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Diet composition and forage intake of horses and cattle grazing in Puna Grasslands during the wet and dry season

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Abstract:
Peruvian puna grasslands are extensively used by horses and cattle but the competitive relationships between both animal species are not known, so a trial was conducted to understand how the composition of the diet and forage intake varied in the dry and wet season. The grassland was of fair condition and was dominated by *Festuca inarticulata* and *Calamagrostis vicunarum*. Diet samples were collected over two seasons, wet (February and April) and dry (August and November), and analyzed for botanical composition at species and plant parts, nutritive value, dead and green proportions, diversity and dry matter intake. Data were analyzed using a two-way ANOVA with season and animal as factors. The results showed that the composition of the average diet was similar and was made up of tall grasses. The average nutritional value and forage intake were similar, improving their digestibility with the advent of the wet season. The greatest difference was obtained at the level of plant parts and functional groups and occurred in the wet season with horses consuming a greater proportion of stems and senescent material than cattle. It was concluded that although both animal species exhibit a high overlap in botanical composition of the diet, their diet composition did not differ at the level of plant parts (stems vs. leaf), quality (green vs. dead) and functional groups (grasses, grasslikes and forbs). Thus, horses could be used in complementary grazing systems to increase forage utilization efficiency.

Keywords: Native plants; Horses; Cattle; Composition; Diet quality; Intake

Introduction

Mixed grazing of horses and cattle is a common practice in the central Andes of Peru. However, the impact of this practice on the composition and quality of the diet of both animals shows contrasting results. Some postulate that both animal present a high dietary overlap because they prefer to feed on plant communities dominated by grasses and grasslike (Lamoot et al., 2005; Edouard et al., 2008), implying strong competition and antagonism when they graze together (Menard et al., 2002), other authors pointed out that both animal species can be grazed together in mixed systems (Celaya et al., 2011; Menard et al., 2002) because horses and cattle differ in many aspects of their eating digestive strategy and eating behavior when grazing (Janis et al., 2010) and given the flexibility of horses feeding tactics, they could well select different species or parts of plants depending on the structure of the vegetation and forage availability (Cymbaluk, 1990; Edouard et al., 2008).

Horses are hindgut fermenters that manage to reduce ingest particle size through sophisticated dental design and have adopted a strategy of high feed intake, faster passage rate, and comparatively low digestive efficiency (Celaya et al., 2011). In contrast, bovids are foregut fermenters with a specific sorting mechanism in the foregut that facilitates not only an extreme reduction in particle size but also a longer ingestion period with greater digestive efficiency (Janis et al., 2010).

The coexistence of horses and cattle has been explained by Fleurance et al. (2022) and Menard et al. (2002), considering there is a structural and functional differences in their digestive tracts and forage apprehension mechanisms that lead to different use patterns of vegetation and the partition of forage resources. The horse has teeth and lips that allow

it to graze much closer to the ground, being advantageous when the height of the available forage decreases, so they take better advantage of the most productive low-growing plants, especially grasslike allowing them to more easily include fibrous grasses in their diet than cattle (Celaya et al., 2011). In contrast, the performance and eating behavior of cattle are determined by their nutritional requirements (Celaya et al., 2011) and unlike horses, they use the upper layer of vegetation more efficiently, showing a greater preference for wide leafy plants, contributing to reducing the invasion rate of undesirable species (Menard et al., 2002).
Many researchers hypothesized that under tussock Puna grassland conditions, there is a potential for competition between the two species because their preference for similar groups of plants, despite their differences in grazing behavior and digestive physiology, would not allow them to graze together unless it is at the expense of a high degree of competition. In this study, it is postulated that certain differences at the level of parts and functional groups could favor their use under complementary grazing which could lead to an efficient use of grassland communities. Thus, we evaluated the composition of the diets between horses and cattle and how they varied depending on the time of year when both species were part of a high-intensity, low-frequency grazing system.

