which increases with the severity of anaemia. Anaemia can be caused by both internal (such as barber's pole worm) and external (such as sucking lice) parasites.

Australian Pesticides and Veterinary Medicines Authority before (APVMA)

The APVMA is the Federal Government statutory authority responsible for the official registration of animal health products in Australia. The product registration process helps to ensure that commercial animal treatments are safe and do not lead to violative residues.

Body condition scoring

Body condition scoring is a way to monitor the tissue over the lumbar vertebrae of goats as an indication of health and nutrition in some goats (this can be less useful in dairy goats). Worms, such as black scour worm and brown stomach worm, can cause poor growth or weight loss and regular body condition scoring can monitor goat performance and highlight these effects.

Ectoparasite or external parasite

Ectoparasites are parasites which infest the skin and hair of animals. They may spend their entire life cycle on the animal (such as lice) or only a part of their life cycle (such as ticks and flies). Ectoparasites are divided into two main groups: arachnids (including ticks and mites), and insects (including fleas, flies, and lice).

Endoparasite or internal parasite

Endoparasites are parasites which infest the inner organs of the animal and include worms and flukes as well as protozoan parasites such as coccidia.

Export Slaughter Interval (ESI)

An ESI is the time that should elapse between administration of a chemical to animals and their slaughter for export. ESIs manage differences between Maximum Residue Limits allowed for chemicals in Australia and its trading partners. ESI advice is particularly important for quality assurance schemes and producers filling out the Livestock Production Assurance National Vendor Declaration and Waybill (LPA NVD/Waybill) as part of the whole-of-chain management of exported product. ESIs have been agreed to by the industry and the registrant of the veterinary chemical. These values can be obtained from the APVMA and MLA websites or from the product manufacturer.

FAMACHA©

FAMACHA© is a method that can be used to estimate the level of anaemia associated with barber's pole worm infestation and then selectively treat individual animals based on this. The colour of the inner eyelid is compared to a colour chart indicating the level of anaemia. This system may be used in both goats and sheep. FAMACHA© was developed in South Africa and named after its originator, Dr Francois "Faffa" Malan (**FA**ffa **MA**lan **CHA**rt).

Proper training is required to correctly use the FAMACHA© system. Visit wormboss.com.au for further information.

Off-label use

An off-label use of a chemical product is use of that product in a way that is not specified by an instruction on the official product label. Product labels are approved for registration in Australia by the APVMA. Off-label use is illegal without detailed instruction from a veterinarian.

Refugia

Refugia is the name given to the proportion of a given parasite population that escapes exposure to an anthelmintic. This sub-population allows the survival of anthelmintic-susceptible parasites and is usually the free-living stages of the parasite outside of the treated host animals at the time of treatment. It can also be worms inside untreated animals within a group or occasionally inhibited larvae within the host.

Registered chemical

Before agricultural and veterinary chemical products can be sold, supplied, distributed or used in Australia, they must be registered by the APVMA. The registration process is governed by Commonwealth legislation and each chemical product undergoes rigorous scientific assessment before its registration can be approved. The APVMA allocates a unique registration number which is printed on the bottom of the product label.

Unregistered chemical

An unregistered chemical active constituent or chemical product is one that has not been assessed and registered in Australia by APVMA.

Withholding period (WHP)

The WHP is the minimum period which must elapse between last administration or application of a chemical product, including treated feed, and the slaughter, collection, harvesting or use of the animal commodity for human consumption or use. WHPs are mandatory for domestic slaughter and on the label of every registered product.

Tool 9.3 - Information on commercially available chemicals registered for parasite control in Australian goats

A number of anthelmintics, insecticides and acaracides are registered for nematode and ectoparasite control in Australian goats.

A list of commercially available treatments registered for Australian goats is maintained by the APVMA and is available from:

- wormboss.com.au
- apvma.gov.au

Case study

◆ Management and breeding to support chemical worm control

Producer	Colin and Rob Ramsay
Location	West Wyalong, NSW
Size of property (ha)	2,500
Current number of goats	500 breeders
Other enterprises	300 White Dorper stud sheep 1,000 White Dorper self-replacing prime lamb flock 5,000 acres of cropping
Average annual rainfall (mm)	400 to 450
Contact	colin.ramsay@bigpond.com

Colin Ramsay and his son Rob run more than 300 Boer breeding does as part of a mixed grazing (sheep and goats) and cropping operation that was established in 1998. The business was initially set up in Cootamundra, NSW, but later moved near West Wyalong, NSW.



Goat producer Colin Ramsay

Worm control is a very important part of the Ramsay's goat operations. Barber's pole worm has been an increasingly important consideration for both goats and sheep on the property. This worm can be a particular problem in spring and summer, causing very high worm egg counts and sudden deaths. Scour worms also need to be regularly monitored each year and can cause significant losses, particularly during periods of nutritional or climatic stress such as in autumn with a flush of short, green pasture or when there are sudden changes in weather with high wind chill.

Colin said that, in his experience, goats are just as susceptible to worms as sheep, maybe more so, and effective worm control is made more difficult due to the limited choice of effective, registered drenches. The Ramsays use faecal worm egg counting (WEC) routinely

to monitor worm burdens and ensure that planned treatments are worth the time and effort. Veterinary advice is also sought to help with achieving an effective and sustainable product rotation to minimise worm burdens and resistance in worms.

According to Colin, drenching goats can also be physically challenging and so pour-on or injectable products would be welcome. Unfortunately, none are currently registered for use in goats in Australia.

