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Chronic wasting of adult goats in Western Canada

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As more and more farmers turn to goat production, veterinarians need to be aware of current and common problems amongst commercial herds and companion goats. Unexplained weight loss is an obstacle frequently encountered in goat herds that can be frustrating for all involved. Diagnoses made on small ruminants are often based on bovine medicine. Although this is a good starting point, goats experience several conditions that do not exist in cattle. This issue of *Large Animal Veterinary Rounds* describes the differential diagnoses for unthriftiness in adult goats. A case of weight loss in a Pygmy goat reinforces the diagnostic principles.

Weight loss in adult goats is a recurrent complaint of goat farmers that can be indicative of considerable underlying herd health problems.¹ Thin goats reduce the producer's income and the decreased milk production and carcass weights are important direct adverse consequences. Indirect economic effects include reproductive deficits and decreased value and saleability of breeding stock. Correction of wasting in a goat herd involves careful investigation by the veterinarian and usually major management changes by the farmer.

Body condition scoring

Since goats, and notably dairy goats, deposit much of their fat intra-abdominally,² they are naturally more bony and scrawny looking than other common livestock. It can be difficult to make an accurate estimate of a goat's body condition, especially when compared to the full appearance of well-fed cattle and horses. Weigh scales are most accurate for monitoring changes in body weight, but are often unavailable on farms. Body condition scoring or weigh tapes are useful substitutes.

Unlike bovine and ovine body condition scoring systems, both the lumbar and brisket regions of goats should be visually and manually examined.¹⁻³ Goats are given a lumbar and a sternal score on a scale of 0 through 5, divided into 0.5 point increments (Table 1). The scores are averaged and reported in 0.25 point divisions. The sternal condition better reflects the fat composition of a goat, and the lumbar region its body protein.¹ Ideally, a goat should be maintained at no less than a lumbar-sternal average score of 3 out of 5, with exceptions for high-producing dairy does in peak lactation.³ The lumbar region of an animal scoring 3 out of 5 has transverse and dorsal processes that are palpable with light pressure, firm musculature, and about 1 centimetre of subcutaneous fat on either side of the dorsal processes of the spine.³ The brisket has a palpable sternum, free of callous and covered with a thin layer of fat and muscle.³ Thinner goats will have prominent and easily palpable lumbar spinal processes, a calloused and easily palpable brisket, and decreased overall muscle mass.³ Body condition scoring done regularly throughout the year is a useful tool in maximizing herd production, in addition to drawing attention to animals that are chronically underweight or those afflicted with unexpected weight loss.

The history

The history includes information about the animal presented for examination and the remainder of the herd. The goat's age and the duration of its weight loss should be determined. Some diseases, like Johne's disease, only affect mature animals and the case may have a long history of recurring diarrhea.



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Determine the type and quality of feed available to the animal, and the level of consumption. Domestic goats should be spending between 20% and 30% of each day eating.¹ Hay should be green and sweet smelling, and concentrates, if available, should be free of mould. Inquire about any recent changes in feed, as goats are fastidious and may be reluctant to try new or different feeds. The incidence of other thin animals and any previous diagnoses that affected the herd should be established. If a high proportion of the herd is affected, the problem is more likely to be nutritional.

Inquire about the vaccination and deworming status of the herd, as well as the source of newly introduced animals. Sickly goats coming from auctions can easily introduce contagious diseases and parasitic infections. Stress, such as recent travel or parturition, may cause a decrease in appetite or trigger clinical signs in a previously subclinical animal (eg, caprine arthritis encephalitis). Ask if there are other species on the farm in addition to the goats, and if they are healthy or not. Johne's disease can spread between cattle, sheep, and goats.¹ Inquire about the possibility that the goat may have access to garbage or toxins. Lead toxicosis from ingesting lead paint may present solely as weight loss. Also, goats that eat garbage may have a gastrointestinal foreign body. Finally, find out the value and the purpose of the goat(s). If it is a pet, it should be treated as such, but if it is one of 200 commercial goats where 50% are underweight for no apparent reason, necropsy is a useful diagnostic tool.