Materials and methods

Study area

The research was carried out in the experimental fields of the Peasant Research and Training Center (CICCA) of the Foundation for Agrarian Development, located in Ayaracra, Pasco region of Peru, at an altitude of 4350 m above sea level. The climate is cold semi-arid, with a moderate thermal amplitude. The average annual temperature is 5 °C and the average annual precipitation is 636.4 mm and there are substantial differences between wet and dry seasons. The wet season comprises the months of December to May and is characterized by average temperatures of 12.5 °C and rainfall of 636.4 mm. Likewise, the dry season runs from June to November, with an average temperature of 5 °C and rainfall of 185 mm (SENAMHI, 2015).
Phytogeographically, the area belongs to the Humid High Andean Pajonal ecosystem (Josse et al., 2009) dominated by the association of *Festuca inarticulata-Calamagrostis vicunarum*. The physiographic characteristics reveal a rolling topography, with a slope that varies between 2 and 5%. The edaphic scenario is made up of soils with a very marked volcanic and glacial influence, in most cases relatively moderately shallow ($0-50$ cm), strongly acidic, pH 4.9, poor in carbonates 0.0%, high in organic matter 4.1%, low levels of phosphorus 9.5 ppm and relatively high levels of potassium 248.3 ppm. The texture is moderately coarse corresponding to the sandy loam class. The cation exchange capacity is low (38.9%) with a base saturation percentage of 50.8%.

Experimental treatments

The treatments resulted from the factorial combination of two animal species, horse and cattle, two seasons of wet and dry, and three growth forms of grasses, grasslikes, and forbs. Four adult criollo-type horses with an average age of 8 years and four adult Criollo Brown Swiss x Criollo cross cows were used. The experimental area comprised 527 ha divided into 8 paddocks grazed under a high-intensity low-frequency scheme. Two out of the eight paddocks were used to carry out to assess the botanical and chemical composition of horses and cattle diets. The study lasted eight months, divided into two periods, wet (February to April) and dry seasons (August to November).

Sampling scheme

Two grazing trials were carried out in the wet season (February and April) and two in the dry season (August and November). Experimental cows and horses grazed together. Two observers participated. Observational periods lasted two days, each one comprising 8 hours of grazing, and four hours in the morning and four hours in the afternoon, with an intermission for water drinking. The evaluations were carried out in representative areas inside each paddock Animals remained penned for the rest of the day.
Eating behavior and diet selection indicators were taken on pairs of random animals, a cow and a horse, and were finally recorded twice during each trial. Diet samples were plucked by hand in places adjacent to the feeding stations located along the path taken by the animals (Austin et al., 1983). During each sampling period, horses followed the route used previously by the cows. A total of 25 feeding stations per animal were sampled each day and then separated into two equal parts, one to estimate the botanical composition and the other to assess the nutritional quality of the diet.
The feces collection was performed day and night. During the day, the animals were carefully observed while grazing in order to determine the moment in which they were defecating to immediately proceed to collect and weigh the fecal material. To collect feces at night, the animals were confined in individual pens and the collection and weighing of the feces was carried out early the next day before the first grazing period began.

Evaluated variables

Botanical and chemical composition of the diet

The botanical composition of the simulated diet was determined using the spot microscopy technique (adapted from (Harker et al., 1964)), on a board of 100 squares (5×5 cm) in the center of which the belonging of the plant material to the functional class (grasses, grasslike and forbs), plant parts (leaf, stem and flower) and mature stage (green or senescent) was recorded (Quispe et al., 2021), whereas the nutritional quality of the diet was assessed from the level of crude protein (CP) (Association, 2001), calcium (Association, 2005), the content of neutral detergent fiber (Goering and Van Soest, 1970) and the *in vitro* digestibility organic matter (IVDOM) of (Tilley and Terry, 1963). Samples of the simulated diets were then dried and grounded to a particle size of 1 mm and combined into two subsamples of 200 g each per animal and grazing period. The metabolizable energy (ME) was estimated from the in vitro digestibility of organic matter (IVDOM) using the equation ME (MJ/KgMS) $= 0.16 \times$ IVDOM (Somasiri et al., 2016).

