

What's Up Doc? New Developments in Camelids

Julie E. Dechant, DVM, MS, DACVS, DACVECC



Overview

- Literature Review
 - Reproduction
 - Pharmacokinetics
 - Medical Conditions
 - Production Management
- Research Update

Reproduction Pregnancy Diagnosis

Progesterone, pregnanediol-3-glucuronide, relaxin and oestrone sulphate concentrations in saliva, milk and urine of female alpacas (*Vicugna pacos*) and their application in pregnancy diagnosis

J. Vuikens, J. Gattschalk, A. Sobral, I. Witek, A. Einspanier

Veterinary Record 2012; in press

- Compared pregnancy-associated hormones in blood, saliva, milk and urine

Reproduction Pregnancy Diagnosis

- 36 alpacas before mating and throughout pregnancy
- Pregnancies verified by ultrasound
- Enzyme immunoassays
- On-farm milk progesterone kit



Reproduction Pregnancy Diagnosis

TABLE 1 Progesterone (P4) and pregnanediol-3-glucuronide (PdG) concentrations in different body fluids of pregnant and non-pregnant alpacas

	P4		PdG	
	Non-pregnant	Pregnant	Non-pregnant	Pregnant
Plasma	0.35±0.04 (n=40)	2.94±0.11* (n=17)	n/a	n/a
Saliva	2.15±0.34 (n=13)	1.01±1.32 (n=2)	4.49±0.99 (n=5)	5.42±0.92 (n=4)
Milk	0.83±0.06 (n=35)	1.02±0.38* (n=4)	n/a	n/a
Urine	0.25±0.04 (n=8)	0.74±0.06* (n=17)	25.70±2.80 (n=13)	152.23±7.37* (n=25)

Mean ± se of the mean in ng/ml (plasma, saliva, milk) or in ng/mg creatinine (urine). *P<0.01; **P<0.05

- Saliva not useful
- Milk and urine progesterone and urine pregnanediol-3-glucuronide significantly different in pregnancy

Reproduction Pregnancy Diagnosis

On-farm milk progesterone kit

- 3/31 (9.6%) false negative
Sensitivity of 90%
- 10/32 (31.3%) false positive
Specificity of 69%
- Positive predictive value: 74%
- Negative predictive value: 88%

Reproduction Pregnancy Diagnosis

Take Home Points

- Saliva not useful for pregnancy diagnosis
- Milk progesterone and urine pregnanediol-3-glucuronide may be alternatives for pregnancy diagnosis
 - On-farm milk test lacked diagnostic accuracy, but may be useful if optimized for camelids
 - Urine sampling is difficult
- Pregnancy should be confirmed with ultrasound

Reproduction Uterine Torsion

Uterine torsion in late gestation alpacas and llamas: 60 cases (2000-2009)

L.K. Pearson^{*}, J.S. Rodriguez¹, A. Tibary

Comparative Theriogenology, Department of Veterinary Clinical Sciences, College of Veterinary Medicine, Washington State University, Pullman, WA 99164, USA

Small Ruminant Res 2012; 105: 268-272

- Cases of uterine torsion in camelids presenting to WSU (2000-2009)

Reproduction Uterine Torsion

- 56 alpacas and 4 llamas
- 81.7% clockwise
18.3% counterclockwise

Rotation	Frequency	Comments
<180 degrees	14.3%	
180 degrees	26.3%	
270 degrees	10.7%	
360 degrees	48.2%	↑ C-section

Reproduction Uterine Torsion

Method of Correction	Frequency	Dam Survival	Cria Survival
Overall		96.7%	78.3%
Rolling only	60%	100%	100%
C-section only	23.3%	85.7%	71.4%
Rolling → C-section	16.7%	100%	70%

Reproduction Uterine Torsion

Take Home Points

- 2 peak times for uterine torsion
 - 8-10 months gestation
 - Parturition
- Severe uterine torsions (360 degrees) more likely to result in debilitation and surgery is best treatment method