The physical examination

A complete, systematic, and thorough physical examination is the cornerstone of diagnosis. The heart, lungs, and abdomen should be auscultated and the body palpated for lumps and bumps. Fresh feces should be collected and urine caught, if possible. Unlike sheep, goats do not urinate by holding the nose shut, so urine should be saved if volunteered.

One part of the goat that is frequently overlooked is the oral cavity. In a young goat, the mouth may contain painful lesions leading to decreased feed intake and weight loss. In goats over 5 years of age, there may be overgrown or loose teeth with ulcers on the tongue and cheeks, or painful, feed-impacted tooth root abscesses.² The feet and legs should also receive special attention. Overgrown hooves or painful joints can make it too troublesome for goats to move to their feeders, leading to weight loss.

The environmental examination

The environment where the goats live is often left unexamined, but can be a key factor. Inspect the cleanliness of the barn and barnyard. If there is extensive manure build-up and crowding among the animals, fecally-transmitted diseases such as Johne's disease or internal/external parasitic infestation may be considered. Standing water and wet areas can promote hoof problems or act as a physical barrier to prevent goats from moving to feeders. Feeds should be personally inspected by the veterinarian for quality and abundance. Feeders should also be

Table 1: Suggested caprine body condition scoring^{1,3}

<p>Score 0: Cachexic</p> <p>Lumbar</p> <ul style="list-style-type: none"> • Vertebrae and intervertebral articulations easily felt • Muscle and fat not evident, only skin on bone <p>Sternal</p> <ul style="list-style-type: none"> • Sternum is easily palpated, with prominent fleshless depressions on either side • Immovable callous over sternum <p>Score 1: Skeletal</p> <p>Lumbar</p> <ul style="list-style-type: none"> • Intervertebral articulations still easily palpable • Some muscle over transverse processes <p>Sternal</p> <ul style="list-style-type: none"> • Depressions on either side of sternum still prominent • Callous is movable <p>Score 2: Thin</p> <p>Lumbar</p> <ul style="list-style-type: none"> • More muscle and fat over transverse processes • Depressions still evident on either side of the dorsal processes <p>Sternal</p> <ul style="list-style-type: none"> • Fat pad palpable over sternum, and on either side of sternum • Callous is small or absent <p>Score 3: Good</p> <p>Lumbar</p> <ul style="list-style-type: none"> • Spinous processes palpable with light pressure • Muscle and fat fill the depressions over the transverse processes <p>Sternal</p> <ul style="list-style-type: none"> • Noticeable indents on each side of sternum, due to the presence of muscle and fat next to the sternebrae <p>Score 4: Fleshy</p> <p>Lumbar</p> <ul style="list-style-type: none"> • Spinous processes challenging to palpate • Plentiful muscle and fat covering over vertebrae <p>Sternal</p> <ul style="list-style-type: none"> • Sternum inpalpable • Indents on either side of sternum felt with light pressure <p>Score 5: Obese</p> <p>Lumbar</p> <ul style="list-style-type: none"> • Prominent furrow along spine with flesh bulging up along either side <p>Sternal</p> <ul style="list-style-type: none"> • Sternum inpalpable • No evidence of indents on either side of sternum
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evaluated, as the quality and quantity of the available feed is meaningless if the animals cannot reach it or it falls to the ground. Goats are notorious for ignoring feed that has touched the ground. There should be enough feeder space for all goats to have easy access. It is recommended that each adult have approximately 20 to 30 cm of linear feeder space at free-feed hay stations.⁴