Forage intake, diversity and similarity of diets

Forage intake (Kg DM/day) was determined from feces production and in vitro organic matter digestibility using the following relationship (adapted from (Lippke, 2002)):

$$\text{Intake} = \left(\frac{\text{Feces Production}}{100 - \text{diet digestibility}}\right) \times 100$$

Diet diversity was estimated according to the Shannon-Wiener index (H′) (Dey et al., 2017) in reference to the different plant species found in the diet of each animal. The similarity of the diets was calculated from the percentage of each plant species obtained between the pairs of horse and cow individuals, according to the Kulcyznski similarity index (Castellaro et al., 2004).

Statistical analysis

The data were analyzed using a factorial experiment based on a completely randomized design. Factor 1 was the animal species (horse vs. cattle) and factor 2 growing seasons (wet vs. dry). The adequacy of the statistical model was assessed with the Shapiro-Wilk test to examine the normality of the dataset and the Bartlett test was used to evaluate the homogeneity of variance (Gutierrez and Vara, 2008). The Difference Limit of Significance test (DLS, $\alpha = 0.05$) was applied to separate the means of the studied parameters. All statistical analyses were conducted using SAS v.9.2 software (SAS, 2004).

Results

The average botanical composition of the diet of horses (H) and cattle (C) was similar, with grasses making the most of the diet followed by grasslike and forb (Fig. 1). When analyzing diets, and a species level, it was found that *Festuca inarticulata* (H: 24.4% vs C: 21.5%), *Bromus catharticus* (H: 6.1% vs. C: 4.9%) and *Calamagrostis breviculmis* (H: 5.9% vs. C: 4.4%) contributed the most to animal diets. Forbs were more important in the diet of cattle than horses ($P < 0.05$). The most selected forbs were *Alchemilla pinnata* (H: 2.7% vs. C: 7.0%), *Erodium sp.* (H: 2.3% vs. C: 1.9%) and *Azorella sp.* (H: 2.7% vs C: 3.2%). Diet botanical composition was significantly affected by season ($P < 0.05$), forb contributed to the animals' diet during the wet season but most of them disappeared during the dry period, except for *Alchemilla pinnata* and *Erodium sp.* revealing their high value for providing protein during the dry period. There were no differences in grasslike in the diets of both species, but the horses tended to include a greater proportion of this plant category in their diet, *Carex sp.* (H: 20% vs. C: 19.4%), *Juncus arcticus* (H: 2.8% vs. C: 1.8%) and *Scirpus totora* (H: 0.9% vs. C: 1.7%) (Table 1, figure 1).
The presence of grasslikes was more important in the wet season and most of them disappeared or decreased in abundance during the dry season. Both species preferably selected leaves, followed by stems, and finally flowers (Table 2, figure 2). The most consumed structural component was leaves (H: 74.4% vs. C: 84.9%), with more similar proportions in the diets during the dry season with cattle maintaining higher levels of this component through both seasons than horses ($P < 0.05$). Horses showed a greater preference for stems compared to cattle (H: 22.0% vs. C: 12.3%), and this difference was much more pronounced during the wet season ($P < 0.05$). Diets were very much similar between both species during the dry season. Animals compensated for the increases in the maturity of leaves during the dry period by consuming more flowers wet (H: 6.2 vs. C: 3.2) vs. dry (H: 1.2% vs. C: 1.5%).
On the other hand, the proportion of green vs. dead material, an indirect indicator of diet quality varied significantly ($P < 0.05$) when the season progressed from wet to dry (Table 2, figure 3), suggesting that the wet season increased the amount of green material increasing the animals' opportunity to include a greater amount of green material in their diets ($P < 0.05$), a trend drastically changed with the offset of the dry season to a