Pharmacokinetics Meloxicam

BMC Veterinary Research



Bioavailability and pharmacokinetics of oral meloxicam in llamas

BMC Veterinary Research 2012, 8:85 doi:10.1186/1746-6148-8-85

BMC Veterinary Research 2012 8:85

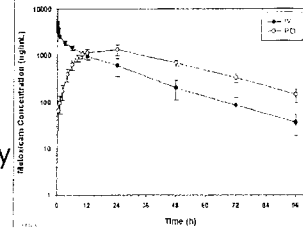
- To determine the pharmacokinetics of IV and oral meloxicam in llamas

Pharmacokinetics Meloxicam

- Meloxicam is a NSAID that can be used IV or orally in other animals
- Oral absorption of drugs generally unreliable in camelids

Pharmacokinetics Meloxicam

- 0.5 mg/kg meloxicam IV
- 1 mg/kg meloxicam orally
- Effective levels by 9 hours
- Peak levels at 21 hours
- Single dose may last 2-3 days



Pharmacokinetics Meloxicam

Take Home Points

- Oral meloxicam may be a practical and long-acting pain reliever
- Safety and efficacy unknown

Pharmacokinetics Florfenicol

Florfenicol pharmacokinetics in healthy adult alpacas after subcutaneous and intramuscular injection

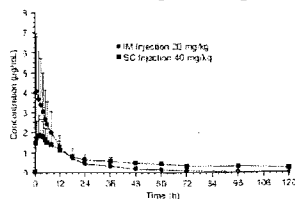
K. HOLMES*
D. BEDENICE* &
M. G. PAPICH†

J Vet Pharmacol Therap 2012, 35:382-388

- Evaluate the pharmacokinetics and clinical effects of SQ and IM florfenicol

Pharmacokinetics Florfenicol

- 20 mg/kg IM vs. 40 mg/kg SQ
- Drug levels higher after IM dosing
- Prolonged drug levels after SQ dosing
- Abnormal blood values after florfenicol use; transient illness in 1 alpaca



Pharmacokinetics Florfenicol

2012 ACVIM Forum Abstract

Florfenicol pharmacokinetics in healthy adult alpacas, evaluating two commercially available drug formulations. Bedenice D, Papich MG, *et al* Nuflor vs. NuflorGold

40 mg/kg SQ q48h x 10 doses

Formulation	C_{max} (log scale)	Time to C_{max} (h)	AUC (log scale)	$t_{1/2}$ (h)	$t_{1/2}$ (h)	$t_{1/2}$ (h)
Nuflor	1.45E+04	2.56E+01	2.67E+02	9.77E+01	-	-
NuflorGold	7.54E+03	7.81E+01	2.11E+02	-	7.14E+01	4.02E+02

- Fewer systemic complications with NuflorGold

Pharmacokinetics Florfenicol

Take Home Points

- Both Nuflor and NuflorGold may be erratically absorbed following SQ administration
- NuflorGold recommended because higher and therapeutic concentrations with fewer systemic side-effects

Medical Conditions Injection Complication

Cervical Myelomalacia in a Lamb (*Ovis aries*) and an Alpaca (*Vicugna pacos*) after Attempted Intramuscular Injection

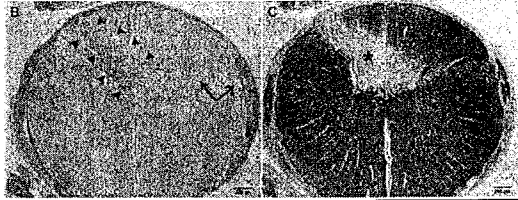
A.L. Johnson, T. Alenghat, and J.B. Engiles

J Vet Internal Med 2012; 26: 1481-1484

- Immediate paralysis after IM cervical injection

Medical Conditions Injection Complication

- Unilateral track lesion in spinal cord and clinical history strong evidence for needle and/or drug penetration of spinal cord



Medical Conditions Injection Complication

Take Home Points

- First report to describe acute spinal cord injury as IM injection complication
- Recommendations for cervical intramuscular injections in food animal species are contraindicated in camelids and small ruminants