Table 2: Differential diagnoses for chronic wasting in adult goats

NUTRITION	
Primary	Secondary
<ul style="list-style-type: none">• Feed quality• Feed quantity• Mineral deficiencies• Copper, cobalt, zinc	<ul style="list-style-type: none">• Inappropriate feeders• Bullying• Dental disease• Lameness
PARASITES	
Internal	
<ul style="list-style-type: none">• Coccidia: <i>Eimeria</i> sp• Nematodes: <i>Haemonchus contortus</i>, <i>Ostertagia circumcincta</i>, <i>Trichostrongylus colubriformis</i>• Tapeworms: <i>Taenia</i> sp, <i>Echinococcus</i> sp• Flukes: <i>Fasciol</i> sp• Lungworms: <i>Dictyocaulus filaria</i>	
External	
<ul style="list-style-type: none">• Biting lice: <i>Damalina caprae</i>• Sucking lice: <i>Linognathus stenopsis</i>• Mange: <i>Sarcoptes</i> sp, <i>Chorioptes</i> sp• Sheep ked: <i>Melophagus ovinus</i> (heavy infestations)	
COMMON INFECTIOUS DISEASES	
<ul style="list-style-type: none">• Caseous lymphadenitis• Caprine arthritis encephalitis• Johne's disease	
OTHER	
<ul style="list-style-type: none">• Cardiac, pulmonary, hepatic or renal disease• Neoplasia• GI foreign body	

Differential diagnoses for unthriftiness

There are often several reasons for chronic poor doers (Table 2), and all must be discovered and addressed if the weight loss is to be corrected.

Nutrition

Nutrition issues can be broken up into primary and secondary causes. Primary nutritional problems are due to a lack of feed or nutrients. This can be as simple as the farmer not feeding enough. For example, an average stress-free 60 kg doe, in early pregnancy with a body condition score of 3 to 4, should be eating about 2% of her body weight in dry matter each day.³ This equates roughly to 1.3 kg of good quality alfalfa daily. Good quality hay has a crude protein >11% and total digestible nutrients greater than 55%. If the quality of the feed is poor, the goats may be filling up, but not meeting their daily requirements. Sometimes the problem is a dietary deficiency of a particular element, eg, goats on a diet low in copper, cobalt, or zinc may present with weight loss.^{2,5}

Secondary nutritional problems pertain to an inability of the goats to move to or consume their feed. Animals at the bottom of the pecking order may be challenged by more dominant goats when they approach the feed bunk, and therefore

will choose not to eat at all. This is especially noticeable when there are goats of drastically different sizes housed together, or when some animals are horned. Animals with dental disease will not be able to prehend or masticate adequately or may completely avoid eating because of the associated pain. Like horses, sharp points on cheek teeth are regularly seen in aged small ruminants. This can be corrected by floating their teeth under general anaesthesia. In small ruminants with advanced dental disease, feed may impact into the cheek or alveoli of missing teeth.

Finally, lameness is considered a cause of secondary nutritional problems. Lameness will decrease ambulation and prevent goats from obtaining feed even when it is in plentiful supply.² Some common causes of lameness in goats are laminitis, caprine arthritis encephalitis associated arthritis, mycoplasma arthritis, foot rot, foot abscesses, puncture wounds, fractures, or other trauma to the limbs.

Parasites

Unlike most other species, adult goats do not acquire significant age-related immunity and can suffer from clinical internal parasitism.^{1,2,6} However, the dry climate of the Canadian prairies does not predispose to serious endoparasite problems and, as a result, severe problems are less frequent than in other parts of the world. The barber pole worm *Haemonchus contortus*, as well as *Ostertagia circumcincta*, and *Trichostrongylus colubriformis* are the most problematic parasites in the northern USA;⁷ it is assumed that the situation is similar in Canada. Flukes, tapeworms, and lungworms are also present in Canada, but do not seem to be of great importance. Lice and keds are common and heavy infestations can cause severe irritation or anemia,¹ leading to secondary weight loss.

Symptoms of parasitic infection include depression, weight loss, anemia, submandibular edema (bottle jaw), weakness, decreased milk production or growth rate, and rough hair coat.^{1,2} However, these symptoms are very generic and could fit many diseases. Additionally, there is a low correlation between fecal float egg counts and the actual parasitic burden in adult goats,² so it can be difficult to diagnose endoparasitism in mature goats *ante mortem*.