higher proportion of senescent fraction in the diet (P <

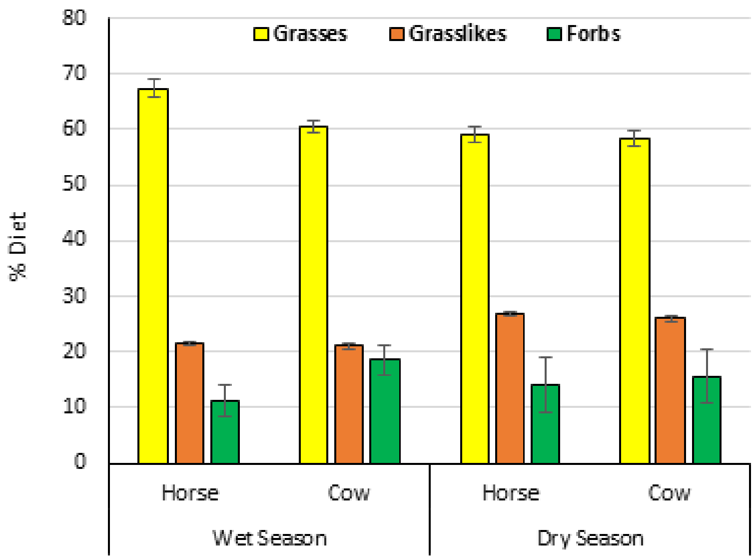

Figure 1. Botanical composition of the diet (vertical bars represent Means+SD).

Table 1. Botanical composition of diets.

Species	Wet Season				Dry Season				Mean	
	February		April		August		Nov.		Horse	Cow
	Horse	Cow	Horse	Cow	Horse	Cow	Horse	Cow		
Grasses										
Festuca inarticulata	39.5	25.7	10.0	11.6	25.4	24.5	22.6	24.0	24.4	21.5
Calamagrostis vicugnarum	5.7	4.6	0.4	0.6	9.1	5.1	1.1	1.3	4.1	2.9
Bromus catharticus	6.1	4.9	4.8	2.3	7.0	7.2	6.5	5.3	6.1	4.9
Polypogon elongatus	1.6	5.2	-	-	0.1	3.4	5.6	8.3	1.8	4.2
Poa candamoana	0.3	-	-	-	0.3	5.0	-	0.7	0.2	1.4
Poa espicigera	-	-	0.2	0.8	0.7	1.2	-	0.1	0.2	0.5
Calamagrostis breviculmis	6.0	7.5	3.1	2.0	3.4	0.7	11.1	7.5	5.9	4.4
Calamagrostis curvula	2.1	0.1	10.1	11.1	7.0	4.5	-	0.4	4.8	4.0
Calamagrostis antoniana	0.0	0.6	1.9	5.9	-	0.1	-	-	0.5	1.7
Calamagrostis rigesens	3.0	2.3	1.8	3.7	0.4	0.1	-	-	1.3	1.5
Calamagrostis heterophylla	0.3	0.7	2.7	2.6	6.5	8.0	0.8	1.3	2.6	3.2
Calamagrostis spicigera	2.0	1.5	0.1	0.5	0.5	1.6	6.5	5.8	2.3	2.4
Stipa brachiphylla	3.2	1.7	6.9	6.7	0.3	0.8	-	-	2.6	2.3
Agrostis glomerata	1.8	-	0.7	-	0.7	-	-	0.1	0.8	-
Festuca rigida	-	-	20.2	18.0	1.9	-	-	-	5.5	4.5
Agrostis breviculmis	-	-	0.3	0.3	0.5	-	-	-	0.2	0.1
Total	**71.6**	**54.8**	**63.2**	**66.1**	**63.8**	**62.2**	**54.2**	**54.8**	**63.3**	**59.5**
