

Camelid 101 – What you always wanted to know but were afraid to ask!

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Abstract

Camelids are new to many veterinary professionals. This session is targeted to introduce common industry standards and owner involvement with their animals, and to teach routine methods and procedures involving camelids.

Key words: camelids, herd health, routine procedures, health papers

Résumé

Les camélidés représentent une nouveauté pour plusieurs vétérinaires professionnels. Cette session vise à présenter les normes communes du secteur et l'implication des propriétaires auprès de leurs animaux et d'enseigner des méthodes et des procédures routinières impliquant les camélidés.

Introduction

Alpacas and llamas are wonderful to work with and so are their owners most of the time. The key thing to remember is that unless they have a large production-type herd, owners consider them in a “pet” livestock category. As owners, they are devoted to them and consider them part of the family. If you are a more traditional livestock veterinarian, when called out to a farm to look at a camelid it is best to treat the owners more like a small-animal client. Camelids, like any animal have many unique attributes as does the industry surrounding them. In veterinary school you may have only had a few lectures or interactions with camelids. This discussion is about the many camelid idiosyncrasies that are actually routine when dealing with camelids and their owners.

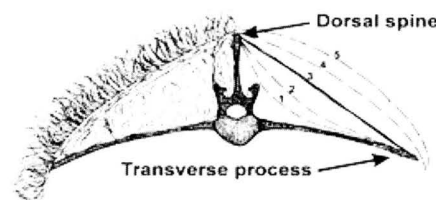
Herd Health

Most camelid owners do what they term “herd health” every 30 to 60 days. This should be used as a process to evaluate if there are problems in the herd, especially with regards to internal parasites. Gastrointestinal parasites can be a significant problem in camelids and must be routinely monitored to avoid clinical disease. A complete discussion of gastrointestinal parasites by Dr. Walker was presented at the AVMA 2016 conference.¹ Herd health should consist of assessing body condition scores (BCS), mucous membrane

check for color (FAMACHA), weight if they have a scale, trim toes and give meningeal worm prevention injections (more later). As a new owner and even experienced owners, they will (should) look to you as their veterinarian to help train them in the proper ways to do these procedures. Most will use a 1 to 10 scale for BCS, some will use a 1 to 5 scale. Emphasize that this is a subjective measurement and is best done by the same person each time. Have owner put hands on them regularly!

How to Body Score

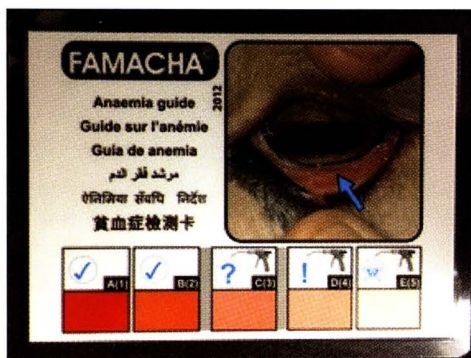
- Place hand behind shoulders at the withers, using angle between the thumb and forefinger determine a score from 1 to 10. This is an estimate of how much space below/beside the back bone is filled (or not filled) up with muscle.



- Feel over the rib area. You should be able to feel the ribs, but they should not stick out.
- Feel over the hips, they should not be very prominent. Note, older females will naturally have more “bony” hips.
- Feel on the chest wall immediately behind the elbow. If approaching a BCS of 7, a linear bulge of fat is present. If that is present, go on to feel the brisket.
- Very heavy animals will have a fatty deposit in the brisket.
- Just like humans, animals put on weight differently.
- Using all these areas as a composite, average the areas and determine a final BCS. A score of 5/10 being perfect; less than 5 - thin, greater than 5 - heavy.

