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Native Forages Asessment for the Improvement of Milk Production in Goats

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Abstract: The study was made in two parts. In the first, the food value was determined for two native Canarian species, Tagasaste (*Chamaecytisus proliferus* sp. *proliferus* var. *palmensis*) and common Tedera hay (*Bituminaria bituminosa*), well adapted to the climate. The chemical composition and digestibility were determined and the energy value for goats was estimated. The second phase of the experiment analysed the effects of the food on the milk production and quality when two different diets were fed. A common base of concentrates was used for the two groups of 20 Palmeran goats. The first diet, the Palmera Diet (PD) had a fibre content made up from the two native Canarian forages, whereas the other diet (Actual Diet or AD) was complemented with cereal straw. The quality and quantity of milk produced was recorded for 105 days, including in the middle part of lactation. The tagasaste was composed of 40% Dry Matter (DM) and 18% Crude Protein (CP), with Crude Protein Digestibility (CPD) reaching 75%, which represents 135g kg^{-1} DM. The daily intake was 0.67 kg DM/animal, corresponding with 44 g DM kg^{-1} $P^{0.75}$, with a considerably high energy value (9.18 MJ kg^{-1} DM of Metabolizable Energy (ME). The tedera hay showed 87% DM and 15% CP, giving 105 g DPIN and 96g DPIE (Digestible Protein in the Intestine (DPI)). The Digestibility of the Dry Matter (DMD), Organic Matter (OMD) and Crude Protein (CPD) obtained in the metabolic cages was 60, 61.6 and 51.4%, respectively. The daily intake was 0.54 kg DM/animal, which corresponds with 31g DM kg^{-1} $W^{0.75}$, with a ME content estimated to be 7.9 MJ kg^{-1} DM. Throughout the experiment the goats in the Palmera Diet (PD) group showed higher daily production values than the Actual Diet (AD) group. This peaked at 60 days when the average daily production was 26% greater in the PD than in the AD, diminishing to a difference of 15% at the end of the experiment. The fat and protein values were also better in the DP diet throughout the controlled time (representing up to 2.27 more fat and 1.01 kg more protein).

Key words: Tagasaste, tedera, diet, goat, milk production

INTRODUCTION

The current diet of the goat population in the Canary Isles has insufficient fibre, most of it is expensive cereal imported straw, underestimating the possibilities of local forages. The lack of fibre causes health problems, reduction of average age of the female milking goat and lower fat. This is a common problem in this region, independent of the possibilities of producing forage adapted to the local climate of the different zones. La Palma was awarded the Denomination of Origin in 2002 for its traditional cheeses, which only use milk from the Palmera goats ought to feed exclusively on locally sourced food. Tagasaste, which is native to La Palma and tedera are both traditionally used in the Canaries for feeding ruminants, but different socio-economical reasons are given as result a progressive abandonment of them in favour of imported and expensive straw. The Canarian Agronomic Research Institute is currently working both to increase the goat consumption of long fibre and to revaluate the production of local forage for the production of high quality milk products. This study also helps to keep the local links to the land, which is necessary to qualify for the Denomination and also the recovery of agricultural land currently abandoned. This experiment determines the nutritional value of the described forage and analyse the milk production of the Palmera goat feeding with them, comparing one diet with a low ratio of fibre (imported straw) to concentrates with another diet with adequate proportion of fibrous material based on the native forages.

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MATERIALS AND METHODS

The following chemical values were determined in both forages (tagasaste and tedera), using the corresponding analytical (AOAC, 1990; Sanz *et al*., 1998): Dry Matter (DM), Organic Matter (OM), Crude Protein (CP), Acid Detergent Fibre (ADF), Neutral Detergent Fibre (NDF), Acid Detergent Lignin (ADL) and minerals (Ca, P, Mg, K, Fe, Zn, Mn and Na). Six castrated males kept in metabolic pens were used to determine the digestibility of the DM (DMD), OM (OMD), CP (CPD), ADF (ADFD) and NDF (NDFD). The experiment took place in autumn and lasted 24 days including the preliminary phase of 14 days to adapt the goats to the pen; data was only being collected in the last 10 days. The forage was collected daily, cut into lengths of between 5 and 10 cm with a maximum width of 10 mm and given to the goats once a day. The energy values were estimated by means of an equation starting with the OMD (Aguitera, 2001).