Grasslikes										
Carex sp.	16.2	17.3	13.3	11.7	16.1	20.4	34.5	28.2	20.0	19.4
Juncus arcticus	1.9	1.2	6.5	2.7	2.8	3.0	-	0.4	2.8	1.8
Scirpus rigidus	0.5	0.7	-	1.2	0.3	-	-	-	0.2	0.5
Scirpus totora	-	-	3.5	6.8	-	-	-	-	0.9	1.7
Eleocharis albibracteata	-	0.5	0.9	-	-	-	-	-	0.2	0.1
Total	**18.6**	**19.7**	**24.2**	**22.4**	**19.2**	**23.4**	**34.5**	**28.6**	**24.1**	**23.5**
Forbs										
Alchemilla pinnata	2.3	12.1	2.0	1.2	5.1	7.6	1.4	7.1	2.7	7.0
Werneria nubigena	0.2	0.4	0.5	-	-	0.4	0.8	-	0.4	0.2
Hipochoeris sp.	0.3	0.4	-	0.2	0.2	-	-	-	0.1	0.2
Geranium sp.	2.5	5.7	0.5	0.4	1.4	-	-	-	1.1	1.5
Descuraina sp.	-	0.5	0.3	-	1.6	1.4	-	0.7	0.5	0.7
Lilaeopsis macloviana	0.1	0.3	-	-	0.3	1.0	-	0.3	0.1	0.4
Erodium sp.	-	0.1	-	-	0.6	0.0	8.7	7.4	2.3	1.9
Azorella diapensoides	-	-	-	-	4.4	1.3	0.4	0.9	1.2	0.6
Viola sp.	0.1	-	-	-	1.3	2.2	0.2	0.5	0.4	0.7
Perezia sp.	-	0.1	-	-	0.3	0.2	-	-	0.1	0.1
Solanum sp.	0.1	0.1	-	-	0.5	-	-	-	0.2	-
Cerastium peruvianum	0.5	0.5	-	-	1.1	-	-	-	0.4	0.1
Paronichia andina	0.2	-	-	-	-	-	-	-	0.1	-
Azorella sp.	3.3	5.8	7.3	7.0	-	-	-	-	2.7	3.2
Muhlenbergia fastigiata	-	-	-	0.3	-	-	-	-	0.0	0.1
Distichia muscoides	-	-	0.9	1.6	-	-	-	-	0.2	0.4
Bidens andicola	-	-	0.1	-	-	-	-	-	0.0	-
Sisyrinchium sp.	-	0.3	1.2	-	-	-	-	-	0.3	0.1
Total	**9.6**	**26.3**	**12.8**	**10.7**	**16.8**	**14.1**	**11.5**	**16.9**	**12.8**	**17.2**

