# CAMELID PARASITOLOGY: 2009 EDITION

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# Parasites

- Internal
  - Strongyles
    - *Trichostrongyle* spp.
    - *Nematodirus* spp.
    - *Haemonchus* spp.
  - Whipworms
    - *Trichuris*
    - *Capillaria* spp.
  - Tapeworms
    - *Monezia* spp.
  - Coccidia
    - *Eimeria* spp.
    - *E. macusaniensis*

# Internal Parasite Control

- Pasture factors
  - Stocking density needs to be <6-8 head/acre
  - Bermuda, brome, other improved pastures, form a dense canopy
    - 155°F in sun-exposed fecal pellets
  - Sparse brush allows for heat and drying of fecal pellets
  - Changes will be reflected in worm burdens in 3-8 weeks

# Internal Parasite Control

- Animal factors
  - Young animals
  - Genetics
    - 20% of animals harbor 80% of worms [sheep and goats]
  - New purchases, social, weather stresses
  - Immunosuppression of individuals
  - Periparturient rise
    - Large increase in infections from 2 weeks prior to until 8 weeks after delivery

# Internal Parasite Control

- Drugs factors
  - Drugs are related
  - Rotation of dewormers is not currently recommended
- No new drugs are being made
  - There are no “better dewormers”
  - There are no “broad spectrum dewormers”
- No drug has ever been or ever will achieve 100% kill
- Drug resistance is a random event
  - But we do speed it up (Meningeal worm prevention)

# Plan of Attack

- Deworm frequently? High doses?
  - No – Monitor risk

- Ways to monitor
  - Composite sampling of fresh dung
    - Test 10% of each animal group or 10 animals, whichever is greater
    - For dewormer decisions and evaluation
    - Serial monitoring of herd
  - Selective sampling of individuals
    - For individual thin animals

# Parasites

- Diagnosis
  - Need QUANTITATIVE and qualitative fecal
  - Direct smear
  - Nitrate flotation media
  - Modified McMaster's technique
    - Sensitive only to 25-50 EPG
    - Not sensitive for *Trichuris* or *Nematodirus*
  - Modified Stoll's
    - Sensitive to 5-10 EPG
    - Sensitive for *Trichuris, Capillaria, Nematodirus*

# Comparison of Diagnostic Methods

- Fecals from 42 alpacas and 62 llamas [Cebra, Stang JAVMA 2008]
- Direct smear
- Modified McMaster's with sucrose or saline
  - 15 and 60 minutes
- Centrifugation-sucrose flotation procedure
  - Overnight soak
  - 10 and 60 minutes

# Comparison of Diagnostic Methods

- Centrifugation-flotation
  - Found more of all parasites except small coccidia
  - Small coccidia required flotation for 60 minutes

- Modified McMaster's method
  - Longer time did not really matter
  - Sucrose solution found more Trichuris, E mac, and strongyles than saline McMaster's
  - Saline solution found more Nematodirus and small coccidia than sucrose McMaster's

# Parasites

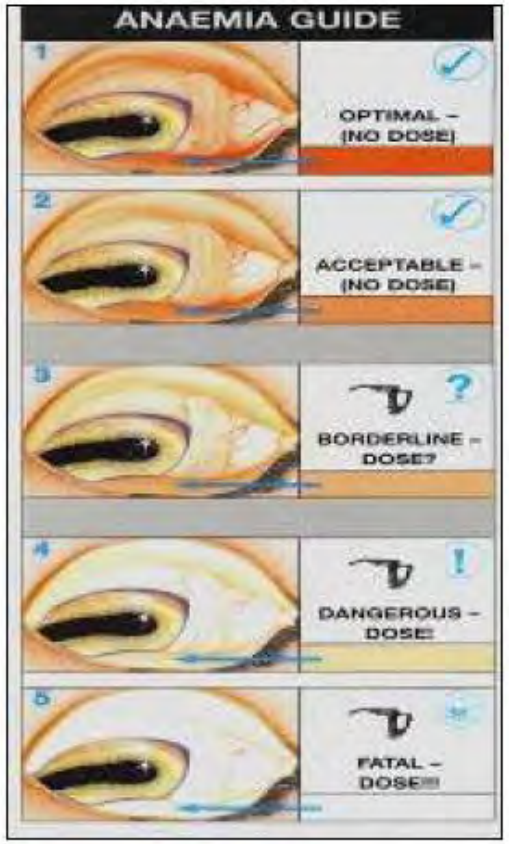
- Diagnostic strategy
  - **Fecal Egg Count Reduction Test (FECRT)
    - Modified Stoll's, deworm, repeat Modified Stoll's in 14 days
  - Used to verify drug efficacy
  - Reduction of EPG by >90%
  - Lower reduction = trouble
    - Resistance
    - Lack of efficacy
      - Dose, route, drug, weight

