

Botanical composition of the diets of alpaca (*Lama pacos*) and llama (*Lama glama*) in the Andean rangelands of Chile

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Abstract

We evaluated and compared the seasonal diet composition of llamas and alpacas feeding on natural flood grasslands and dry-lands typical of the Andean highlands. The availability of dry matter were evaluated using point quadrat transects and the botanical composition of diets using analysis of faecal samples. Grasses of flood- and dry-lands formed the main dietary component for both animal species regardless of seasons. Llama consumed more shrubs during the dry season and more forbs on flood-lands in the rainy season than alpacas did. Both animal species highly preferred *Festuca orthophylla* and avoided *Oxichloe andina*, but llamas also preferred *Eleocharis albibracteata*.

Key words: camelids, diet selection, fecal analysis, South America

Introduction

There are four species of New World Camelids: the alpaca (*Lama pacos*), llama (*Lama glama*), the vicuna (*Vicugna vicugna*) and the guanaco (*L. guanicoe*). The first two are domesticated and important to the highland inhabitants of the Andean mountains of southern Peru, northern Bolivia, and Chile because of their varied use as a source of fiber, meat, dung and for transport. Alpacas and llamas are physiologically adapted to living at high elevations and are capable of efficiently utilising poor quality forages found in the Andean rangelands. Because of local husbandry practices, rangelands are often severely overgrazed. Precipitations are markedly seasonal and rangeland forage production reflect this pattern with an abundance of forage in the wet season. Improvements in alpaca and llama production require adequate nutrition, and this is influenced by the plant species selected (San Martin, 1991; Reiner et al., 1987). As little is known about the comparative seasonal botanical composition of alpaca and llama diets, it is imperative to accurately evaluate the diet of these animals as a basis for improving their range management.

The objective of this study was to determine the botanical composition and selectivity of llama and alpaca diets in relation to plant availability in natural flood grasslands and dry-lands of the Andean highlands of Chile.

Materials and Methods

This study was conducted at Chingany, located in the Northern Zone of Chile, I. Region in the province of Parinacota (18°10'S, 69°20' E, 4400 m. a. s. l.). Mean annual temperature lies below 6.5°C but large variations occur at night and during day time. Annual precipitation averages 315 mm and 96% of this occurs in summer. The potential evaporation averages about 452 mm. The vegetation communities at the study site consisted of 1) dry-land grasses of the family *Festuca*, *Stipa* (“pajonal”); 2) flood-land grasses and forbs (*Cyperaceae*, *Poaceae* and *Asteraceae* (“bofedal”)) and 3) plants of the woody stratum (“tolar”) dominated by *Parastrephia lucida*.

To evaluate the availability of plant species, we used the “modified point quadrat method” (Daget and Poissonet, 1971). The identification of the botanical composition of alpaca diet was based on fecal analyses using microhistological techniques (100 fields for each mixed sample). As epidermal identification requires reference slides of plant material, these were prepared and studied prior to fecal analysis. Fecal samples were collected directly from 10 free-ranging adult female alpacas and 10 adult female llamas in the study area on five successive days. The frequency of each species identified in each location (microscopic field using 100 to 400 power magnification) was recorded. Percentage frequencies were first converted to density using the table developed by Fracker and Brischle (Sparks and Malechek, 1968), then to relative density, and finally expressed as a percentage of each plant species in the sample.

Diet composition was analysed using the following model:

$$y_{ijk} = \mu + \alpha_i + \beta_j + (\alpha\beta)_{ij} + \delta_{ijk} \quad \text{Eq.(1)}$$

(i = 1,2; j = 1,2; k= 1,...,40)

where:

- μ = Overall mean
- α_i = Effect of animal species
- β_j = Effect of season
- $(\alpha\beta)_{ij}$ = Interaction between animal species and season
- δ_{ijk} = Experimental error

Dietary preferences were detected using the electivity index of Ivlev (1961) (i.e., use proportional to availability):

$$IS = \frac{Da - Pa}{Da + Pa} \quad \text{Eq.(2)}$$

where:

- Da = the proportion (%) of species a in the diet, and
- Pa = the proportion (%) of species a in the range.

