EFFECTS OF TWO GRAZING CONDITIONS ON THE REPRODUCTIVE ACHIEVEMENT OF MALE ALPACA IN THE NORTHERN PERU GRASSLANDS

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ABSTRACT

Alpaca have recently been introduced to the northern Peru grasslands (*Jalca*). Effects of two systems of grazing management, co-grazing (with sheep) under fair grassland condition (CGFC) versus exclusive grazing under good grassland condition (EGGC), upon the reproductive achievement was examined from the 6th to the 16th month of age. Each system involved 20 Huacaya animals, managed by individual herders. Availability of herbage preferred by alpaca (HMA) and animal measurements (herbage intake, liveweight, testicle size, penis release from preputial attachments, plasma testosterone) were monitored monthly. Puberty, judged by the penis release from the preputial attachments, was achieved by 7 animals in the EGGC system, compared to nil in the CGFC system. Although this achievement was positive and closely related to the rate of body growth as influenced by the feeding level, it might be subject to some underlying process of adaptation.

KEYWORDS

Alpaca, Andes, grassland condition, puberty, co-grazing, Pinus

INTRODUCTION

The southern Andean grasslands of Peru (*Puna*), is the ecosystem where alpaca have traditionally been raised. As a consequence of a series of droughts and subsequent overgrazing, the condition of the *Puna* grasslands has become poor (Florez and Malpartida 1987), with dramatic effects on alpaca productivity and survival. In order to alleviate this problem, the Peruvian government has introduced alpaca into the northern Andean grasslands (*Jalca*), an ecosystem where the primary production is higher and better distributed than in *Puna*.

Nutrition-reproduction relationships in male alpaca are poorly known. Sumar (1991) and Pinares *et al.* (1991) have indicated that the puberty achievement is closely related to the rate of body growth, as influenced by the feeding level. In fact, Pinares *et al.* (1991) found that under rangeland in fair condition, 70% of the experimental animals completed penis release from its preputial attachments at an average age of 13.7 months and 47.2 kg liveweight (75% of the adult liveweight).

The objective of this study was to determine whether the reproductive achievement of the male alpaca was affected by the grassland condition and the grazing management at the *Jalca* habitat. The treatments chosen mimicked two contrasting alpaca management systems adopted in *Jalca*.

METHODS

The study was carried out between August, 1992 and June, 1993 at the *Atahualpa* Cooperative, Cajamarca (7°04' S, 78°38' W, 3400 m altitude) on grasslands dominated by *Calamagrostis trichophylla* and *Calamagrostis tarmensis*. Average minimum and maximum monthly temperatures and total rainfall were 12.4 and 2.8 °C; and 930 mm, respectively.

Two typical systems of alpaca management were considered as experimental treatments: (1) co-grazing with sheep (30 wethers) under fair grassland condition (CGFC); and (2) exclusive grazing under good grassland condition (EGGC). Each system involved 20 six-months old animals (at the start of the experiment), which were monitored during a one year period. The CGFC system mimicked that used by small stockholders; whereas the EGGC system, established in marginal areas of forest plantation (*Pinus spp.*), represented that used by enterprises. Each flock was independently herded, with overnight (14 h) enclosures.

Herbage and animal measurements were carried out monthly. Total herbage mass (HM, kg DM/ha) was estimated by the Comparative Yields technique (Smith and Despain, 1991); whereas plant species composition was estimated by the Dryweight Rank technique (Smith and Despain 1991). Based on alpaca foraging behaviour, plant species were ranked as poorly (P), fairly (F) or highly (H) preferred. Then, the availability of the herbage mass preferred by alpaca (HMA, kg DM/ha) was estimated as that proportion of the HM made up of the F and H species. Daily herbage intake (HI, g DM/kg $LW^{0.75}$) was indirectly estimated from 2 consecutive days total collection of faeces (4 animals) and *in vitro* dry matter digestibility (IVDMD, Tilley and Terry 1963) of plucked herbage samples. Crude protein (CP, %DM) was determined by the Kjeldhal procedure. Liveweight (LW, kg) was measured after overnight enclosure. Testicle size (TS, mm^2) was estimated by multiplying the length and width (mm) of the left testicle, measured by a caliper. The degree of release of the penis from its preputial attachments (DRP, mm) was examined by a protrusion effort. Blood samples were taken from the jugular vein (5 cc) for testosterone quantification (T, ng/ml) in plasma by the radioimmunoassay (RIA) technique, using coat-a-count solid phase kits (Diagnostic Products Corporation, USA).

Treatment differences were analysed using the least square means, on whole period (HM, HMA, CP, IVDMD and HI) or particular periods (LW, TS, DRP and T) basis.

RESULTS AND DISCUSSION

Grazing conditions and herbage intake. Mean values for daily herbage availability, nutritive value and herbage intake are given in Table 1. HM was lower for the EGGC system than for the CGFC system, but not significantly ($p>0.05$). Nevertheless, due to the different proportion of P, F and H species, the HMA was significantly higher ($p<0.05$) for the EGGC system. Undoubtedly, the microclimatic influences of the forest increased the presence of F and H species in the surrounding areas, where the EGGC was established.