Production Management Nutrition & Semen Quality

Alpaca semen quality in relation to different diets

N. S. Juyena^A, J. Vencato^A, C. Pasini^B, I. Vazzana^C and C. Stelletta^{A,D}

Repro Fertility Develop 2012; in press

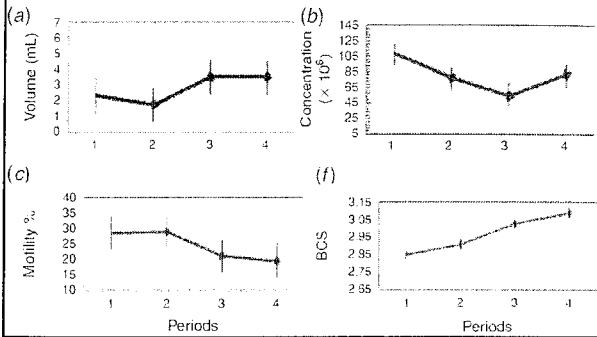
- Evaluate semen quality of alpacas maintained on different diets

Production Management Nutrition & Semen Quality

- 5 alpacas fed different diets for 6 weeks

Periods	Time	Diet
1	2 Mar 2009–12 Apr 2009	Hay
2	13 Apr 2009–24 May 2009	Hay + pasture grazing
3	25 May 2009–5 Jul 2009	Pasture grazing + sheep concentrate ^A
4	6 Jul 2009–16 Aug 2009	Pasture grazing + horse concentrate ^B

Production Management Nutrition & Semen Quality



Production Management Nutrition & Semen Quality

Take Home Points

- Feeding of sheep or horse concentrate had a negative effect on semen quality... HOWEVER confounding effects of season and body condition score
- More research is needed to determine effects of different nutritional regimens on reproductive performance

Production Management Nutrition & Fiber Quality

Undegradable dietary protein in alpaca diets affects fibre diameter and time spent urinating

K. E. Lund^A, J. T. B. Milton^{AC}, S. K. Maloney^B, K. M. M. Glover^A, J. L. Vaughan^D and D. Blache^{AE}

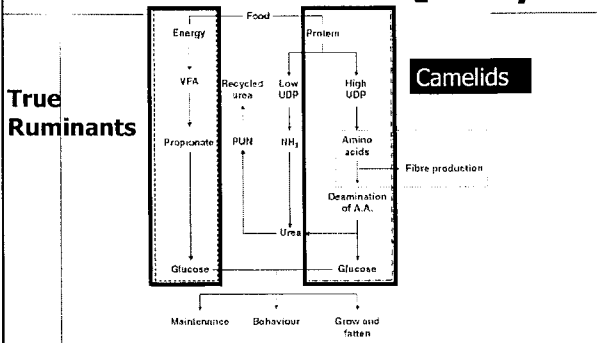
Animal Production Sci 2012; 52: 959-963

- Supplemental protein may optimize fiber production

Production Management Nutrition & Fiber Quality

- Protein entering C1 is either degraded or non degraded
 - Degraded protein synthesized into microbial protein or excreted in urine
 - Undegraded protein absorbed by alpaca for fiber growth or energy
- Theory that diets high in undegradable dietary protein would increase fiber production and decrease urination

Production Management Nutrition & Fiber Quality



Production Management Nutrition & Fiber Quality

Table 1. Mean (±s.e.) metabolisable energy (ME) intake, change in liveweight, body condition, fibre growth and fibre diameter of alpacas fed diets containing different proportions of undegradable dietary protein (UDP) over 14 weeks

Within rows, values followed by different letters are significantly different at $P < 0.05$

Measurement	Proportion of UDP from concentrate in diet			
	0%	30%	60%	100%
ME intake (MJ/kg ^{0.75} /day)	4.2 ± 0.22	4.3 ± 0.21	4.2 ± 0.27	4.2 ± 0.26
Change in liveweight (kg)	1.7 ± 0.28	1.5 ± 0.85	2.9 ± 1.11	1.5 ± 1.33
Change in condition score (1-5)	0.0 ± 0.15	-0.2 ± 0.16	0.0 ± 0.19	-0.2 ± 0.16
Fibre growth (mg/cm ²)	33.8 ± 3.42	39.5 ± 3.29	42.2 ± 3.97	37.7 ± 3.10
Fibre diameter (µm)	18.1 ± 0.56a	20.4 ± 0.93b	21.4 ± 0.63b	20.4 ± 0.52b