To help the overall worm control, goats need space and a varied diet to thrive. The Ramsays monitor stocking rates on an ongoing basis and plan paddock rotations to maximise goat nutrition. This helps to avoid the build up of and exposure to high levels of worm contamination on the pastures.



Stocking rate and paddock rotation is an important worm management strategy on Colin Ramsay's property

Goat selection is a critical tool for the Ramsays in their management of internal parasites. WEC from individual goats have revealed a high degree of variation between goats in the level of resistance to worms. Individual tests are used to select and breed from those animals with high worm resistance and avoid using those that carry high worm burdens and shed high numbers of worm eggs.

“There is huge potential to select breeding stock using objective measurements and KIDPLAN is a very important tool to improve production traits including goat resistance to parasites. Identification of worm-resistant sires provides another tool in the integrated parasite management tool box,” Colin said.

Managing animals introduced to the property is just as important as managing those already living there. All animals coming on to the property are quarantine drenched, vaccinated and kept separate from existing stock for at least a few days. This protocol helps to reduce the risk of introducing drench resistant worms and other diseases the introduced goats may be carrying.

Case study

◆ The integrated package to effective and sustainable goat worm control

Producer	Craig and Joanne Stewart
Location	Collie, NSW
Size of property (ha)	1,500
Current number of goats	750 mature goats
Other enterprises	250 beef cattle
Average annual rainfall (mm)	500
Contact	admin@bvfarmfresh.com.au

Craig and Joanne Stewart run Boer goats on their mixed farming property near Collie, between Dubbo and Coonamble in NSW. They had previously grazed sheep but now run about 500 breeding does and some cattle, combined with cropping.



Craig and Joanne Stewart

The Stewarts strongly believe in a coordinated approach to achieving effective worm control in their goats.

Faecal worm egg counting is a regular feature of their worm control program with the samples sent to either a laboratory in Temora or the Elizabeth Macarthur Agricultural Institute (EMAI) near Camden. Individual goat worm egg counting, rather than bulk samples from a mob, are preferred as these allow the prevalence of worms in individual animals to be assessed. The timing of sampling is also important and this can be unique to a property or region. Understanding when worm egg counting sampling should occur on any given property is a key part of effective worm control planning.

The Local Land Services (LLS) veterinarian provides the Stewarts with excellent advice on worm egg counting results and treatment choice. By combining regular monitoring with a range of non-chemical based worm control strategies, the Stewarts generally don't need to drench breeding stock more than once a year.

The property is at risk from barber's pole worm in wet summers, requiring regular worm egg counting monitoring to help prevent problems before they happen. Monitoring is intensified when conditions are considered to be particularly favourable for worm persistence.

The current plans also involve trying to rotate between different effective drenches to avoid exposing worms to the same drench groups more frequently than absolutely necessary. The Stewarts use a V machine to help with the job of drenching. By reducing the work of drenching, they can focus more on making sure that the doses are correct and that each product is administered correctly to all animals.

To complement the worm egg counting monitoring and treatments, the Stewarts plan their grazing program as much as possible to keep 'clean paddocks', including stubbles, up their sleeve for grazing at key times. They also try to prepare low worm contaminated paddocks for kidding does.



Preparing low worm contaminated paddocks for kidding does is a helpful worm management strategy used by the Stewarts

Good nutrition is another key component of production and worm control. "Goats need good feed to be able to perform well", Joanne said.



Good nutrition assists production

The Stewarts buy-in some wether goats opportunistically to finish for meat markets and maintain a dynamic biosecurity plan to minimise the risk posed by this activity. They try to avoid drenching these goats, to reduce risks with violating withholding periods, but are vigilant in keeping the introduced livestock, away from breeding livestock. They also keep these goats on good feed to maximise production and feel that this helps by boosting the goats' immunity to avoid any ill-effects from worms.

Case study

♦ Organic worm control

Producer	David and Mary Booth
Location	Cootamundra, NSW
Size of property (ha)	1,600
Current number of goats	400 mixed age breeders 150 Angus cows and calves 1,100 White Dorper ewes and lambs
Other enterprises	Cropping wheat and oats
Average annual rainfall (mm)	550
Contact	info@burongaorganics.com.au

David and Mary Booth have been involved in meat goat production in NSW for more than 30 years. Originally farming near Ivanhoe, they now run their Boer goat herd on their property near Cootamundra. Their enterprise also includes sheep and cattle as well as cropping.

The Booths run a certified organic goat herd and supply directly to butchers and other specialty meat markets. Organic certification limits parasite control measures meaning the Booths have to try to stay at least one step ahead of parasites at all times.

Barber's pole worm can cause problems on the property during warm, wet conditions which are not uncommon at Cootamundra and winter scour worms are also on the radar.

Overall, the Booths' are very happy with the natural worm resilience that has built up in the herd over time. They regularly visually assess goat body condition, coat and signs of scours (dags) and identify poor performing animals which are culled from the herd. Worms are not eradicated, but they are managed to acceptable levels to avoid significant problems.

They are also careful not to try to run 'too many' goats, thus avoiding problematic stocking rates. "Worm problems become a risk as soon as you put a fence around a goat," David said.

Pasture length is carefully monitored and managed to provide good grazing conditions, with browse at least 10cm in length, and good nutrition to support the goat's immune system to help counter worms and any other pests or diseases.

David has observed that goats perform best when rotated strategically through sections of hilly, weedy, timber country as well as pastures. An added bonus is that the hilly, rougher country provides good shelter during cold, wet weather. The goats also provide excellent weed control in country that is otherwise difficult to access.

Veterinary advice is sought whenever required and faecal worm egg counting has been used in the past to help with worm monitoring.

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