A herd of 40 Palmera breed goats was divided into two homogenous groups of 20 for the analysis of milk production. One group received the named Actual Diet (AD), composed of a mix of concentrates (granulated alfalfa, commercial mix for milk production, grain maize and barley) and cereal straw Table 1. The other group was offered the Palmera Diet (PD) Table 1 with the same base of concentrates but with fibre from tedera and tagasaste. The rations can be considered to be isoenergetic, covering the requirements of a lactating goat Table 2. The evolution of the milk production was determined using the A4 method of control of the International Committee for Animal Recording (ACAR) modified for this experiment. The first milking record was made approximately 90 days after birth, so that the experimental period coincided with the middle part of lactation (from weeks 12 to 26 inclusive). The results refer to milk produced during the 105 days of lactation and not total production. The amount of milk produced was measured and also analysed with a Milko-Scan 133B to determine the percentage of fat, protein, lactose and dry matter. For the statistics Windows SPSS 11.0 was used. Descriptive statistics were used for the quality and quantity of the milk, for both daily and accumulated production were estimated according to Fleischman's method (Craplet *et al*., 1973), using the equation evaluated by Caja *et al*. (1986), typifying the production at 60, 90 and 105 days. A variance analysis was done, including the effect of diet on milk production (quality and quantity) as a fixed factor.

RESULTS AND DISCUSSION

The chemical composition of tagasaste Table 3 shows that, on average, the DM is higher than that found by Ventura *et al*. (2002) and Mc Gowan *et al*. (1988), who studied samples taken throughout the year. However, the results are similar to those found by others, such as Fernandez *et al*. (2004). The mean content of OM was slightly less than that determined by Varvikko and Khalili (1993) and Ventura *et al*. (2002), who found values greater than 90% over the year. The CP was all within the range found by other authors (Klee *et al*., 2001; Ventura *et al*., 2002) and slightly superior to that determined by Méndez and Almeida (1997) also using samples taken in the autumn. The percentage rose to above 20% when only leaves were used (Hassan *et al*., 2000). The mineral analysis of the tagasaste Table 3 indicate that this shrub has a relatively high concentration of Ca, P, Mg and K, with a correlation of Ca:P (<3), which is adequate absorption of P by small ruminants (Lambert *et al*., 1989) and a moderate content of Na and Fe.

As with other shrub forages, the fibre content of the tagasaste depends on diverse factors, in particular the agroclimatic conditions and the proportion of stalk/leaf in the samples analysed. In our case higher values were found for different fibrous parts (ADF, NDF and ADL) when compared with other works, only Varvikko and Khalili (1993) have noted higher values (42.6% ADF and 59.2% NDF). This could have been due to the inclusion of branches more than 5 mm thick as well as using shrubs older than a year, which have a greater degree of lignifications. In despite of the higher values on the fibre fraction, the intake of tagasaste Table 4 shows higher values than those obtained in other experiences using

Table 1: Chemical composition and mineral content of tagasaste and tedera

	DM	OM	CP	ADF	NDF	LAD	Ca	P	Mg	K	Na
Tagasaste	38	88	17.5	31.5	49.5	12.5	5.8	5.1	6.3	10.8	0.17
Tedera	86	84	15.6	31.5	43.3	31.0	12.8	4.2	2	22.6	0.16

DM, OM, CP, ADF, NDF, ADL in %; Ca, P, Mg, K and Na in g Kg^{-1}

Table 2: Intake, digestibility and energy values of tagasaste and tedera

	DMI	DM kg^{-1} $W^{0.75}$	DMD	OMD	CPD	DPIN	DPIE	EM
Tagasaste	764	44	68	67	75	100	99.18	9.18
Tedera	541	31	60	62	51	105	96	7.9