- Undegradable dietary protein did NOT significantly increase fiber growth but DID significantly increase fiber diameter

Production Management Nutrition & Fiber Quality

Table 2. Time budget of alpacas fed a diet containing either 0% undegradable dietary protein (UDP) or 100% UDP for each behaviour category observed

Times for each behaviour category are expressed as percentage of total time. Within rows, values followed by different letters are significantly different at $P < 0.05$

Behaviour	Proportion of UDP from canola meal in diet	
	0%	100%
Eating	27.1 ± 4.68	32.6 ± 3.71
Lying	29.2 ± 4.27	17.1 ± 1.65
Standing	73.5 ± 3.91	76.4 ± 2.26
Walking	4.1 ± 0.77	6.4 ± 1.79
Grooming	0.8 ± 0.19	1.6 ± 0.57
Defecating	0.4 ± 0.13	0.2 ± 0.06
Drinking	0.4 ± 0.13	0.2 ± 0.11
Urinating	0.4 ± 0.13a	0.1 ± 0.04b

- Alpacas fed no undegradable dietary protein spent more time urinating than those fed 100% undegradable dietary protein

Production Management Nutrition & Fiber Quality

Take Home Points

- Fiber diameter was finer in alpacas fed 0% undegradable dietary protein (→ microbial protein or urine) with no decrease in fiber production
- Increased urine production suggests increased water consumption

Production Management Nutrition & Fiber Production

Rumen-protected methionine supplementation and fibre production in alpacas (*Vicugna pacos*)

K. E. Moore¹, S. K. Maloney², J. L. Vaughan³, J. T. B. Milton^{1,4} and D. Blache¹

J Animal Physiology and Animal Nutrition 2012; in press

- Sulfur-containing amino acids might increase fiber growth if protected from degradation in C1

Production Management Nutrition & Fiber Production

- Methionine supplementation did not improve the quantity or quality of the fiber produced
- Possible explanations:
 - Adequate methionine in the diet already
 - Limited genetic potential of animals
 - Energy diverted for thermoregulation

Production Management Nutrition & Fiber Production

Take Home Point

- As administered in this study, supplemental methionine did not increase fiber growth

Production Management Genetics

The Genetic Inheritance of the Blue-eyed White Phenotype in Alpacas (*Vicugna pacos*)

FELICITY C. JACKLING, WARREN E. JOHNSON, AND BELINDA R. APPLETON

Journal of Heredity 2012; in press

- Identify gene markers with the blue-eyed white (BEW) alpaca

Production Management Genetics

- BEW=solid white coat, blue irises, often deafness
- Inheritance of BEW unknown, but thought to be interaction between gray gene and white-spotting gene
- Alpaca KIT gene major candidate for white-spotting patterns



Production Management Genetics

- 2 genes responsible for BEW
 - Cumulative hypopigmentation effects of 2 KIT mutations (*bew1* and *bew2*)
- One gene mutation responsible for gray fiber (*bew1*)
 - Some non-gray animals have gray gene → hidden gray animals
 - Double gray appears to be lethal (no homozygous *bew1* animals)

Production Management Genetics

- Effect of second gene mutation (*bew2*) by itself unclear
 - Tendency for white fleece with pigmented eyes, but also seen in colored animals
 - May be result of difficulty in identifying subtle white-spotting patterns

Production Management Genetics

- Take Home Points
- Is BEW a genetic flaw?
 - Genes for *bew1* and *bew2* relatively common and breeders may inadvertently get BEW from 2 carriers
 - Future potential for genetic screening?