FAMACHA SCORE

- Score 1 – very bright pink
- Score 2 – pink
- Score 3 – paler pink
- Score 4 – very pale pink
- Score 5 – white/dead

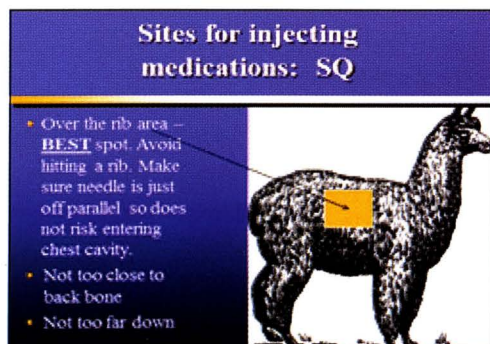


Source: Dr. Ray Kaplan, famacha@uga.edu³

When doing FAMACHA score on camelids, it is similar to goats with the exception that you will have an easier time if you assess the color of the upper eyelid rather than the lower. Camelids do not like to have their heads touched and will throw their heads up when touched. This allows the eye to roll down, and with slight pressure you can push in the eye using the lower eyelid which causes the tissue under their upper eyelid to evert. This also takes into account that the lower eyelid is more tightly adhered and harder to roll out. As this is also subjective, the same person should do this each time.

Sites for injecting medications - MOST injections are subcutaneous (SC)

- The area over the ribs is **best** for SC injections. Make sure to have the needle at a $\sim 45^\circ$ to the ribs. You can use the fiber to tent the skin: pull up on fiber and the skin is "tented" and ready to put needle either across (careful of not going through), or down the "tented" fold.
- Connection of neck and shoulder (IM)
- Triceps of front legs (SC, IM), small volume – best site for sedatives
- The lightly-haired area on the back of the rear leg (SC, IM)
- Vaccines can be given with a 20-gauge, 1-inch needle, 3 mL syringe. SC
- Procaine penicillin G^b – use an 18-gauge needle in adults, 20-gauge in crias (smaller volume). Let warm up to room temperature before administering. SC ONLY



Newborn Exams

Camelids can have many congenital abnormalities that need checking when doing a newborn exam. To determine early in life if there is a problem, encourage owners to have a thorough exam done on crias within the first few weeks, if not days, of life. This is a partial list of abnormalities – choanal atresia/stenosis, wry face, cleft palette, atresia coli/atresia ani, vulvar hypoplasia, pointed tongue, congenital cataracts, angular limb deformity, carpal valgus, polydactyly, arthrogryposis, deformed uneven legs, numerous heart defects, ear pinna defects, lack of ear canal (cauliflower ear), supernumerary teats, etc.

Choanal atresia/stenosis is a lack of complete union of the nasopharynx and pharynx and considered to be a heritable genetic defect. There can be either a bony or membranous barrier between the nasal and pharyngeal cavities, preventing air passage. Frequently these crias are born looking anatomically normal, so it is not always immediately apparent. Clinical signs are flared nostrils, "gurgling" breathing sounds, open mouth breathing, and puffing out cheeks when they breathe out. As they cannot breathe through the nose, they also cannot nurse. If they try any activity, including nursing, they may turn bluish and collapse. It is important to definitively diagnose this condition so normal crias are not mistakenly euthanized. To diagnose, several things can be done on the farm initially without advanced diagnostics. First, take a mirror or eye glasses and hold up to the cria's nostrils. Be careful that the cria does not breathe from the mouth on the glass. If there is fog on the glass from the nostril, then there is a passageway present. This does not test the size of the passageway and it is possible that there is choanal stenosis present or unilateral atresia. It is also possible that there may be an abnormal amount of mucus in the nares. In that case, time and activity will usually resolve the clinical signs. If there is no fog, further tests need to be performed. Next, using a small red rubber feeding tube (~ 16 French) and a small amount of lube, pass the tube along the ventral floor of the nasal cavity and pass down into the nasopharynx. If the tube does not pass and you are unsure of your technique, take a normal cria and pass the tube. It is not always easy to find the right place/angle, so make sure the tube stays