DMI (Dry Matter Intake) g DM. $animal^{-1}$ day; DMD, OMD, CPD in %; DPIN and DPIE in g kg^{-1} DM; EM in MJ kg^{-1} DM

Table 3: Ingredient composition (g kg^{-1}) of the diets

	Diet[1]	
	PD	AD
Commercial concentrate	161	304
Barley grain	48	63
Corn grain	48	51
Lucerne pellets	-	304
Tagasaste	582	-
Tedera	161	-
Wheat straw	-	278

[1]Diet: PD = Palmero Diet and AD = Actual Diet

Table 4: Chemical composition and metabolizable energy content of the diets

	Diet[1]	
Item[2]	PD	AD
DM, %	59.2	89.2
OM, % of DM	89.1	92.8
CP, % of DM	16.2	13.8
NDF, % of DM	40.6	43.2
ADF, % of DM	25.4	28.7
ADL, % of DM	12.7	5.8
Metabol. energy, MJ kg^{-1} of DM	9.9	10.4

[1]Diet: PD = Palmero Diet and AD = Actual Diet. [2]DM = Dry Matter; OM = Organic Matter; CP = Crude Protein; NDF = Neutral Detergent Fibre; ADF = Acid Detergent Fibre; ADL = Acid Detergent Lignin

samples from the Canaries that were taken in spring, summer and autumn, but at the same level of winter, when the cutting up was made in pieces bigger than 10 cm (Mendez and Almeida, 1997). It appears that the consumption was less affected by the higher fibre content than by the size of the cutting up of the branches. In a sheep experiment, tagasaste made up 90% of the food ration, the other 10% being dried alfalfa pellets (Fernandez *et al*., 2004), daily consumption actually increased (842 g MS/animal/day).

The DMD Table 4 of the tagasaste does not appear to be a problem when it has high percentages in leaves (70-80%) (Borens and Poppi, 1990), stressing the importance of offering lactating animals forage with plenty of foliage. The levels of CPD reached 125g kg^{-1}, which is a relatively high level. Furthermore, the OMD is very close to the mean annual values observed in previous experiments by Ventura *et al*. (2000) (63.2-65%) and less than results obtained by Borens and Poppi (1990), using only leaves (78%). The energy value of the tagasaste Table 2 was estimated to be 9.18 MJ kg^{-1} DM.

The chemical analyses of the tedera hay Table 3 indicate a relatively high average content of DM and OM, with very acceptable coefficients of digestibility Table 4. The average content of protein was the same as previous analyses (11 and 20%) (Mendez, 1992; Ventura *et al*., 2000). The percentage of cellular walls (NDF) is within the values previously found Ventyra *et al*., 1999; 2000). The protein and fibre contents were similar to those obtained for woody alfalfa or tree medic (*Medicago arborea*) (Ventura *et al*., 1999), a known medium quality forage.

As with the tagasaste, the contents of Ca, P, K and Na are adequate and balanced for ruminants (Borens and Poppi, 1990) Table 3. The intake Table 4 was somewhat less than the amounts consumed (0.78 kg DM/animal/day) in a trial in which the animals were allowed to choose between tedera and alfalfa hay, so as to determine preference. (Mendez, 2000). DMD and the DPI oscillate between very acceptable values. The ME was estimated to be 7.9 MJ kg^{-1} DM Table 4.

In Table 1 and 4 are showed AD (Actual Diet) and Palmera Diet (PD) after the analysis of forages were obtained. The average daily production obtained at 60, 90 and 105 days of lactation for both the AD and PD groups are showed in Table 5. Throughout the experiment, the goats on the PD showed higher milk production values than those on the AD, although no statistically significant differences were found. On the sixtieth day of lactation the average daily yield was 26% greater in the PD group than in the AD group. This difference diminished however at 105 days of lactation it was still greater than 15%.