# Parasites

- Diagnostic strategy
  - Larval Development Assay
  - *H. contortus* most prevalent worm from 2 llama herds
    - Highly ivermectin and benzimidazole resistant
  - UGA and Fort Valley State University [Williamson, Proc. ICHC 2009]
    - 26 camelid farms with nematodes and coccidia 2007-2008
    - *H. contortus* most common
    - LDA performed in all, FECRT on 4 farms
    - Multiple drug resistance was common
    - LDA predicted susceptibility and FECRT showed resistance
    - Inappropriate dosing?

# FAMACHA System

- For *Haemonchus contortus* only
- 921 alpacas and llamas [Williams and Storey Proc. ICHC 2009]
- Correlation of eyelid color to anemic
  - 1 and 2 scores – not anemic
  - 5 definitely anemic
  - Not as easy to score as sheep and goats



# Treatment Failures

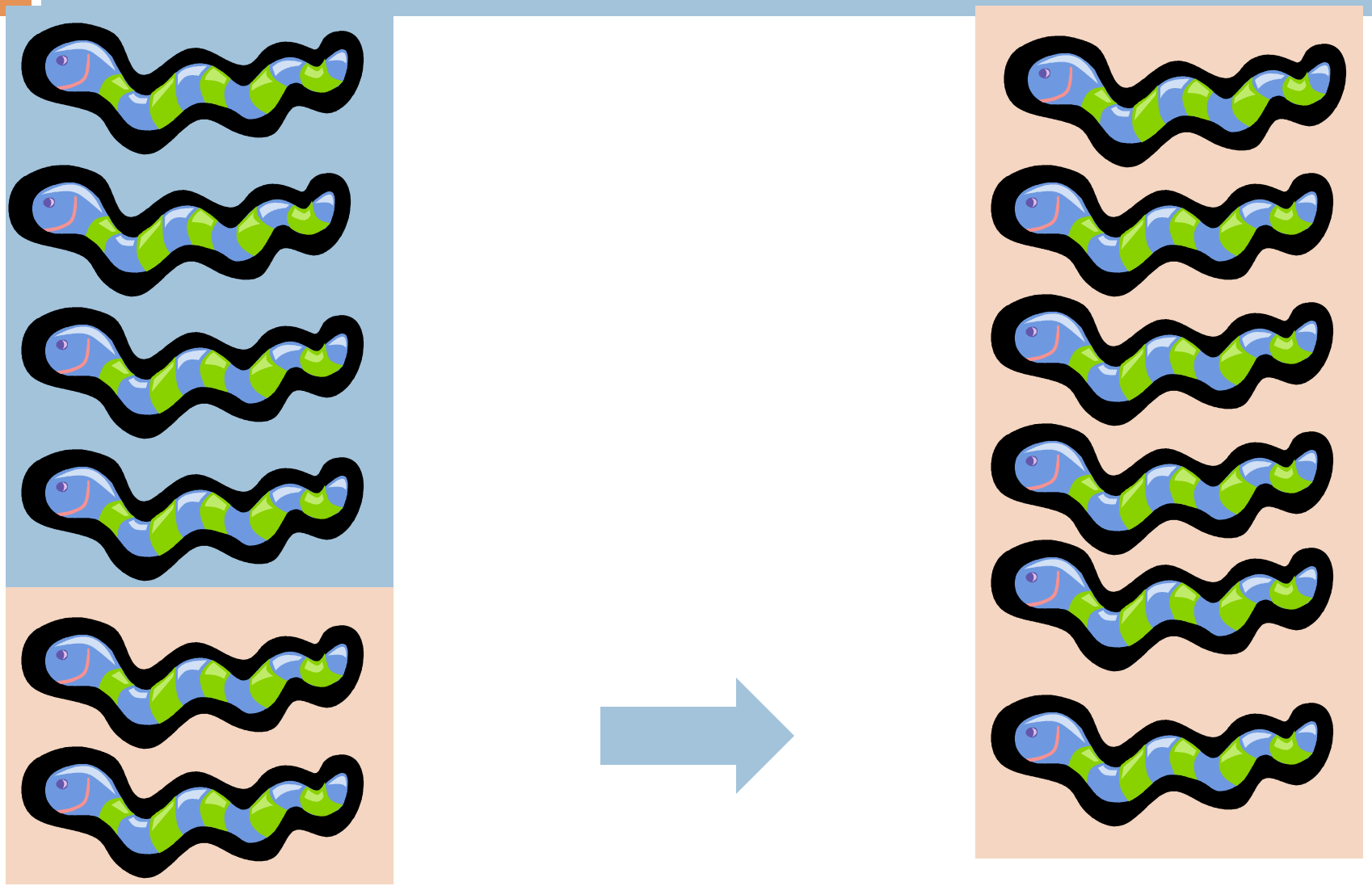
- Treatment failure ≠ Resistance
  - Insufficient dosage administered
    - Suspensions, spit out, inaccurate weights
    - What is the correct dose?
  - Insufficient drug activity
    - Out of date, improper storage, generics, thin animals
  - Reinfection
  - Fecal flotation inaccuracy
    - 1+, 2+…, larvae vs. adults
  - Incorrect parasite spectrum of activity
    - *Nematodirus* and *Trichuris* limited susceptibility to ivermectin
    - Benzimidazoles limited against *Trichuris* (except oxfendazole and oxi

