Metabolic blood values and body weight effect of legume tree feeding in lactating Cuban meat sheep

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Contents

Abstract. Using a completely randomised design, three experimental groups and a control group of lactating meat ewes, i.e. Cuban Pelibuey breed, were exposed to supplementary feeding of *Leucaena leucocephala* with 1.50, 1.25 and 1.0 kg of green stuff. Body weight, corporal condition and biochemical blood indicators (i.e. haemoglobin, glucose, total blood protein, albumin and urea) were monitored at different times. Ewes from the group with the highest level of legume tree consumption achieved higher body weight, excellent corporal condition and normal biochemistry blood indicators compared to the remaining experimental groups. The two experimental groups with higher legume tree supply achieved faster reproductive cycle performance. An ANOVA test confirmed the statistical significance of the group differences.

Keywords: Cuban Pelibuey meat sheep, supplementary feeding, blood indicators, legume trees.

Introduction

In tropical extensive livestock production systems it is difficult to achieve a proper balance in the nutrient supply of grazing animals. This is particularly critical when special physiological conditions such as lactation require a higher supply of nutrients. To overcome this imbalance it is necessary to provide additional feeding resources to the grazing animals. This is particularly important when milking demand and reproductive demand converge in the physiology of the breeding female. In order to ensure a competitive profitability of breeding animals it is necessary to design combined grazing management practices and/or supplementary feeding and/or to attempt new technological design matched to the available feeding resources to overcome the limitations of the single grazing systems (Alvarez 1999).

It is known that *Leucaena leucocephala* is a legume tree used as a grazing resource or as a supplementary feeding option to grazing (Paretas and Valdés 1994). Its high nutritional value, high drought resistance, high digestibility and high nitrogen fixing capacity are arguments supporting strongly its use as a grazing resource as well as an ecosystem building tool (Yumy and Rodriguez 1999).

Justification and objectives

To ensure low-cost meat production, integrated and sustainable grazing systems need to be developed for meat sheep breeds such as the Cuban Pelibuey. These farming systems must be evaluated not only in economic and management terms but firstly from a physiological perspective.

An experiment using Cuban Pelibuey breeding ewes was organised between October and December of the year 1999 – which corresponds to the dry and cold season as per Cuban conditions – to evaluate the effect of three different levels of supplementation using *Leucaena leucocephala* and its effect in physiological indicators. A monitoring of blood indicators of lactating ewes such as haemoglobin, glucose, total blood protein, albumin and urea was conducted. The time was coincident with the reproductive cycle of the ewes; therefore the monitoring of the reproductive performance of these lactating tropical meat ewes was also conducted, aiming to have an indication of the effect of supplementation on ovarian cycle.

Methodology

Using a completely randomised design three experimental groups and a control group of lactating ewes, each containing nine animals, were organised.

Analysis of variance – ANOVA- Duncan test (1955) was chosen as the statistical tool to evaluate the significance among treatments in mean performance variability for the critical variables of the study. The age of the ewes ranged between three to four years; and the feeding trial started 60 days before lambing and continued along the first 60 days after lambing.

A description of the experimental groups follows:

Group 1: 1.50 kg green matter supplementation / animal / day plus eight grazing hours plus 0.2 kg of molasses and urea (2 per cent). Mineral supplementation and water *ad libitum*.

Group 2: 1.25 kg green matter / animal / day plus eight grazing hours plus 0.2 kg of molasses and urea (2 per cent). Mineral supplementation and water *ad libitum*.

Group 3: 1.00 kg green matter / animal / day plus eight grazing hours plus 0.2 kg of molasses and urea (2 per cent). Mineral supplementation and water *ad libitum*.

Group 4: Eight grazing hours plus 0.2 kg of molasses and urea (2 per cent). Mineral supplementation and water *ad libitum*.

The corporal condition was evaluated as per the following ranking scale as per Vera y Vega (1986) :

Condition 1: poor condition with plain loins and no fat over the eye muscle area. Vertebral cord bones are prominent.

Condition 2: Vertebral cord bones and fat over the eye muscle area are moderately perceptible.

Condition 3: Vertebral cord bones are only perceptible under pressure. Fat covering over the eye muscle area is evident.

Condition 4: Vertebral cord bones difficult to perceive. Full muscle and fat cover are evident.