Nematodes are controlled by decreasing the stocking density of pastures, avoiding feeding on the ground, regularly removing manure from stalls and pens, and using dewormers. Goats metabolize most anthelmintics much faster than sheep; therefore, the commonly administered sheep doses are not always effective in goats.^{1,2,7} Underdosing is an invitation to contribute to the increasing small ruminant anthelmintic resistance already occurring in most, if not all, dewormer classes.^{2,8}

There are very few drugs labelled for goats in Canada and anthelmintics are no exception. Ovine oral-formulated ivermectin with an extralabel goat dose identical to the sheep dose (200 ug/kg by mouth) is often recommended.^{1,2} Eprinomectin pour-on is also used at a dose of 0.5 mg/kg on the skin.² This drug has a zero-day milk withdrawal in cattle, but its use in goats is extralabel. Pour-on ivermectin products burn goat skin

and their use is discouraged. Flukes and tapeworms are not affected by avermectins, but albendazole may be effective at 15 mg/kg by mouth (off label).^{8,9}

Coccidiosis is usually a disease of kids. Severe cases are characterized by diarrhea and dehydration. Sometimes death ensues, but if the animal lives, it may have permanent damage to the intestinal mucosa resulting in a malabsorption syndrome and chronic illthrift.¹ Goats and sheep each have their own specific *Eimeria* species. The most common goat coccidia species in North America is *Eimeria arlongi*.¹⁰ Most adults have mild coccidia infections and continuously shed oocysts into the environment.^{10,11} Adults are usually asymptomatic, but may have outbreaks of diarrhea when stressed.¹¹ Diagnosis is made by fecal floatation and treatment involves a combination of drug therapy, improved sanitation, and time.² Control is achieved by the use of an in-feed coccidiostat.

Selected infectious diseases

The following common infectious diseases cause illthrift in Canadian goats.

Caseous lymphadenitis is a zoonotic bacterial disease of goats and sheep caused by *Corynebacterium pseudotuberculosis*. It causes abscesses in the superficial lymph nodes (particularly those of the head), but can also affect lymph nodes and organs in the thorax and abdomen.¹² This form is known as visceral caseous lymphadenitis. Caseous lymphadenitis is significant in that its presence decreases the value of breeding stock and hides¹ and can cause carcass condemnation and cachexia.⁶ Ruptured and draining abscesses, either superficial or bronchiolar, are a source of infection for other goats^{1,2} and transmission occurs mainly when the bacteria is introduced into an area of breached skin.^{1,2,6}

Diagnosis of superficial caseous lymphadenitis can be made by aseptically collecting and culturing pus aspirated from an abscess. Definitive diagnosis of the visceral form is more challenging. The synergistic hemolysis inhibition (SHI) serological test can be used to help determine if the goat has an active *C. pseudotuberculosis* infection. False negatives are rare, but false positives occur 28% of the time in goats.⁵ Generally titers of ≥ 512 are considered evidence of an active infection, while titers of 128–512 are indicative of exposure.⁵ The intensity of the test reaction depends on several things, including the chronicity of infection and the thickness of the abscess capsule.⁵ There is a highly specific and sensitive double-antibody sandwich ELISA test that has been effectively used to eradicate caseous lymphadenitis from participating herds in the Netherlands,¹³ but it does not differentiate between visceral and superficial cases.

Treatment philosophies vary. They include benign neglect; isolation, surgical removal, lancing and flushing; or culling.^{1,5} Care should be taken to prevent contamination of the environment since the bacteria can survive for

several months and serve as a source for new infections.⁶ Antibiotic usage is impractical, although erythromycin (4–15 mg/kg bid IV), with or without rifampin (2.5–5 mg/kg bid PO), for 6 to 12 weeks may be an option for special goats (off label).⁵ Prevention is focused around screening new introductions into the herd, quarantining affected animals, controlling factors that may cause open wounds on goats (fighting, sharp objects, external parasites), and vaccination. In Canada, a formalized exotoxin vaccine with incomplete Freund's adjuvant is available. Although goat use is off label, this vaccine has been shown to decrease the incidence of abscesses, but fails to prevent them entirely.^{1,2,5}

Caprine arthritis encephalitis (CAE) (maedi-visna in sheep) is an incurable lentiviral disease. It is extremely common, especially in dairy breeds where the herd seroprevalence has been reported to be $>60\%$ throughout the US.⁶ There are 4 clinical manifestations of CAE and goats can present with one or more of them. These are: nerve dysfunction and progressive paresis seen in 2–6-month-old kids, hardening of the udder, chronic interstitial pneumonia, and arthritis.^{1,2} Of these 4 syndromes, chronic arthritis is most commonly associated with weight loss. Lentivirus-infected animals are lifetime shedders, regardless of their clinical state.^{2,5}