# Internal Parasite Control

- Treatment strategies
  - Goal is not no worms, but manageable numbers in animals and on pasture, who are susceptible to treatment if they become a problem

- Refugia
  - A population of susceptible worms on pasture
  - Dilute the population
  - Hybrid vigor

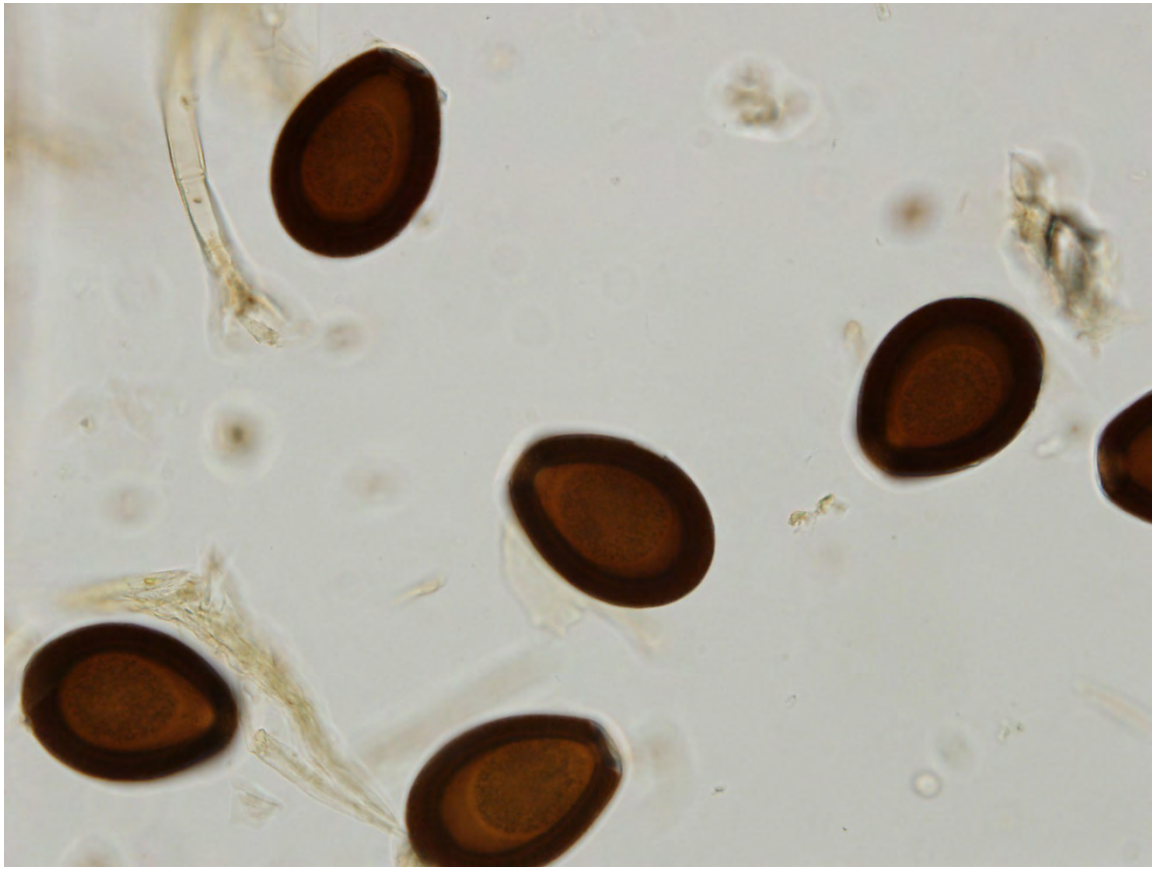
# Internal Parasite Control



# Role of Nutrition

- Immunity closely related to protein nutrition
- Phosphorus inhibits worm establishment
- Cobalt deficiency related to reduced immunity to GI nematodes
- Adequate copper required for development of immunity against GI nematodes
- Molybdenum addition of 6-10 mg/d reduced worm burdens in lambs
  - Copper deficiency?
  - Increasing jejunal mast cells and blood eosinophils

# *Eimeria macusaniensis*



# *Eimeria macusaniensis* infection in 15 llamas and 34 alpacas

- Cebra et al, JAVMA 2007
- Animals between 3 week and 18 years old with fecal oocysts or intestional coccidial stages morphologically consistent with *E. macusaniensis*
- Clinically, many were severely affected with weight loss, circulatory shock and diarrhea
- 15 of the 30 treated animals died or were euthanized
- Severity of disease related to infective dose of oocysts, host immunity and other factors

# Coccidia Life Cycle

- Ingestion of a sporulated oocyst
- Release of sporozoites
- Invasion of epithelial cells of the intestinal villi
- Asexual multiplication of the organism
- Destruction of the cells and release of many more organisms
- Repeat

# Coccidia Life Cycle

- Sexual reproduction occurs in the lower GI tract