ventral and does not stop in the dorsal pharyngeal recess. Pay close attention and ensure the tube does not bend back on itself or coil up, mimicking being passed the full length. If the tube still does not pass, then further diagnostics should be done before the cria is euthanized. Contrast radiographs can be taken to confirm, although endoscopy (6 mm) is the definitive test. Put 5 to 10 mL of radiopaque contrast material (hypaque) in each nostril with the head and neck extended. Using a horizontal beam, keep the cria in sternal position for the picture. If there is a passageway present, the cria may swallow or cough and only small amounts of contrast will be seen on radiographs. If there is no passageway, the cria will not react and the contrast will be seen on radiographs; also the contrast will run out when the head is lowered. Any attempt at correction of the bony form is a long-term and painful procedure. Most crias are euthanized, as they have poor quality of life and will develop fatal secondary problems (aspiration pneumonia, septicemia, malnutrition, etc.). Research has shown that frequently these crias have other abnormalities, such as only 1 kidney. Even if only a partial or unilateral atresia/stenosis is present, they should not be used as breeders.

Wry face is a condition where the maxilla and mandible are misaligned to differing degrees. This is considered a heritable, congenital defect, although not definitively proven. Frequently they can manage to adapt to their abnormality and survive in a managed herd situation, but their quality of life can be marginal and they may need to be euthanized if severe. Also, camelids can be born normal and have wry face develop as they grow.

Cleft palate is a condition where either a portion or all of the soft or hard (or both) palate is absent. This may either be heritable, or possible toxins that interfere with normal movement of the tongue during gestation and the tongue "is in the way" during palate formation. The cria may present due to history of milk coming from the nostrils, or nasal discharge or aspiration pneumonia in the first few weeks of life. All newborn exams should include an assessment for cleft palate. These crias should be euthanized as treatment is unsuccessful.

Umbilical evisceration is rare, but can happen when the cria is born. If this happens at an observed birth, the intestines can be kept clean and moist and attempted to be surgically replaced. There is a high likelihood of peritonitis following replacement of the intestines. The 1 case the author has seen was in an unobserved birth early in the morning, and the cria was found walking on its own intestines.

Atresia coli/Atresia ani is heritable in calves and unknown in camelids, but probable. Crias with atresia coli can go an unbelievably long period of time with the condition without showing signs of pain. The author had a bottle cria that went 7 days, taking a bottle every 3 hours, with the abdomen growing in diameter. It died at 3 am, after drinking its full bottle at midnight. Atresia ani can be seen alone or in conjunction with a rectovaginal fistula. These conditions can

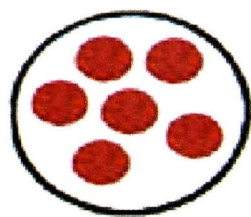
be corrected, but frequently other abnormalities are present. These animals should never be bred and it is more humane to euthanize them.

Vulvar hypoplasia is a defect where the vulvar opening is either partially or completely absent (labial fusion). It appears to be heritable in camelids, although not always expressed in subsequent matings. If it is complete, the cria will have stranguria and a "balloon" filled sac of urine at the vulva. If not corrected, the cria will die. As a newborn, the "balloon" can quickly be incised allowing the cria to urinate. Using triple antibiotic ointment with steroids topically for a few days can help to prevent closure. This opening will have to be surgically enlarged at puberty to allow comfortable urination as an adult. On occasion, the cria will have a complete fusion of the tissue, but is passing urine out of the clitoris. These crias should also have surgery because an adequate amount of urine cannot be passed in this fashion in a growing cria. These animals should not enter the breeding pool.

Some of these are terminal conditions, some can be corrected or will correct on their own, and some are cosmetic and not life-threatening. In addition to those listed above, special attention should be paid to the tail of the cria. On occasion they can have a bent/crooked or kinked tail, which is important they are a possible carrier of a genetic condition, hemi-vertebrae. This is where 1 or more vertebra does not develop properly, causing a wedge shape with subsequent misalignment of adjacent vertebra (subluxation) and pressure on the spinal cord. When this abnormality occurs in the cervical, thoracic or lumbar part of the spinal cord, it is a fatal condition, diagnosed by radiographs. Clinical signs are usually an uncoordinated gait and possibly falling down when attempting to restrain, especially if the head and neck are manipulated. With the exception of crooked tails, these animals do not live, we have no idea if it is a heritable condition, but it is recommended that this breeding match not be repeated.