Condition 5: Vertebral cord bones are not perceptible; eye muscle is covered by a thick fat layer.

The availability of dry matter during the grazing period was between 4.1 to 3.1 t/ha. The grazing time was between 06.00 to 10.00 am and between 2.00 to 6.00 pm. The botanical and chemical composition of the pastures was determined to ensure standard conditions in all the experimental paddocks. Chemical analysis of the supplementary feeding was conducted. Live-weight, corporal condition of the animals as per the determined ranking scale and the biochemical indicators haemoglobin (Hb), glucose (GL), total protein (TP), albumin (AS) and urea (UR) were measured over a 30-day interval (see Tables 4 and 5 – Appendix). The chemical analysis for the grass and the legume was also calculated over a 30-day interval using traditional biochemical techniques. For determining the nutritional requirements of the animals, the Perez-Infante's technique (1976) cited by Herrera (1983) was used as a benchmark.

The techniques used for biochemical analysis were as follows:

- Haemoglobin: Drabkin (MINSAP)
- Glucose: Rapid-Gluco-Test (MINSAP)
- Total protein and albumin: Kreld *et al* (1982)
- Urea: Morros (1967)

Results

The recorded environmental parameters were temperatures between 24.1^0 and 24.8^0 Celsius. The relative environmental humidity was between 80 and 89 per cent. Rainfall recorded was 131.4 ml in October with a slow down by November - December to 52 ml corresponding to dry season values.

Table 1 –Appendix- contains the results of the chemical composition of the *Leucaena leucocephala.* It is important to highlight the values related to total protein percentage, calcium and phosphorus.

Table 2 –Appendix- indicates the pasture and supplementation relationship. It is possible to observe in this table the percentage contribution of the supplementation to the daily nutritional requirements of the animals. The remaining nutritional requirements were provided by the complementary grazing. For example, in the group 1 the supplementary dry matter supply fluctuated between 38 per cent and 40 per cent; total protein fluctuated between 80 and 94 per cent and the energy values oscillated between 172 per cent and 156 per cent. This indicates that the nutritional requirements of the ewes were over-fulfilled for energy (i.e. up to 172%); slightly below for protein (i.e. up to 94%) and average for dry matter (i.e. up to 40%). It was estimated that between 15% to 17% of the crude protein was supplied by the urea.

Table 3 – Appendix- contains the evolution of body weight and corporal condition. At lambing time the ewes in the experimental groups I and II overcame the benchmark weight (i.e. 30 kg) for breeding purposes with significant statistical difference related to groups III and IV. The body weight loss within the first 30 days of lactation was lesser in groups I and II compared to groups III and IV. However it is interesting to notice that only group I ewes recovered normal reproductive body weight at 60 days of lactation. Similar is the situation with corporal condition where groups I and II showed meaningful differences compared to the body condition of groups III and IV. Table 4 –Appendix- shows the values of haemoglobin and glucose at lambing time, 30 days of lactation and 60 days of lactation. Haemoglobin values decrease over the experimental period, though groups I, II and III indicate haemoglobin values kept within normal physiological ranges (i.e. 80-160 g/L). Glucose values remained within normal physiological ranges for the experimental and control groups between 2.2 and 3.3 mmol/L.

Table 5 –Appendix- contains the values for the remaining biochemical indicators, i.e.

total protein, albumin and urea. These indicators have a close relationship with energetic metabolism. Total protein was between the normal physiological ranges (i.e. 60-80 g/L) for groups I, II and III. Albumin has a similar performance with the exception of treatment III where the physiological range was not achieved (i.e. 24-30 g/L). There is also a significant statistical difference in this value related to group I. The urea value remained within normal ranges (i.e. 2.8 – 6.6 mmol/L) for the groups I and II during the experiment. Group II recovered the normal value after 60 days of lactation.

From Table 1 –Appendix- it is possible to observe that the grasses available in the paddocks, in spite of having at least nine per cent of total protein, did not fulfil the nutritional requirements of lactating ewes, with weights ranging between 31 and 37 kg. The *leucaena leucocephala* protein values obtained in this experiment are consistent with similar reports by Palma (1995), Roman (1997) and Caceres and Gonzalez (1996).