With respect to the food effect in the accumulated milk production, greater values were noted for the PD group in all the experiments, although this difference decreased during the test period. At 60 days the difference was 25%, this being reduced to 18% at the end of the experiment. These figures are in accordance with those found by Alvarez *et al*. (2004) in an experiment done on Majorera breed goats which also studied the forage/concentrates ratio.

Table 6 shows the average percentages of fat at 60, 90 and 105 days. The results observed can be qualified as excellent for both groups. The results are notably better than those obtained in other experiments with Canarian breeds, not only with the Majorera breed goat (Fresno, 1993) or the Tinerfeña (Capote *et al*., 2000), but also with the Palmera breed, where values of 3.66% are referred to (Fresno, 1993). The effect of the diet on the fat content can be considered to be reduced, with figures that are not statistically significant, although they are slightly higher than in the AD group. This could be attributed to the fact that the Palmeran breed is still very rustic and this helps the goat to maintain the chemical composition of the milk from its own reserves. More study is needed on the determination on breeds and their influence in the quality of the milk. When the total fat was analysed using the

Table 5: Milk Production[1] in AD and DP groups (l day^{-1})

	Diet	
Period (days)	Actual Diet (AD)	Palmera Diet (PD)
60	1.34±0.05	1.69±0.09
90	1.37±0.07	1.62±0.14
105	1.38±0.06	1.59±0.14

[1]Average±standard deviation

Table 6: Milk fat content[1] in AD and PD groups (%)

	Diet	
Period (days)	Actual Diet (AD)	Palmera Diet (PD)
60	4.91±0.22	4.74±0.11
90	4.85±0.22	4.79±0.23
105	4.81±0.23	4.80±0.21

[1]Average±standard deviation

Table 7: Protein content[1] in AD and PD groups (%)

	Diet	
Period (days)	Actual Diet (AD)	Palmera Diet (PD)
60	3.69±0.14	3.59±0.13
90	3.72±0.11	3.65±0.12
105	3.78±0.17	3.69±0.14

[1]Average±standard deviation

Fleischman method, higher net values for the DP diet group were observed in all three tests (at 60, 90 and 105 days), representing an increase of 23% at 60 days, reducing to 15% at 105 days. This means that in terms of the whole experiment time, 1.27 kg more fat was produced from the PD diet than the AD one. On analysing the protein contents Table 7, it was noted that the diet had less effect. In the tests there were higher values for the AD group than the PD one. Other experiments on nutrition, using other breeds confirm these results (Sanz *et al*., 1998; Morand *et al*., 2000; Alvarez, 2004).

If the total protein is analysed from the perspective of accumulated production, there are significant differences in all three tests. Over the 105 days there is an increase in 1.01 kg of protein produced per animal.

REFERENCES

AOAC, 1990. Oficial methods of análisis. Association of official analytical chemist. (15th Edn.), Arlington, USA.

Aguilera, J.F., 2001. Aportaciones al conocimiento de la nutrición energética de pequeños rumiantes, con particular referencia al ganado caprino. Arch. Zootec., 50: 565-596.

Álvarez, S., 2003. Influencia de la alimentación del ganado caprino en la caracterización físico-química y organoléptica del Queso Majorero (D.O). Doctoral Thesis. Universidad de La Laguna, pp: 355.

Álvarez, S., M. Fresno, P. Méndez and J. Capote, 2004. Efecto de la alimentación (dieta actual vs tradicional) en la producción lechera de la raza caprina Majorera. Pequeños Rumiantes, 5: 30-36.

Borens, F. and D. Poppi, 1990. The nutritive value of tagasaste (*Chamaecytisus palmensis*), a leguminous tree. Anim. Feed Sci. Tech., 28: 275-292.

Caja, G., A. Torres, N. Fernández, M.P. Molina and L. Gallego, 1986. Estimación de la producción total de leche durante la lactación. Jornada Sobre Mejora Genética Del Ganado Ovino De Leche.