Identification. Although some owners will put ear tags in their camelids, the use of microchips is much more common and is necessary for an animal to go to a show. These do not have to be the type that needs to be registered, as they will be checked to confirm ID for health papers at a show or if they travel out of state. The most common brands of microchips used are Deston,^c Smartchip,^d and AVID.^e It is standard for placement to be by the LEFT ear or the base of the tail. The chip can be administered at any time, even newborns, however, in the very young you must be VERY careful when placing as any wrong movement of the head (crias are very wiggly) can be dangerous as the needle may go through the skull. To avoid this, it is recommended that 3 people be used to restrain very young crias: 1 to hold the cria up in the arms, 1 to "clamshell" the head between 2 hands, and 1 to place the chip. The chips should be placed by the left ear. Use the ear as a "handle" and hold the ear down to the side of the head and place the needle (facing forward) by the base of the left ear (side closest to center of head). Place the

needle, no preparation is needed, make sure the tip of the needle is NOT all the way out the other side of the skin, and advance the plunger. Hold a finger over the needle site as it is being pulled out and keep pressure on the spot after the needle is removed. Sometimes the site will bleed quite a lot, so use pressure with a gauze/towel to stop the bleeding. After placement, use a microchip reader to make certain the chip reads and verify the number is the same as on the package. In some crias, you can actually feel a small “rice-like” bump under the skin. Make certain it is not just within the fiber, but under the skin. It is considered acceptable to place the microchip at the base of the tail. Do not use any other area, as it will be hard for a new owner or show check-in person to find the location if different.



Camelid registration. It is routine to DNA test and register alpaca crias, and this is a requirement to show or if selling as a breeding animal. Registration is suggested for llamas, but not required unless registering as a breeder. To register, a DNA sample must be submitted using a DNA card that can be purchased from the Alpaca Owners Association (AOA)^f or the International Llama Registry. Frequently owners will have cards available, but if planning on doing camelids in your practice, it is a good idea to have some on hand. The jugular vein is commonly used to draw blood for DNA sampling; however, the tail or ear vein can also be used, and frequently is used by owners. Using a 20-gauge needle, put small spots of blood within the circle on the DNA card; do not just fill the circle with blood. If using the DNA card also for bovine viral diarrhea virus (BVDV) testing (see later), make sure to date the card and have the owner send it in quickly as the BVDV testing window is only 60 days. The DNA will be good regardless of time.

Blood from jugular vein. In crias, the jugular vein can be felt and sometimes visualized, especially if a Suri. If needed, wet the fiber with alcohol. Try not to shave the neck, but if needed, shave only a small area. Some crias have what is described as “wrinkles” on their neck and are a normal finding, but can make collecting a blood sample even more challenging. These wrinkles represent extra skin and extra fiber density and will “stretch out” as they grow. In adults, it can be more challenging to find the jugular vein due to thickness of skin, especially in males, over conditioned female alpacas, and llamas as well if severely dehydrated. The jugular vein can be seen (after fiber removed) most of the time in female alpacas, younger male alpacas, and thinner llamas. In the remainder of our camelids, it is common to be unable to see the jugular vein but be able to detect it when the vein is held off and the vein is “thrummed” with your finger from above. Using anatomy, locate the 6th or 7th cervical vertebrae (largest) and work up the neck, keeping in line with the transverse process. Place your thumb to hold off the vein medial to the transverse process, then “thrum” down

the vein to feel it on your thumb. If needed when learning how to take blood from the jugular vein, most owners will let you shave a small area in adults, unless the animal is for sale. Once shaved, the fiber never “catches” up with remaining fiber until shorn again.

Health papers. These are needed as in other species, and are filled out as routine if traveling interstate. For alpacas going to shows, there are a few unique additions. The alpaca’s name and microchip number must both be listed. As these can be lengthy, it is recommended to put the name on 1 line and the microchip number in the line below, crossing out the line number. The breed should be listed as alpaca or llama, not Suri or Huacaya, and the species listed should be camelid. The location of the microchip should be stated next to the number. The phrase BVDV PCR “negative” or “not detected” (depending on lab reporting) should be listed in the area of “Other Tests” as well as the date of test recorded for each animal. Somewhere on the paper the name of the testing lab should be recorded. Some shows have some special state requests, and the owners should make you aware of them.