Table 2. The proportion of leaf-stem-flower and green material in the diet.

Variable	Wet Season		Dry Season		Mean	
	Horse	Cow	Horse	Cow	Horse	Cow
Plant Structure						
Leaf	67.5[b]	87.3[a]	81.2[a]	82.5[a]	**74.4[b]**	**84.9[a]**
Stem	26.3[a]	9.5[b]	17.7[a]	15.0[a]	**22.0[a]**	**12.3[b]**
Flower	6.2[a]	3.2[b]	1.2[a]	2.5[a]	**3.7[a]**	**2.9[a]**
Fraction						
Green	64.5[b]	77.0[a]	38.3[a]	43.8[a]	**51.4[b]**	**60.4[a]**
Senescent	35.5[a]	23.0[b]	61.7[a]	56.2[a]	**48.6[a]**	**39.6[b]**

Means of treatments (in rows) with different letters are significantly different at $P < 0.05$.

0.05). In both seasons, horses selected a higher proportion of senescent material compared to cattle (H: 48.6% vs. C: 39.6%), a result that was much more marked during the wet season ($P < 0.05$).
As with the botanical composition, diets of horses and cattle were on average similar in nutritional value. However, significant differences were found in Natural Detergent Fiber (NDF) and IVDDM content during the dry season (Table 3). The protein level in the diets of both improved during the wet season ($P < 0.05$); however, the calcium level was neither by the animal species (H: 0.45% vs C: 0.45%) nor by the season (0.4% wet vs. 0.5% dry).
Horses consumed a higher level of NDF (H: 73.1% vs. C: 70.5%) and it was influenced by the dry season ($P < 0.05$). The in vitro digestibility of the diet was lower in horses compared to cattle (H: 37.9% vs. C: 41.9%) but it improved noticeably during the wet season (44.6% wet vs. 35.2% dry) ($P < 0.05$). A similar energy value was found in the diets of horses and cattle (H: 6.1 vs C: 6.5 MJ/kg MS). Horses and cattle ingested similar levels of dry matter concerning their percentage of live weight ($P > 0.05$). In the case of horses, dry matter intake varied from 4.2 to 5.3 kg/day, while in cattle, it was 4.9 to 5.8 kg/d, for the dry and wet seasons, respectively. This is translated into a percentage of DM consumption concerning live weight of 1.1% to 1.3% for horses and 1.2 to 1.5% for cattle, for the dry and wet seasons, respectively.
The diversity of the botanical species included in animals' diets (H: 2.0 vs. C: 1.9 H′) was similar, both in the dry and wet seasons (Table 4). Regardless of the season and animal species, the similarity of the diets was high. The degree of overlap in the diets of horses and cattle, measured using the Kulczyński similarity index, did not exhibit a significant change as the season progressed. Furthermore, a strong correlation of 97% was observed between their diets, indicating that horses and cattle select their food in a significantly similar manner. This similarity is particularly pronounced in November, coinciding with lower plant richness and diversity.

Discussion

The diets of the experimental animals were composed mainly of grasses and to a lesser extent of forb and grass-likes, however, horses included a greater proportion of the latter than cattle (Duncan et al., 1990; Celaya et al., 2011). These researchers attributed these differences to the fact that horses have a better adaptation to grazing closer to the ground surface, due to the advantages that their oral

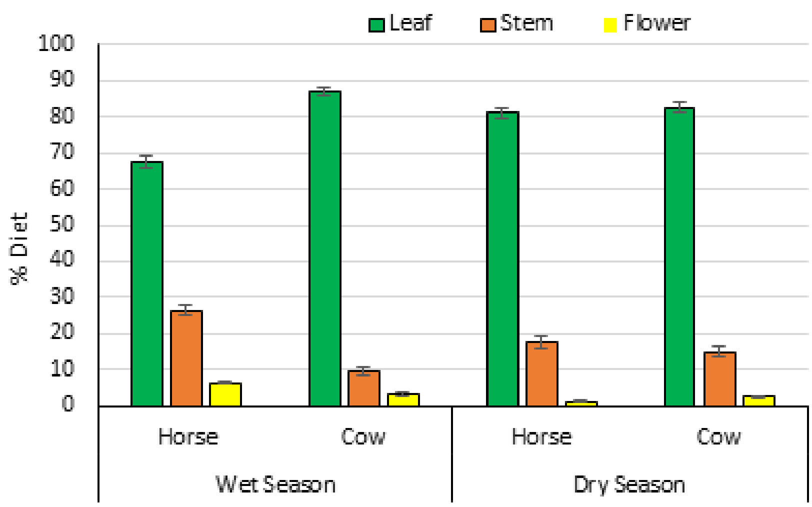

Figure 2. The proportion of leaf, stem and flower in the diet (vertical bars represent Means+SD).

Table 3. Nutritive value of horse and cattle diets.