IS varied from -1 to 0 for negative selection and from 0 to +1 for positive selection. Similarity of diets between llamas and alpacas was calculated using Kulczynski formula (Oosting, 1956). The similarity index expresses the percentage overlap of two diets. Diets were also compared by computing the Spearman’s rank-order correlation. Data were subjected to ANOVA using the GLM procedure of the SAS (1996) package.

Results and discussion

The average dry matter availability of the rangelands was 1860 and 2940 kg/ha⁻¹ in the dry and rainy season, respectively (Figure 2). The main plant species in the diets were *Oxichloe andina*, *Festuca nardifolia*, *Festuca orthophylla*, *Deschampsia caespitosa*, *Agrostis tolucensis*, *Poa lilloi* and *Distichia muscoides* (Figure 1). During the rainy season floodland grasses constituted a higher proportion of the diets of both alpaca (62%) and llama (53%) compared to dry-land grasses (31%, 35%, respectively). During the dry season, the percentage composition of grasses from flood-lands dropped for alpaca (9%) and llama (10%) whereas that of dry-lands grasses increased (9% for alpaca and 11% for llama).

Figure 1. Seasonal consumption of plant species (%) for alpaca and llama.

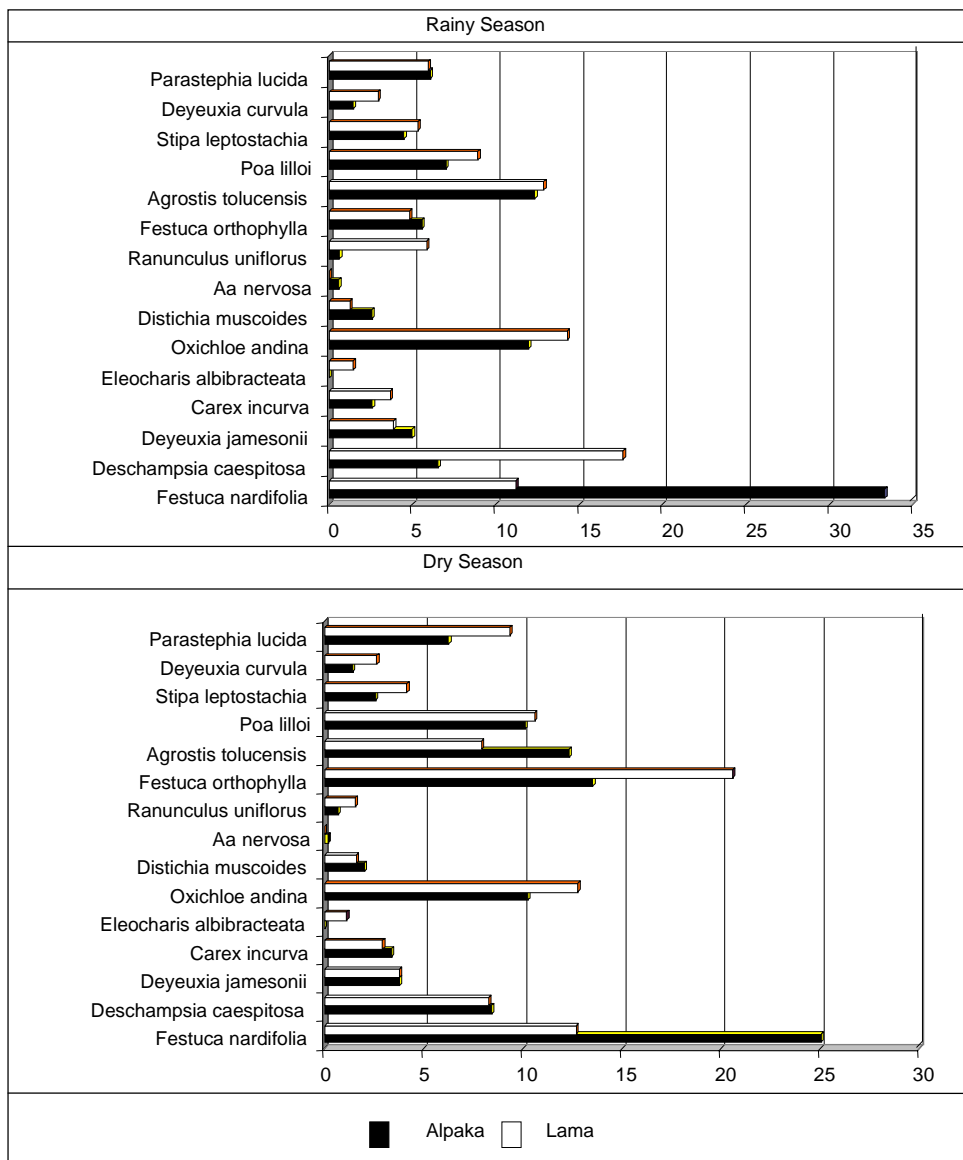
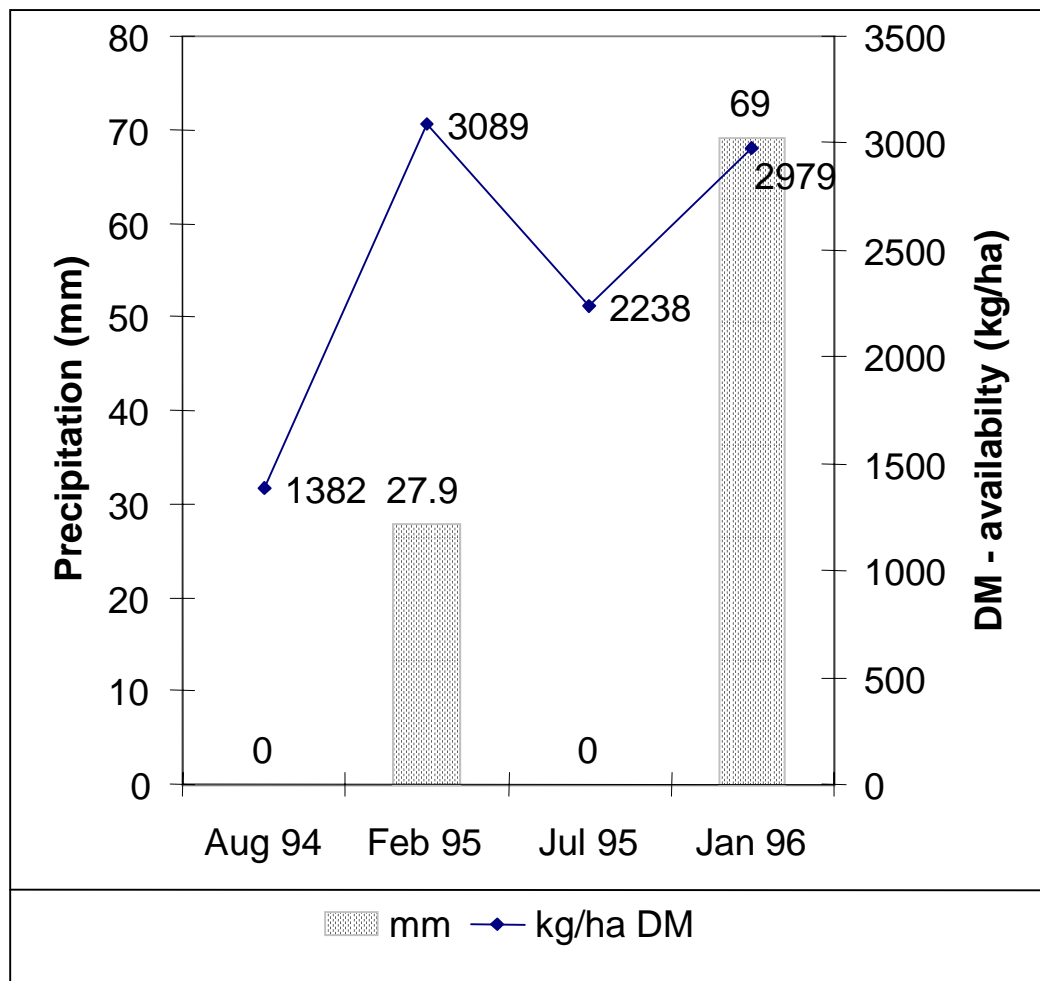


Figure 2. Dry matter availability (kg/ha) and average monthly precipitations (mm) in the study area.