Tuberculosis testing. Testing is required by some states, and therefore some shows and auctions. The location for TB testing in camelids is in the minimally haired area behind the elbow on the chest wall. It is best to draw a circle around the area injected, then using calipers, measure the thickness of the skin, then inject 0.1 mL of PPD tuberculin as in cattle. Return in 72 hours to check for any thickness using a caliper. It is not an ideal test for diagnosis of tuberculosis in camelids, but it is what is required in the United States at this time.

Bovine viral diarrhea virus. This virus has caused persistent infection in crias, as in cattle. It is not that prevalent in most of the US, but in an effort to keep BVDV permanently out of the US camelid population it is recommended that all camelid crias be tested. PCR testing on whole blood is the test of choice, and it is appropriate for the diagnostic labs to pool the samples for testing. The AOA DNA blood cards, if submitted by 60 days after the blood was collected, can also be used for testing. BVDV testing is a requirement for alpacas to be shown, but not llamas.



Teeth. Fighting teeth (up to 3 pair) are more developed in males than females. They come in between 3 and 4 years of age. Once they are fully erupted (4 to 5 years of age) they must be cut off to prevent injury when fighting other males. Sedation may be required in some males. Sawing them off using OB wire is the safest method, especially if the animal is not sedated. Be careful not to cut into the gums. It is best to booster *Clostridium perfringens* (CD&T) before procedure. Also in some animals, incisors may need to be trimmed to maintain proper tooth angle. OB wire can also be used for this procedure, spraying the teeth occasionally to cool them down. A dremel can be

used to either cut off the teeth using a diamond cut-off wheel or a ceramic or diamond conical tip to smooth the rough edges left over by the wire. Retained deciduous incisors can be seen on occasion. Under sedation, they can be elevated and removed as in other species. If they are not interfering with eruption of adult incisors, they can be left alone. Some animals (usually older) may develop excessive points on their molars and start to chew on the lining of their cheek. These animals will develop a habit of packing cud in their cheek pouch. Using pony floats and heavy sedation; float the molars on all arcades. As in horses, do not make them smooth. Older camelids are prone to developing very long hooks of the back molars, so be sure to check if having any chewing problems or weight issues. It is common for many shearers to offer the services of trimming fighting teeth and incisors using a grinding tool.

Open-mouth breathing. Camelids are obligate nasal breathers, and it is usually a concern and sign of heat stress if they are truly open-mouth breathing. However, camelids have an odd habit that is alarming to owners when first seen. If they have just had a spitting fight with a neighbor, they will be seen walking around apparently breathing through their open mouth. The thought is that when bringing up liquid cud to spit, it leaves a bad “taste” in their mouth. As a result, until they eat or drink they do not like to close their mouth – looking as if they are open-mouth breathing.

Castration. Any non-breeding male should be castrated to minimize possible unwanted pregnancies if males unexpectedly/unknowingly get in with females, plus to control normal male behavior. It is recommended to wait until alpacas are 1 year old, and llamas are 2 years old. Early castration may lead to a chance of arthritis due to delayed closure of growth plates and development of straighter leg angles. Castration can be done either standing (llamas) or down (alpacas) and is approached similar to cats, cutting over the scrotum, or in dogs in a pre-scrotal position. It is best to ligate with suture and leave the wounds open. A booster vaccination with CD & T vaccine before the procedure is recommended, as is applying Catron fly spray to wounds to prevent fly strike. Post-surgical antibiotics are generally not required. Sedation with xylazine, torbugesic, and ketamine in the “Ketamine Stun” technique is used with minimal complications.