Transmission is principally from dam to kid via colostrum. To limit spread, kids should be permanently separated from their mothers immediately after birth and fed heat-treated colostrum.¹⁴ Even animals that are symptomless and seronegative will shed the virus if they are infected and it is not sufficient to simply feed colostrum from seronegative, normal-looking does.⁵ There is increasing evidence for horizontal transmission between adults via contaminated secretions, aerosolized virus, and blood-contaminated equipment.^{1,2}

Currently, there are no practical laboratory methods to definitively diagnose clinical CAE in live goats. It is possible to detect serum antibody to CAE with ELISA or AGID, but this does not prove that the goat has clinical CAE infection.^{1,14} On post-mortem, CAE can be diagnosed by characteristic histopathologic changes in the brain, spinal cord, or synovium, and possibly the udder and lungs.¹

Johne's disease (paratuberculosis) is a terminal ruminant disease that occurs predominantly in 2–3-year-old goats. It is caused by the Gram-positive, acid-fast bacterium *Mycobacterium avium*, subspecies *paratuberculosis* (MAP). The organism is long-lived in the environment, surviving for up to 11 months in bovine feces and 9 months in pond water. The predominant clinical sign is progressive weight loss, often accompanied by a dry, rough hair coat, and flaky skin. Diarrhea is rare, occurring in only 10%–20% of cases, but soft unpeletted feces are not uncommon. In the terminal stage, anorexia, depression, anemia, and edema may be present. Paratuberculosis has significant

economic importance as it decreases milk production, increases susceptibility to other diseases, decreases slaughter weight, decreases feed conversion, and increases culling.⁵

The main route of transmission is fecal-oral, with infection occurring in the first few months of life from contamination of teats during suckling, or fecal-contaminated feed, pasture, and water. Animals can clear the infection, but in those animals that eventually become clinical cases, there is the inexorable development of a granulomatous enteritis. The intestinal lesions result in a significant loss of protein into the gut, and affected animals are often hypoalbuminemic. Fecal shedding of the organism occurs with, or without, accompanying clinical signs. There is excretion of the organism in milk and *in utero* fetal infection occurs in a small proportion of clinical cases.

Diagnosis of Johne's disease can be difficult. The Agar Gel Immunodiffusion test, AGID, is reliable (sensitivity 80%) for confirming the disease in clinical cases. This test was designed for use in cattle, but may be successfully used for goats as well. Fecal culture has a high specificity in clinical cases, but is inconvenient because of the lengthy incubation period of 12–16 weeks.⁵ In addition to the inconvenience of long incubation periods, fecal culture has a sensitivity of only 18%–25%, a characteristic shared with the fecal DNA probe.¹⁵ If an animal is the first suspected case of Johne's disease in a herd, a necropsy and histopathological studies are required to confirm the diagnosis.

More problematic diagnostically are infected, but subclinical animals. Although animals become infected when very young, they do not become seropositive for many months, often months after they have begun to shed the organism in their feces. The AGID test is the most suitable for the detection of infected, but preclinical cases; however this has limitations. ELISA serological tests have been applied to goats, but there are no validated ELISA tests for paratuberculosis in goats. The specificity of ELISA tests may be reduced by cross-reacting antibodies to *Corynebacterium pseudotuberculosis*.

Other causes

Other causes of cachexia common to all species should not be ignored. Chronic renal, cardiac, or pulmonary diseases can cause weight loss in goats. Chronic hepatic disease exists in goats where photosensitivity (not icterus) is the common symptom.¹⁶ Caprine neoplasia is rare, but can occur.^{1,2} Foreign bodies are not unusual in goats that eat garbage. Plastic bags or baler twine can cause partial GI obstructions, then chronic indigestion, and illthrift.¹

Case discussion

A 3-year-old intact male Pygmy goat was presented with a 1-month history of weight loss and diarrhea. For the previous 10 days, he had become very selective about his diet, until finally he was consuming only oats, bread, alfalfa, carrot peels, lettuce, and apples when fed by hand.