The addition of molasses to the urea at a two percent level is insignificant in nutritional terms. It only was used as a palliative to ensure the urea consumption. It was observed that the ewes consumed the urea-molasses mixture within two hours. The addition of urea was supported in Huerta's (1995) results which indicate that non-proteic nitrogen supply produces an increase in digestibility and consumption.

Normally all the lactating ewes lose weight (see Table 3) though it is possible to observe that group I ewes weight loss is less than the remaining groups. Related to weight loss the results of this experiment are better than those reported by Abecia *et al* (1993) for a similar experiment. Corporal condition (see Table 3) seems to be highly correlated with body weight trends, therefore having superior values in group I. The results of this experiment are more consistent than those offered by Fiasentier *et al*. (1995).

Conclusions

A summary of the conclusions of this experiment is as follows:

(a) The results achieved in body weight are a clear indication of an improved protein and energy metabolism associated with a better supply of nutrients.

(b) A balanced diet ensuring an adequate supply of nutrients is a positive factor to ensure normal blood chemistry. This statement is consistent with Ruiz' (1998) results. The benchmark ranges were previously reported by Kulachevko and Krastocherskaia (1986), Yagos (1987), Urzula and Sokol (1987) and Desco *et al*. (1989) though the haemoglobin values of this experiment were inferior to those reported by Alonso *et al*. (1997) of 107.94 g/L.

(c) The glucose value is a clear reflection of an improved energy nutritional threshold when legume-tree rations are made available to grazing animals. This is supported by the performance values of group I. These results are consistent with those reported by Landan *et al.* (1996).

(d) The total protein values from group I are evidence that the legume-tree supplementation plays a beneficial role in the metabolism of lactating ewes. The results of this experiment are superior to those reported by Fonseca (2000) of 73 g/L at the 60th lactation day, and similar to those results reported by Figueredo (2000) of 74 g/L.

(e) The albumin results from group I indicate a better proteic metabolism compared to the other groups.

(f) The urea results are consistent with those reported by McNeill *et al*. (1997) of 4.0 mmol/L.

(g) Supplementary feeding of *leucaena leucocephala* played a definite role in improving and maintaining body weight, corporal condition, blood biochemistry and reproductive physiology of Cuban Pelibuey lactating ewes.

(h) In general it can be concluded that with a better supply of nutrients, facilitated by the supplementation of *leucaena leucocephala* in extensive grazing systems it is possible to ensure normal physiological blood values. Group I evidenced as per this condition a better capacity to re-conception within the breeding period since at the end of the lactation the ewes showed better body weight. Considering that the blood metabolic values are within normal ranges – and superior in experimental group I - and that body weight is beyond the benchmark (i.e. 30 kg), it is possible to argue that the reproductive efficiency of the supplemented ewes is ensured. This is consistent with Fonseca's (2000) observations.

(i) Experimental results indicate that it is possible to improve the nutritional supply of lactating Cuban Pelibuey ewes using available resources such as legume shrubs and trees, common in tropical ecosystems. In doing this not only is there an economic improvement of the meat production system, but also there is an opportunity to improve the status of the ecosystem because of the incorporation of more legumes which facilitates nitrogen incorporation to the soil and increases biodiversity.

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Appendix

Table 1. Chemical composition of grass and *leucaena leucocephala*

Date	Species	DM (%)	AS (%)	PT (%)	FB (%)	Ca (%)	P (%)
061099	Grass	40	12.74	9.50	25.92	0.45	0.19
	Leucaena	32	8.81	24.74	18.84	1.86	0.17
061199	Grass	38	12.33	9.00	30.51	0.38	0.10
	Leucaena	31	8.39	27.88	17.68	1.58	0.18
061299	Grass	40	14.91	9.40	29.75	0.52	0.05
	Leucaena	33	9.58	24.75	16.95	2.23	0.16

DM= Dry Matter, AS= Ashes, PT= Crude Protein, FB= Crude Fibre, Ca= Calcium, P= Phosphorus.