Production Management Fiber Sampling

Variation of fibre characteristics among sampling sites for Huacaya alpaca fleeces from the High Andes

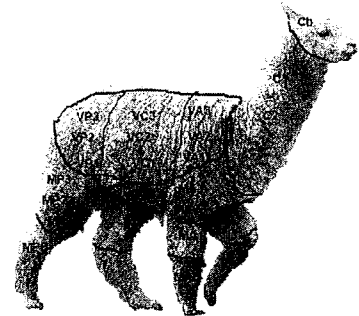
B.A. McGregor^{a*}, H.E. Ramos^b, E.C. Quispe Peña^b

Small Ruminant Res 2012; 102: 191-196

- Evaluate the differences in fiber attributes from different sampling sites

Production Management Fiber Sampling

- 24 sites sampled



Production Management Fiber Sampling

General pattern:

1. Top to bottom
 - Increase in mean fiber diameter
 - Decrease in fiber curvature and staple length
2. Neck
 - Decrease in staple length
3. No marked differences front to back

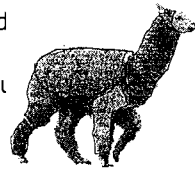
Production Management Fiber Sampling

- Mean fiber diameter of the mid back site was more correlated to the mean fiber diameter of the whole fleece
 - Better correlation than mid-side and withers

Production Management Fiber Sampling

Take Home Points

- Mid back site may be preferred site for fleece sampling
- Highest quality fiber from saddle sites and hind legs
- Neck and head fiber fine, but short
- Front leg fiber coarser than saddle; hock and belly fiber short and coarse



Production Management Fiber Classification

A feasibility study of the classification of Alpaca (*Lama pacos*) wool samples from different ages, sex and color by means of visible and near infrared reflectance spectroscopy

A.W. Canaza-Cayo^{a,b}, D. Cozzolino^{c,d}, D. Alomar^b, E. Quispe^d

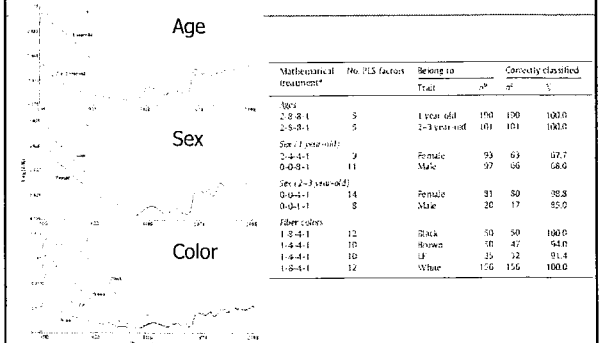
Computers and Electronics in Agriculture
2012; 88: 141-147

- Evaluate near infrared reflectance spectroscopy to classify alpaca fiber

Production Management Fiber Classification

- Classification
 - Age: 1 year vs. 2-3 years
 - Sex: Male vs. female
 - Color: White vs. light fawn vs. brown vs. black

Production Management Fiber Classification



Production Management Fiber Classification

Take Home Points

- Near infrared spectroscopy can be used to rapidly classify ages and color
 - Only 4 colors evaluated
- Not reliable for sex of animal
- May improve classification for industrial textile products

UC Davis Camelid Research

Isolation of Alpaca Anti-Hapten Heavy Chain Single Domain Antibodies for Development of Sensitive Immunoassay

Hee-Joo Kim,¹ Mark R. McCoy,² Zuzana Majkova,³ Julie E. Dechant,² Shirley J. Gee,² Sofia Tabares-da-Rosa,³ Gualberto G. González-Sapienza,³ and Bruce D. Hammock^{1,2}

- Research using unique camelid antibodies to develop new diagnostic tests

Camelid Antibodies in the News

Hospital Infections: Unique Antibody from Llamas Provide Weapon Against Clostridium Difficile *Mar. 18, 2011*

Tiny Antibody Fragments Raised in Camels Find Drug Targets in Human Breast Cancer Cells *Apr. 13, 2011*

Are Llamas the key to stopping HIV? *Jun. 26, 2012*

Camels to Help Fight Alzheimer's? New Class of Antibody from Camelids That Can Cross the Blood-Brain Barrier *Oct. 1, 2012*

Camelid Research and Current Events

Thank you for your attention!
Any Questions?