He came from a herd of 9 other pet goats and all the others were apparently normal.

Physical examination revealed depression, marked amounts of soft, green feces caked on the perineum, a slight underbite, and weak rumen contractions. The body condition score was approximately 1/5 and there were a few lice over his withers. The rectal temperature was 38.8°C (38.6–40.0°C); pulse 108 beats per minute (70–90 beats per minute), and respiratory rate 16 breaths per minute (10–30 breaths per minute) (normals). Rumen contraction rate was not recorded, but normal is 1–1.5 contractions per minute.

What are the differential diagnoses, therapeutic recommendations, and prognoses for this goat?

Given the history, symptoms, and physical examination findings, the top 3 differential diagnoses are: parasitism, Johne's disease, and dental disease. This buck was somewhat young for dental disease, but mandibular prognathia increased the suspicion that this might exist. Although probably not the case here because his herd mates were in good body condition, primary nutritional issues should be considered. Pet goat owners have the best intentions, but they may not be properly informed on appropriate ruminant nutrition.¹

To focus the list of differential diagnoses, a fecal float, paratuberculosis AGID test, and closer inspection of the oral cavity and teeth were performed. As Johne's disease was suspected, a fecal smear was stained and examined for acid-fast organisms typical of MAP. A CBC was ordered to check for inflammation, anemia, and hypoproteinemia.

The oral cavity appeared normal. The fecal floatation showed 2+ *Eimeria* sp oocysts, which is fairly non-significant since adult goats frequently shed small numbers of coccidia. An AGID for paratuberculosis was positive, which is quite reliable in a clinical animal. Additionally, acid-fast rods were seen on the fecal smear. A hemogram identified changes consistent with mild to moderate chronic inflammation stress, a moderate anaemia of chronic disease, and a severe hypoproteinemia. Based on these findings, a diagnosis of Johne's disease was made.

Given the advanced stage of this buck's disease, he was euthanized and a necropsy examination was completed. The pathological examination confirmed the presence of Johne's disease.

What control efforts can be put in place?

Control programs depend on the goals and economics of each farm. Some owners may opt to accept a low level of infection and clinical cases without implementing any control measures. Even if herd mates are asymptomatic, it is highly unlikely that they are free of infection given their communal housing and the hardiness of MAP in the environment. For every advanced clinical case of

Johne's disease, it is estimated that 15 to 25 herd mates are also infected.⁴

Ideally, each remaining goat in this herd would be serologically tested with the paratuberculosis AGID every 3 months and have feces cultured for mycobacteria every 6 months.¹⁷ Animals that are positive should be culled or strictly isolated immediately.¹⁷ These procedures may not be economically feasible. Weighing goats monthly will help detect affected animals faster.¹⁷ At the very least, management practices should attempt to reduce fecal-oral transmission to young animals. This means cleaning stalls and pens regularly (especially kidding areas), preventing fecal contamination of feeders and waterers, decreasing stocking density, and rearing replacement stock in facilities uncontaminated by adult manure run off. Feeding on the ground should be avoided for all age groups, but is especially important in kids up to 6-months old. Frequent harrowing of pastures will help kill bacteria by sun exposure.⁶ Purchased replacements should only be sourced from herds of known status, but this is fraught with uncertainty. There are ethical issues pertaining to the movement of animals off farms known to be infected, and possible subsequent infection to other animals of the same or different species.

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Dr. Lyall Petrie graduated from the University of Glasgow Veterinary School in 1969 and is presently a Professor in the Department of Large Animal Clinical Sciences at the WCVM. His current research interests include neonatal calf diarrhea, bovine lameness and problems of the bovine hoof.

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Abstract of Interest

Zinc responsive dermatopathy in goats: two field cases

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Two adult female goats presented with symmetrical alopecia, rough hair coats, weight loss, and generalized unthriftiness. In light of the history and clinical signs, a mineral deficiency or endocrine imbalance was suspected. These goats were being fed a diet of alfalfa, a legume high in calcium, which can block zinc uptake. Serum zinc levels were low, and skin biopsies supported the diagnosis of zinc deficiency. It is concluded that the main factor blocking zinc absorption was increased dietary calcium intake.

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