Alpaca

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Abstract

- Based on the gastrointestinal anatomy and physiology of the horse, the alpaca, and the sheep, the study measured the Neutral Detergent Fiber (NDF) digestibility in 3 independent experiments.

Experimental methods

- It is suggested that the digestive tract anatomy and physiology accounts for the differences in NDF digestibility in the 3 animals selected.
Introduction

- Two types of Alpaca: the Suri and the Huacaya
- Ruminant from Camelidae family; related to the camels
- Similar but smaller than a llama
- They have been domesticated for 6000 years
- The Incas developed these camelids into a superior fiber producer in ~22 different colors
In South America

- Strict grazers
- Raised here for its wool
- Found in elevations of 4400-4800m
- Consume tall grasses in the wet season and short grasses in the dry season
Gastrointestinal tract of the alpaca

Duodenum

Small Intestine

True Stomach

C3

Oesophagus

C2

C1

Large Intestine

Cecum

Rectum

Spiral Colon

Glandular Saccules
Anatomy of the Digestive Tract

- Upper lip is split by a labial cleft to allow independent movement of each side of the lip
- Incisor teeth located on lower front of jaw and takes 4.5 years for their development
- Tongue does not participate in grabbing food nor in licking
Anatomy of the Digestive Tract

- Saliva used for: lubrication of dry feed, addition of bicarbonate and phosphate to buffer against acids, and recycling nutrients
- Thus, alpacas are selective about what they eat
- The alpaca is a pseudoruminant having 3 stomach compartments compared to 4 in ruminants.
- These compartments are called C-1, C-2, and C-3, in order of decreasing size.
Anatomy of the Digestive Tract

- Glandular Saccules in C-1 and C-2 compartments: absorb nutrients, add mucus secretions, glycoproteins, and urea for the microbes, and may secrete bicarbonate to buffer the said compartments

- Alpacas have a greater forestomach motility than true ruminants

- C-1 and C-2 motility mixes ingesta to allow exposure of feed to microbes and for degradation
Anatomy of the Digestive Tract

- Microbes in C1 produce gas.
- Increased stomach motility is why alpacas are resistant to both foregut gas accumulation and bloat compared to true ruminants.
- Regurgitation occurs during mixing.
- Stomach contents are sucked into the esophagus and carried into the mouth.
- Large fibers are regurgitated for more chewing and to stimulate salivation.
Anatomy of the Digestive Tract

- Small intestine is 8m long in an adult and digests and absorbs nutrients.
- Large intestine absorbs water, minerals, and vitamins, secretes mucus, and allows further microbial action on digesta.
- Feces formation begins at the start of the spiral colon.
Alpaca and Microbes

- Microbes break down cellulose in the feed
- Microbes provide VFAs for energy and B-complex vitamins
- Alpaca provides the feed and a stable environment
Materials and methods

Voluntary intake and digestibility of forages with different nutritional quality in alpacas (Lopez et al, 1997)

Objective: Determine apparent digestibility coefficients and voluntary intake of 4 forages

- Commercial Hays:
  - Clover
    - 52% *Trifolium pretense*, plus *Lolium multiflorum*, *Festuca arundinacea*
  - Ryegrass
    - 68% *Lolium multiflorum*, plus *Festuca arundinacea*
- Wheat straw
  - 70% *Triticum aestivum* plus *Bromus hordaceus*
- Fescue
  - 100% *Festuca arundinacea*

Stage of maturity not established
Voluntary intake and digestibility of forages with different nutritional quality in alpacas (Lopez et al, 1997)

- Chile
  - Central region: Andean plateau
    - Native forages are low quality, very high in cell wall content, deficient in protein
    - Consequences: malnutrition, negative effects on reproductive performances, high mortality of alpaca calves

- 8 male adult alpacas
  - Huacaya
  - Similar age and weight
Voluntary intake and digestibility of forages with different nutritional quality in alpacas (Lopez et al, 1997)

- Total collection method
  - Harness and collection bags
- Hay offered as is
- Daily collection of feces
  - Weighed
  - Sampled
  - Dry matter determined
  - Stored at -20°C for analysis
- Dry matter (DM), organic matter (OM), crude protein (CP) and ether extract (EE)
Voluntary intake and digestibility of forages with different nutritional quality in alpacas (Lopez et al, 1997)

Results:

- Forages low quality
- High cell wall content:
  - NDF: up to 80% in wheat straw
  - Lignin: highest in wheat straw and clover
    - 11% in clover
- Protein content: 2.2 - 10.9%
  - Below 7.4% in fescue and wheat straw
    - Minimum suitable level for maintenance in adult alpaca
Voluntary intake and digestibility of forages with different nutritional quality in alpacas (Lopez et al, 1997)

Results:

- Differences in DM and OM intakes
  - DM digestibility
    - Best in fescue: 55.9%
    - Least in wheat straw: 48.4%
    - Clover: 54.5%
    - Ryegrass: 55.3%
  - Other studies show that when good quality forages were fed, values for DM digestibility ranged from 63.5 to 65.1% (Lopez et al., 1996) and 63.8% for ovines (Hintz et al., 1973)
Voluntary intake and digestibility of forages with different nutritional quality in alpacas (Lopez et al, 1997)