Table 2: Grass:supplementation offer relationship and nutritional value of supplementation ration

Date	Experimental group	Relationship grass: supplementation	Nutrients supplied by the supplementation ration					
			MS (kg)		PB (kg)		EM (Mj)	
			Total	%SNR	Total	%SNR	Total	%SNR
061099	I	62:38	0.624	38	141	80	5.75	156
	II	66:34	0.544	34	120	70	5.04	140
	III	69:31	0.464	31	101	64	4.34	132
	IV	90:10	0.144	10	22	15	1.52	49
061199	I	61:39	0.609	39	157	94	5.61	161
	II	65:35	0.531	35	135	83	4.92	145
	III	67:33	0.310	33	112	76	4.25	137
	IV	89:11	0.144	11	22	17	1.52	54
061299	I	60:40	0.649	40	145	85	6.17	172
	II	63:37	0.556	37	124	79	5.39	164
	III	65:35	0.474	35	104	73	4.62	154
	IV	88:12	0.144	12	22	17	1.52	56

MS= Dry Matter PB= Gross Protein; EM= Metabolic energy SNR= % Supply of Nutritional Requirements

Table 3. Live weight and corporal condition among experimental groups

	Experimental groups				
Concepts	I	II	III	IV	ES (standard error)
Leucaena leucocephala levels (kg/day)	1.50	1.25	1.00	0.00	
Weight at lambing	37.65^{a}	35.81^{a}	33.42^{b}	30.71^{b}	0.63
Weight at 30 days post lambing	35.94^{a}	33.92^{ab}	31.44^{bc}	28.62^{c}	0.57
Weight at 60 days post lambing	36.47^{a}	33.67^{b}	30.86^{c}	27.08^{c}	0.58
Corporal Condition at lambing	3.24^{a}	3.06^{a}	2.70^{b}	2.21^{c}	0.74

Corporal condition 30 days post lamb.	3.23^{a}	3.05^{a}	2.56^{b}	2.07^{c}	0.78
Corporal condition 60 days post lamb.	3.24^{a}	3.08^{a}	2.60^{b}	2.11^{c}	0.85

Index numbers indicate statistical significance $p < 0.05$ (CL= 95%) in a decreasing manner from a to c

Table 4. Haemoglobin (Hb- g/L) and glucose (GL – mmol/L) values

Leucaena kg/d	1.50	1.25	1.00	0.00	ES
Hb at lambing	98.0^{a}	95.0^{ab}	88.6^{b}	75.6^{c}	2.29
Hb at 30 days post lambing	93.6^{a}	84.6^{ab}	82.0^{b}	73.2^{c}	2.07
Hb at 60 days post lambing	90.4^{a}	82.8^{b}	79.6^{bc}	74.8^{c}	1.69
GL at lambing	2.92^{a}	2.38^{b}	2.28^{b}	1.82^{c}	0.08
GL at 30 days post lambing	2.84^{a}	2.28^{b}	2.24^{bc}	1.90^{c}	0.08
GL at 60 days post lambing	3.08^{a}	2.78^{ab}	2.52^{bc}	1.90^{c}	0.11

Index numbers indicate statistical significance $p < 0.05$ (CL = 95%) in a decreasing manner from a to c

Table 5. Chemical results for total protein (TP – g/L), albumin (AS-g/L and urea (US- mmol/L

Leucaena kg/d	1.50^{a}	1.25	1.00	0.00	ES
TP at lambing	74.2^{a}	70.4^{a}	63.8^{b}	57.0^{c}	1.73
TP 30 days post	75.6^{a}	67.8^{b}	63.8^{b}	59.0^{c}	1.77
TP 60 days post	74.8^{a}	71.0^{a}	64.8^{b}	59.2^{b}	1.65
AS at lambing	28.35^{a}	24.8^{b}	24.04^{b}	19.94^{c}	0.78
AS 30 days post	28.18^{a}	25.02^{b}	22.81^{b}	19.55^{c}	0.85
AS 60 days post	29.84^{a}	26.69^{b}	24.18^{c}	21.44^{d}	0.78
US at lambing	3.46^{a}	2.84^{b}	2.60^{b}	2.30^{c}	0.12
US 30 days post	3.30^{a}	3.11^{a}	2.49^{b}	1.96^{c}	0.13
US 60 days post	4.29^{a}	3.37^{b}	2.91^{c}	2.22^{d}	0.18

Indexes indicates levels of statistical significance $p<0.05$ (CL= 95%) in a decreasing manner from a to c