***Clostridium perfringens* type C, D, and tetanus.** “CD&T” (Bar-Vac CD&T[®]) is the most common vaccination given to camelids and is preferred over the “8-way clostridial” unless proven necessary. Some owners do not see the need, as camelids in general do not get the “CD” part, but emphasize to them that camelids can get the “T” part and vaccinating with CD&T vaccine is the least costly method of prevention. It is generally “boostered” during shearing to all males and non-pregnant females. It is best to avoid giving it to pregnant females in case of an endotoxin surge that will lyse the corpus luteum (CL) – the only progesterone-producing structure in camelids. It is recommended to give 2 mL SC to crias 2 to 3

days old, repeated with 3 mL SC at 30, 60, and 180 days of age, and yearly 3 mL SC boosters.

Rabies vaccinations. There is no vaccine labeled for camelids; however, they are frequently vaccinated in high-risk areas. The Imrab^h large animal rabies vaccine is the product to be used, 2 mL after 3 months of age with yearly boosters. The owners must be informed that since the product is not labeled for camelids, they are not “legally” protected.

Ivermectinⁱ/Dectomax^j is used in camelids as a prevention for meningeal worms wherever white tail deer live. It is given as a part of “herd health” day. Although no research has been done to determine the proper dosing interval, every 30 to 60 days is considered to be routine, with the possibility of Dectomax having the longer duration of action. These products must be given as a subcutaneous injection for prevention of meningeal worm, as the oral route is not effective for this purpose. The ivermectin dose is 1.8 mL/100 lb (45 kg), the Dectomax dose – 2.5 mL/100 lb (45 kg).

Skin conditions. There are many skin conditions in camelids: chorioptic mange, zinc – responsive dermatosis, follicular (sebaceous gland) cysts to name a few, plus an odd condition that is termed “munge”. Munge is typically seen in younger animals or animals under severe stress. The exact cause is unknown, but appears to be a combination of bacterial infection with sensitivity to their own saliva. It is seen as crusts or what looks like dirt on the lips. There is a superficial to deep skin infection on the commissures of the lips. It is a very painful condition and can develop into a generalized infection and require systemic antibiotics, but most of the time the condition can be treated topically. Treatment consists of gently daubing with chlorhexidine scrub at the crusts to loosen (may take several days to remove), blot dry, and gently work in a 50:50 mixture of hydrocortisone ointment and triple antibiotic ointment; mix ahead of time in a container and use ointment, not cream. In severe cases, clean daily and treat with either procaine penicillin G^b (20,000 IU/lb; 44,000 IU/kg, SC, daily for 5 to 7 days) or Excenel^k (1.8 mg/lb; 4 mg/kg, SC, daily for 5 to 7 days). Milder cases can be treated topically every other day until skin is pink and soft.

Chorioptic mange presents as gray, thickened skin that looks like “folds” or “ridges” in the skin. Lesions are located between toes, on the front and back of feet, inside thighs, abdomen, axilla, beneath the tail and on udder in females, and along the prepuce of males – sometimes on the face and ears. The lesions are usually only mildly itchy. The chorioptic mite is a surface-dwelling mite that feeds on epidermal debris. It lives its entire life on the animal, but can live in the environment for 70 days. Transmission is by direct and indirect contact. Can be found on animals with NO lesions (and frequently is), so suspect that animals with lesions may have a hypersensitivity to the mite. There are many types of treatment proposed for chorioptic mange. It can be hard to completely “cure”, and regardless of treat-

ment takes a long time to resolve. Topical treatment works best as it is a surface-dwelling mite, but frequently systemic treatment is attempted with little success (ivermectin at double dose (3.6 mL/100 lb (45 kg))). The author has found that lyme-sulfur ointment^l (compounded product) is the best treatment because it can be rubbed into the skin and helps to soften the skin and helps heal. In animals that have a large portion of the body affected, it is recommended to bathe with an anti-seborrhea shampoo every 2 weeks and rub in the ointment every 3 days. Milder cases can be shampooed monthly, and concurrently rub in ointment every 3 days. The goal is to have fiber grow back. If just the feet are involved, Frontline[™] spray can be used. Attempts to eradicate mites on the farm can be challenging as they can be in the bedding, barn walls, etc. Using a livestock concentrate premise spray is a cost-effective way to treat the environment.