Results:

- Protein digestibility (CPD) related to CP in forage
  - Highest in clover (63%)
  - Lowest in wheat straw (-42%)
  - Ryegrass: 55.5%
  - Fescue: 34.6%

- Other studies observed a protein digestibility of 60% in alpacas and 61.9% in sheep, in diets with 10.5% CP (San Martin and Bryant 1989b)
  - Decline in digestibility in diets less than 7.5% CP
    - 42.1% in alpacas
    - 36.1% in sheep
Voluntary intake and digestibility of forages with different nutritional quality in alpacas (Lopez et al, 1997)

Results:

- **EE digestibility (EED)**
  - Highest in clover: 60.7%
  - Lowest in wheat straw: 46.8%
  - Ryegrass: 57.3%
  - Fescue: 49.7%

- **NDF Digestibility (NDFD)**
  - Highest for fescue: 54.3%
  - Lowest for clover: 46.9%
  - Wheat straw: 54.2%
  - Ryegrass: 50.9%
Voluntary intake and digestibility of forages with different nutritional quality in alpacas (Lopez et al, 1997)

Results:

- NDFD

- Other studies that show similar results
  - 40.5 - 52.3% for forages of comparable quality (Lopez et al., 1995)

- With medium quality forages, San Martin and Bryant (1989b) found that NDFD was 11% higher in llamas than in sheep, in a diet with 68% NDF
  - 7% higher, in a diet with 58% NDF
  - 17% higher, in a diet with 42% NDF
Voluntary intake and digestibility of forages
with different nutritional quality in alpacas
(Lopez et al, 1997)

Results:

- **ADF digestibility (ADFD)**
  - Similar for all forages
    - Highest in fescue: 49.3%
    - Lowest in clover: 45.3%
    - Wheat straw: 49.2%
    - Ryegrass: 43.2%

- **Hemicellulose digestibility**
  - Highest in wheat straw: 64%
  - Lowest in clover: 51%
  - Fescue: 63%
  - Ryegrass: 61.5%
Voluntary intake and digestibility of forages with different nutritional quality in alpacas (Lopez et al, 1997)

- Cellulose digestibility:
  - Highest in wheat straw: 64.8%
  - Lowest in clover: 58%
  - Fescue: 61.4%
  - Ryegrass: 58.2%

- This study shows:
  - Feed intake related to forage quality
    - Correlated with digestibility
  - Very low quality forages show a high NDF and ADF digestibility in spite of a negative protein digestibility from low nitrogen intake
  - Alpacas have a great adaptive capacity even when poor quality forages are fed
## Results

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Within three of the animals selected, the alpaca had a greater NDF digestibility than the sheep and the horse; the horse having the least NDF digestibility.
Pseudoruminant vs. Ruminant

Gastrointestinal tract of the alpaca

- Duodenum
- True Stomach
- Oesophagus
- C3
- C2
- C1
- Large Intestine
- Cecum
- Rectum
- Spiral Colon
- Glandular Saccules

- Esophagus
- Omasum
- Reticulum
- Abomasum

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Reason for highest Digestibility in Alpaca than the Sheep and the Horse

- Although the alpaca and the sheep are both ruminants, their gastrointestinal anatomy is different in some ways.
- The alpaca retains the particulate material longer in their stomach compartments which allows for greater exposure to the microorganisms (Clemens and Stevens, 1980 as cited by Lopez et al.).
- There is greater motility in the alpaca’s forestomach (AAA).
Reason for highest Digestibility in Alpaca than the Sheep and the Horse

- Also, the more neutral pH of the C-1 and C-2 compartments of the alpaca neutralizes the VFAs which make them into ions that are more slowly absorbed (Lopez et al.).

- The faster liquid passage time also contributes to the rapid division of the microbial population leading to a greater efficiency in the conversion of fiber to VFAs (AAA).
Digestive Tract of the Horse
Reason for lowest NDF Digestibility in the Horse

- Horses are hindgut fermentors. The microbial fermentation site in the horse is the enlarged colon.
- In ruminants and pseudoruminants, the microbes have the advantage of degrading the NDF constituents first whereas the horse could not degrade the constituents until after it has gone through the foregut.
Reason for lowest NDF Digestibility in the Horse

- In the hindgut, the microbes get only what the animal cannot digest so the environment is less nutritionally favorable (Cheeke, 2005).
- As a consequence, the horse may consume the same quantity of feed as the ruminants but obtain less nutrients from it.
Voluntary Feed Intake (VFI)

- The MRT also affects the voluntary feed intake (VFI) of the alpaca.
- The lesser VFI in the alpaca is associated with the longer retention times in their forestomach (Pinares-Patiño et al.).
- The larger forage intake in the sheep reflects the faster passage rate of the feed material in the rumen.
- Since the horse ferments fiber in its hindgut, the fiber is not retained there long enough to be exposed to the microbes.
References