Quality traites	Wet Season		Dry Season		Mean	
	Horse	**Cow**	**Horse**	**Cow**	**Horse**	**Cow**
Crude Protein (%)	9.2[a]	10.2[a]	7.8[a]	8.1[a]	**8.5[a]**	**9.2[a]**
Calcium (%)	0.4[a]	0.4[a]	0.5[a]	0.5[a]	**0.5[a]**	**0.5[a]**
NDF (%)	71.5[a]	70.6[a]	74.7[a]	70.3[b]	**73.1[a]**	**70.5[a]**
IVDDM (%)	42.2[b]	47.0[a]	33.5[b]	36.8[a]	**37.9[a]**	**41.9[a]**
ME (MJ/kgDM)	6.8[a]	7.5[a]	5.4[a]	5.4[a]	**6.1[a]**	**6.5[a]**

Means of treatments (in rows) with different letters are significantly different at $P < 0.05$.

anatomy and ability to selectively apprehend forage with the help of their lips and incisors gives them. Instead of the tongue and the dental reel as cattle do (Janis, 1976). These adaptations allowed horses to include shorter plants in their diet in a greater proportion than cattle (Menard et al., 2002; Fleurance et al., 2022), as revealed by the presence of a relatively greater proportion of the grasses *Calamagrostis vicunarum* and *Calamagrostis breviculmis*, grass-likes such as *Carex sp.* and *Juncus arcticus* and forb such as *Alchemilla pinnata* in the diet of the former.

The quality of the diet diminished in both species with the advent of the dry season and was closely related to the leaf-stem proportion and green-senescent material, relationships that improved in the wet season probably due to differences in the phenological state and maturity of the available forage (Bueno and Florez, 1986; Edouard et al., 2008). Both species increased the amount of senescent material in the diet during the dry season, always maintaining a high preference for leaves even when senescent. This reduction in the nutritional value of the diet usually occurs when old plants and senescent material accumulate in the paddocks due to a combination of factors, among which the underutilization and heterogeneous use, an aspect that finally translates into a notorious elevation in cell wall content, lower protein and digestibility as well as forage consumption rate (Wilson, 1994; Harper and McNeill, 2015; Tacuna et al., 2024).

The diverse diets were quite similar suggesting high levels of competition at the plant level between cattle and horses (Osoro et al., 2017; Lopez et al., 2019) in the range found by other authors (Menard et al., 2002) as 0.58 to 0.77, which could rise significantly in the dry season as occurred in the present study. The selection process involves several scales of plant community, species, plant parts and fractions of green and senescent material (Tacuna et al., 2024). Consistent with this hierarchical concept of diet selection, no significant effect of the interaction between season and animal species was observed on the botanical composition (grass, grass-likes and forbs), as well as on the leaf-stem-flower proportion and the nutritional value of the diet (CP, NDF, IVDDM and ME).

These trends were consistent in both wet and dry seasons, revealing certain stability in the selection process patterns throughout the two seasons under consideration. In contrast, notable impacts of interactions between seasons and animal species were observed at the level of the green: senescent ratio in the diet, with comparatively higher ratios in the wet season than in the dry season. Horses included a greater proportion of dead material than cattle in both seasons, and the differences in forage digestibility and cell wall content were more pronounced during the dry season. Dead stems as an important part of horse's diet contain more lignin, hemicellulose, and cellulose than green stems which would have influenced forage digestibility (Ammar et al., 1999).

Forage intake of horses was lower than cattle, probably in response to a greater inclusion of cell walls in the diet, lower nutritional requirements and differences in social behavior (Molle et al., 2022) that could have been compensated by higher intake and excretion rates, revealing that horses could subsist on diets of lower quality and digestibility than cattle (Lopez et al., 2019; Menard et al., 2002). The results also re-

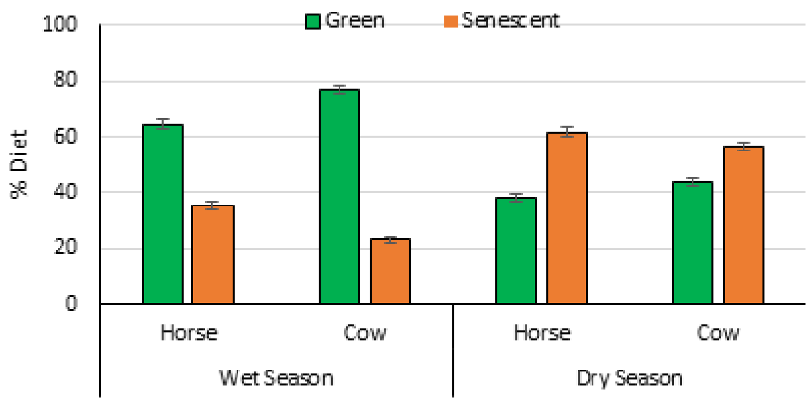

Figure 3. The proportion of green material in the diet (vertical bars represent Means+SD).