As a consequence of the above, the CP content and the IVDMD of the herbage grazed were higher for the EGGC system than for the CGFC system (Table 1). Treatments slightly differed for HI (60.8 vs 54.4 g DM/kg $LW^{0.75}$), although per unit animal basis, this difference was much higher than that quoted in Table 1.

The foraging pattern of alpaca in the EGGC system was that normally observed; i.e. plant components of the lower strata of the community (forbs, grasslike species and short grasses) were highly (H) preferred to those of the upper strata (tall grasses). On the contrary, foraging strategy in the CGFC system, reflected the limited HMA and competition with sheep. In fact, sheep exhibited higher rates of foraging activity than alpaca and dominantly grazed the lower strata of the vegetation. Under that situation, alpaca were forced to shift their consumption to those species normally ranked as poorly (P) preferred and they spent longer time at each feeding station. The latter can be recognized as a compensatory mechanism for decreased bite sizes, such as suggested by San Martin (1987) and Pfister *et al.* (1989).

Reproductive achievement. Table 2 shows the mean values for LW, TS and T at key points of the experimental period (start, mid and end). Even though the rates of increase in these parameters were faster for the EGGC system than for the CGFC system, changes in TS and T did not show the time at which the hypothalamus-hypophysis-gonad axis was established. First, unlike other ruminants, testicles in alpaca are very small (about 0.05 % LW; Sumar 1991), which associated with the anatomical location (perineal) made it

difficult for measurements to be accurate. Second, T concentration (Table 2) was very low compared to those (1 to 2.5 and 3.4 to 8.8 ng/ml, for pre-puber and adult alpaca, respectively) reported by Pinares *et al.* (1991), using a liquid phase of RIA. The lack of success of the solid phase kits used in this experiment is unclear, but might involve the lack of reactivity of the human antibody used.

The rate of penis release from the preputial attachments (DRP) was slow until the last two months, when it turned much faster. Up to the end of the experiment, the proportion of animals that completed penis release was nil in the CGFC system; whereas it was 35% (7 animals) in the EGGC system. The average age, LW, TS and T for these animals was 13.7±2.4 months, 44.6±3.7 kg, 646±37 mm^2 and 1.2±0.6 ng/ml, respectively. Although this proportion (35%) is just half of that (70%) reported by Pinares *et al.* (1991), the average age and LW are similar. Thus, the rate of body growth was a driving force leading to puberty. In fact, LW (pooled data) was highly ($p<0.01$) correlated with TS ($r=0.75$), DRP ($r=0.51$) and T ($r=0.59$).

Finally, it is important to note that treatments had a marked effect on alpaca survival. In fact, 9 animals (45 %) died in the CGFC group; whereas the mortality in the EGGC was nil. The cause of mortality was pneumonia, but a high internal parasitism also was observed. Probably animals in poor body condition were unable to counteract the microclimatic stress (cold-windy) due to the extra costs of maintenance associated with grazing activity and parasitism.

It is concluded that the improved grazing management in the northern Peru Andean rangeland (*Jalca*) had a positive influence upon the body growth and reproductive achievements of male alpaca. Nevertheless, the slower rate of these achievements, compared to those observed at the southern Peru Andean rangeland (*Puna*) under similar grazing condition, suggests some underlying process of adaptation to the new habitat.

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Table 1

Mean (±sem) values for herbage mass (HM), availability of herbage mass preferred by alpaca (HMA), crude protein (CP) and *in vitro* dry matter digestibility (IVDMD) of the grazed herbage and herbage intake (HI).

PARAMETER	SYSTEMS OF GRAZING MANAGEMENT		sig[1]
	CGFC[2]	EGGC[3]	
HM (kg DM/ha)	1310±141	1049±141	ns
HMA(kg DM/ha)	410±81	663±81	*
CP (%DM)	11.8±0.9	13.2±0.9	ns
IVDMD (%)	59.6±1.8	65.0±1.75	*
HI (g DM/kg $LW^{0.75}$/day)	54.4±3.8	60.8±3.8	ns

[1] Statistical significance of differences: ns, $p>0.05$; *, $p<0.05$.

[2] CGFC, co-grazing with sheep and fair grassland condition.

[3] EGGC, exclusive alpaca grazing and good grassland condition.

Table 2

Mean (±sem) values for liveweight (LW), testicle size (TS) and plasma testosterone (T) at the 6th, 12th and 16th months of age.

PARAMETER	SYSTEMS OF GRAZING MANAGEMENT		sig.[1]
	CGFC[2]	EGGC[3]	
LW (kg/animal):			
6th	20.7±0.8	20.5±0.8	ns
12th	27.9±1.0	38.3±1.2	**
16th	30.4±1.8	43.9±1.3	**
TS (mm^2/animal):			
6th	131±7	142±7	ns
12th	313±21	448±27	**
16th	325±30	582±39	**
T (ng/ml):			
6th	0.02±0.02	0.02±0.01	ns
12th	0.03±0.02	0.52±0.13	**
16th	0.12±0.07	0.81±0.13	**

[1] Statistical significance of differences: ns, $p>0.05$; **, $p<0.01$.

[2] CGFC, co-grazing with sheep and fair grassland condition.

[3] EGGC, exclusive alpaca grazing and good grassland condition.