- Oocysts passed in the feces
- Sporulate to become infective in the environment
- The infective stage of this parasite is in the pasture!

# *E. mac* Oocyst Infectivity

- Alpaca and guanaco *E. mac* oocysts [Jarvinen J Parasit 2008]
- Stored 41-84 months
- Infected 4/4 llamas
  - Prepatent 36-41 days; patent 38-55 days
- 3 llamas and 1 alpaca fed 1000 oocysts stored 3 months
  - Llamas: prepatent 33-34 days; patent 14-20 days
  - Alpacas: prepatent 58 days; patent 1 day

# *E. mac* Diagnostics

- Flotation in high SG solutions, prolonged flotation
  - 1.27-1.33
- Blood ELISA – high prevalence = ⬆ + rate
- Fecal PCR – DNA shed during prepatent phase
- Impression smears of intestine
- Histopathology

# *E. mac* Therapy

- Supportive care as indicated by case
- Sulfonamide antibiotics
- Amprolium
- Triazinetriones (includes ponazuril, toltrazuril)

- Intraluminal therapy may have limited use due to lamina propria invasion

# *E. mac* Therapy

- Sulfas and amprolium best against early stages
  - May not see immediate drop in fecal oocysts
- Triazinetriones effective against all stages
  - Decrease shedding
  - Relatively safe
    - Some have voiced concern about teratogenic risks
    - Prolonged exposure in rodents and rabbits has led to bony defects

# Take Home Messages

- Perform routine fecal egg counts at a laboratory that does lots of camelid fecals
  - FECRT – currently recommended
- Target deworm only when animals need it and only animals that need it
- Watch your management
  - Stocking density
  - New additions