Capote, J., J.L. López and G. Caja, 2000. El Ordeño En Las Cabras Canarias. Santa Cruz de La Palma: La Palma (Ed.), pp: 257.

Craplet, C. and M. Thibier, 1973. La vache laitiére. 2nd: Vigot, 1973. Tomo V.

El Hassan, S.M., A. Lahlou, C.J. Newbold and R.J. Wallace, 2000. Chemical composition and degradation characteristics of foliage of some African multipurpose tree. Anim. Feed Sci. Tech., 86: 27-37.

Fernández, E., J. Avendaño, C. Ovalle, A. Fraga and F. Blue, 2004. Ovinos alimentados con raciones que incluyen tagasaste (Chamaecytisus proliferus subs. Palmensis) en reemplazo de heno de alfalfa. I. Consumo y variaciones de peso vivo. Agricultura Técnica (Chile), 64: 364-370.

Fresno, M., 1993. Estudio de la producción láctea de la Agrupación Caprina Canaria. Doctoral Thesis. Universidad de Córdoba, Facultad de Veterinaria, Córdoba, pp: 168.

Klee, G., A. Fraga and J. Cannobi, 2001. Producción de carne bovina utilizando tagasaste (Chamaecytisus proliferus ssp. palmensis) y praderas naturales en la provincia de Arauco, Chile. Agric. Téc., 61: 151-161.

Lambert, M., G. Jung, H. Harpster and J. Lee, 1989. Forage shrubs in North Island hill country.1.-Chemical composition and conclusions. New Zealand J. Agric. Res., 32: 499-506.

McGowan, A.I. Robinson and P. Moate, 1988. Comparison of liveweight and mineral metabolism of sheep fed pasture or Tagasaste. Proc. Soc. Anim. Prod., 17: 230-233.

Méndez, P., 1992. Evaluación de forrajeras endémicas de Canarias:I. In: XXXII Reunión Científica de la S.E.E.P., Pamplona (España), pp: 71-75.

Méndez, P., 2000. El heno de tedera (Bituminaria bituminosa): Un forraje apetecible para el caprino. In: III Reunión Ibérica de Pastos y Forrajes. A Coruña (España), pp: 411-414.

Méndez, P. and J. Almeida, 1997. Palatabilidad para caprino de cuatro taxa intraespecíficos de Chamaecitysus proliferus (L.fil)Link (tagasaste y escobones). In: XXXVII Reunión Científica de la S.E.E.P., Sevilla-Huelva (España), pp: 301-307.

Morand-Fehr, P., M. Sanz R. Sampelayo, Y.V. Fedele, Y. Le Frileux, M. Eknaes, P.H. Schmidely, S. Giger Reverdin, P. Bas, R. Rubino, O. Havrevoll and D. Sauvant, 2000. Effects of feeding on the quality of goats milk and cheeses. 7th International Conference on Goats. Poitiers (Francia).

Sanz Sampelayo, M.R., L. Amigo, J.L. Ares, B. Sanz and J. Boza, 1989. The use of diets with different protein sources in lactating goats: Composition of milk and its suitability for cheese production. Small Rumin. Res., 31: 37-43.

Varvikko. T. and H. Khalili, 1993. Wilted Tagasaste (*Chamaecytisus palmensis*) forage as a replacement for a concentrate supplement for lactating crossbred Friesian x Zebu (Boran) dairy cows fed low-quality native hay. Anim. Feed Sci. Tech., 40: 239-250.

Ventura, M.R., M.P. Flores and J. Castañón, 1999. Nutritive value of forage shrubs: Bituminaria bituminosa, Acacia salicina and Medicago arborea. Options Méditerranéenes, 39: 171-173.

Ventura, M.R., P. Méndez, M.P. Flores, R. Rodríguez and J. Castañón, 2000. Energy and protein content of Tedera (*Bituminaria bituminosa*). Cahiers Options Méditerranéenes, 45: 219-221.