Alpaca consistently ate a higher proportion of flood-land grasses during both seasons than did llamas. However, llama consumed a significantly higher proportion of shrubs during the dry season and more herbs during the rainy season than did alpaca (Figure 3). Alpacas and llamas highly preferred *Festuca orthophylla* ($0.45 < E' < 0.81$) and avoided *Oxichloe andina* ($-0.64 < E' < -0.45$), *Distichia muscoides* ($-0.23 < E' < -0.52$), *Carex incurva* ($-0.34 < E' < -0.49$) in both seasons. Llamas avoided *Festuca nardifolia*, preferred *Eleocharis albibracteata* and *Ranunculus uniflorus*; alpacas avoided *Eleocharis albibracteata* in both seasons but preferred the herbaceous species *Aa nervosa* and *Ranunculus uniflorus* in the dry season (Figure 4). The indices of diet similarity were 82% in the dry, and 74% in the rainy season. The correlation between availability and botanical composition of diet for alpacas was higher ($0.70 < R < 0.87$) than for llamas ($R=0.68$) in both seasons. To summarise, the botanical composition of diets and diet selection were seasonal and species-specific.

Figure 3. Seasonal botanical composition (%) of alpaca and llama diets.

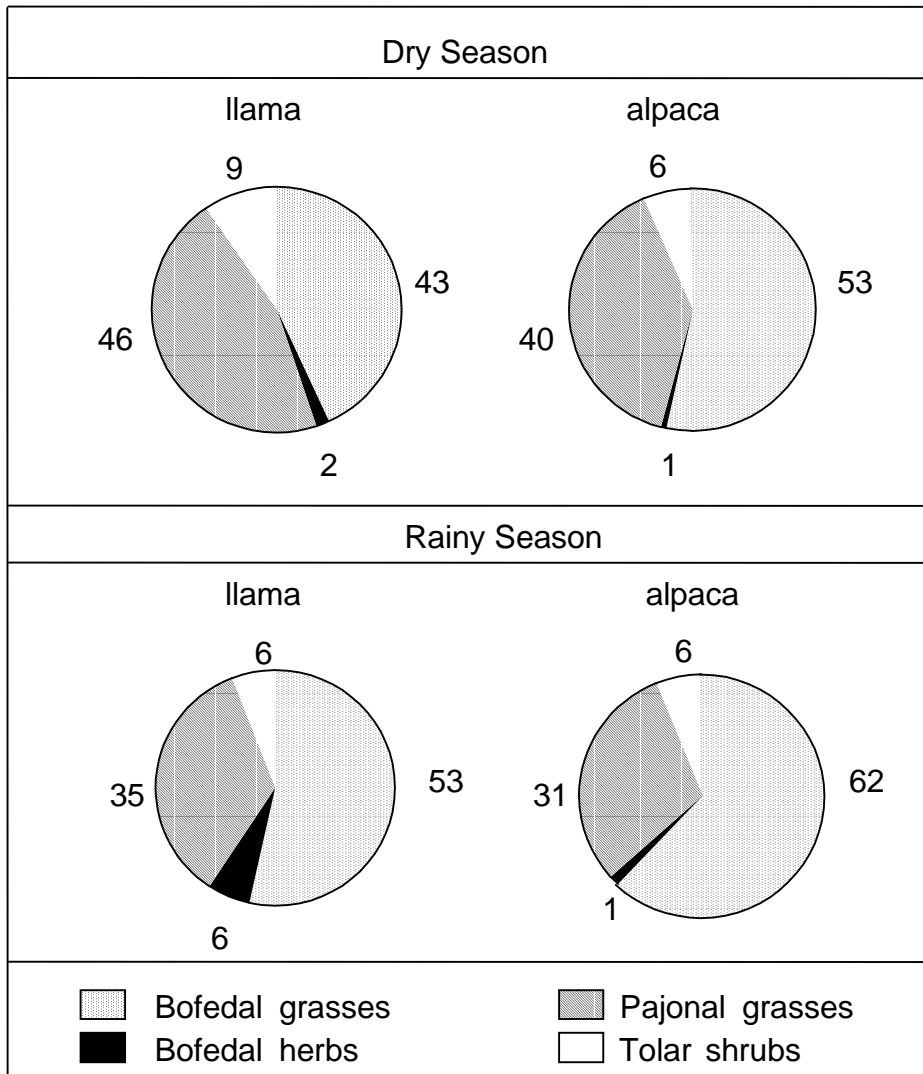
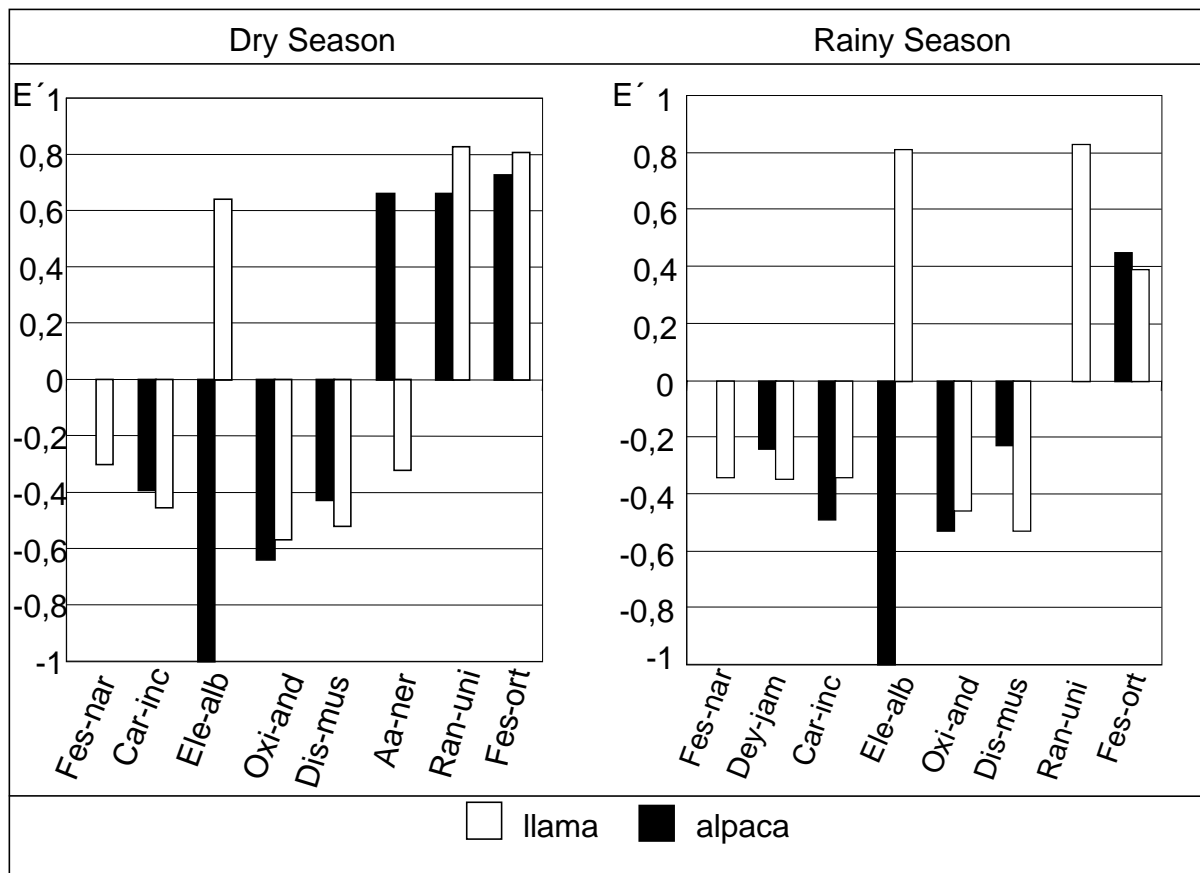


Figure 4. Seasonal Electivity Index (IS=E') for the most consumed plant species for alpaca and llama.



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This study was supported by project FONDECYT 1940292