Zinc-responsive dermatosis is generally seen in young males and females 1 to 2 years old. Colored-fleeced animals are apparently more susceptible. Lesions are not itchy, and present as thickened plaques of grayish crusts on the skin. Affected areas are in the hairless regions (frequently at the margins): thighs, belly, “armpits”, and “groin”. To diagnose: full-thickness biopsies, making sure to have a section of adjacent normal skin included with affected skin as part of the biopsy. The biopsy may help determine if parasites may also be a possibility. Measuring zinc concentration can sometimes be helpful, but keep in mind that some animals have “normal” zinc levels and still be actually deficient. That is why this is called zinc-responsive, as some individuals seem to need more zinc than others. To measure zinc concentration in the serum, a special tube **MUST** be used. Normal red-top tubes used to collect serum have a zinc-based component. Royal blue tubes must be used to store and send the sample. These tubes can be tricky to find; the diagnostic lab at Michigan State University is a source, plus it is the best laboratory to send the samples for testing (Michigan State University Veterinary Diagnostic Laboratory (VDL) - (517) 353-1683). For treatment give 2 to 4 grams of zinc methionine (10% zinc). This can be found in TruCare ZM for camelids manufactured by ZinPro.ⁿ It does not taste good and should not just be top-dressed on the feed, but rather it should be given mixed with a flavoring agent, such as applesauce. It will take several months before any change may be seen. Keep in mind there may be other elements (calcium, copper) in the diet/water that are interfering with the uptake of zinc by the affected animal, so it may not be a complete cure.

Follicular cysts (sebaceous gland cysts) can be seen on certain individuals as small firm, non-movable swellings under the skin, especially along the back bone. If ruptured, they will release a yellow or black waxy secretion. Some animals will have quite a few and will increase with age. They are incidental findings and unless become infected, do

not cause any problems. Shearers “cut off tops” and evacuate them; caution owners, as these will attract flies and may become infected.

Conclusion

Camelids in general are easy to take care of and wonderful to interact with. Careful, regular observation is important because as a species, they are prone to hiding when they are severely ill. Overall they are not prone to major health issues, but they, just like any other animal, they need some general care on a routine basis. As a service, the author recommends for all camelid owners to have 3 key drugs available on the farm: banamine, thiamine, and epinephrine, not to replace the services of their veterinarian, but rather to avoid a delay in treatment in critical situations.

Endnotes

- ^a FAMACHA, Kaplan Lab, Department of Infectious Diseases, 501 D.W. Brooks Drive, Athens, GA
- ^b Procaine penicillin G, Pfizer Inc., 235 East 42nd Street, New York, NY
- ^c Destron, 2805 East 14th Street, DFW Airport, TX 75261
- ^d Smartchip, Light Livestock Equipment, 697 Glen Road, Jay, NY 12941
- ^e Avid Identification Systems, Inc., 3185 Hamner Avenue, Norco, CA
- ^f DNA card, Alpaca Owners Association, Inc., 8300 Cody Dr, Ste A, Lincoln, NE
- ^g Bar-Vac CD&T, Boehringer Ingelheim, Inc., 3239 Satellite Blvd, Duluth, GA
- ^h Imrab, Boehringer Ingelheim, Inc., 3239 Satellite Blvd, Duluth, GA
- ⁱ Ivermectin, Merck Animal Health, 2000 Galloping Hill Road, Kenilworth, NJ
- ^j Dectomax, Zoetis, 10 Sylvan Way, Parsippany, NJ
- ^k Excenel, Zoetis, 10 Sylvan Way, Parsippany, NJ
- ^l Lyme-Sulfur Ointment, Cornerstone Pharmacy, 100 S Main St., Versailles, KY
- ^m Frontline, Boehringer Ingelheim, Inc., 3239 Satellite Blvd, Duluth, GA
- ⁿ TruCare ZM, 10400 Viking Drive, Suite 240, Eden Prairie, MN

Acknowledgement

The author declares no conflict of interest.

Reference

1. Walker PG. Gastrointestinal parasites-management for the herd, in *Proceedings. Annu Conv Am Vet Med Assoc*, 2016.