Table 4. Dry matter intake and diet indices of horses and cattle according to season.

Variable	Wet Season		Dry Season		Mean	
	Horse	Cow	Horse	Cow	Horse	Cow
Intake DM (kg/d)	5.3[a]	5.8[a]	4.2[a]	4.9[a]	**4.8[a]**	**5.4[a]**
Intake DM (live weight %)	1.3[a]	1.5[a]	1.1[a]	1.2[a]	**1.2[a]**	**1.4[a]**
Diversity (H′)	2.1[a]	2.2[a]	1.9[a]	1.7[a]	**2.0[a]**	**1.9[a]**
Similarity (K′)	68.6[a]		68.5[a]		**68.5[a]**	

Means of treatments (in rows) with different letters are significantly different at $P < 0.05$.

vealed that both species quickly adapted to the changes that the vegetation experienced as season progressed (Fleurance et al., 2022). The dry matter intake and the percentage of consumption in relation to live weight obtained were relatively low and very similar to others reported in Puna grasslands (Cruz, 2008; Flores et al., 2009). Many factors affect forage consumption in grasslands (Allison, 1985) but everything indicates that the ingestive response was driven by high cell wall content, more than 70%, present in the grasses and the diet of animals grazing mature and dormant Puna grasslands. (Flores et al., 2009) or grasslands typical of arid and semi-arid climates (Huston and Pinchack, 1991).

Our results suggest that under Puna conditions, both animals are highly competitive at the species level but not necessarily at the level of functional groups, plant parts, or green: senescent fractions, considering that they include grasses and grass-likes in similar proportions of their diets, in contrast to the use of forb that are included in the diet in a greater proportion by cattle (Edouard et al., 2008). A species that also showed a greater preference for green material, rich in nutrients, by its greatest requirements. On the other hand, horses included more flowers than cattle in their diet, taking advantage of the greater selection capacity that the use of their lips gives them. While cows retain feed in the digestive tract for longer periods, horses seem to adopt a feeding strategy of accelerating the rate of passage which eventually translates into a greater frequency of grazing and excretion, allowing them to compensate for a less efficient fermentation as compared with cattle (Janis et al., 2010).

The results also reveal that previous grazing with horses in mature grasslands could be used to manipulate the composition of the vegetation for the benefit of cattle (Gudmundsson and Dyrmundsson, 1994) considering that horses include a greater proportion of stems and senescent material than cattle, subsequently, facilitating cattle selection in favor of a greater amount of green material and leaves, allowing them to improve the quality of the diet, especially during the dry season.

Conclusion

Horses and cattle are two animal species that exhibit similar diets in botanical composition and functional groups, but not necessarily at the level of plant parts. Horses consume more stems and senescent material than cattle, exhibiting nutritional behavior consistent with the nature of their digestive anatomy and physiology and lower nutritional requirements than cattle, cecal fermentation and higher passage rates. Therefore, horses could be used to provide cattle with a better quality diet in range sites where senescent material and dominance of tall grasses have accumulated as a result of the combined effect of underutilization and non-uniform use patterns caused by repeated grazing year after year by a single species that prefers short species. Horses enter the old and mature grassland first, to open the community, by consuming the accumulated growth of previous years, such as stems and grasslike, to allow an increase in the abundance of forb and green grasses of greater nutritional value preferred by cattle.

Authors Contributions
All authors have contributed equally to prepare the paper.

Availability of Data and Materials
The data that support the findings of this study are available from the corresponding author upon reasonable request.

Conflict of Interests
The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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