Performance of Dairy Goats to Alfalfa Silage Based Diets Supplemented with Different Sources of Carbohydrates

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PERFORMANCE OF DAIRY GOATS TO ALFALFA SILAGE BASED DIETS SUPPLEMENTED WITH DIFFERENT SOURCES OF CARBOHYDRATES.

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Abstract

Lactating Saanen dairy goats fed alfalfa silage (AS) based diets in four 4x4 Latin Square designed experiment were studied for the effects of supplementation of three different type of carbohydrates (wheat grain, (W); sorghum grain, (SG) and dry citrus pulp, (DCP)) on milk yield, composition and chewing activities. Sixteen does (45± 10 DIM and 2.016 kg ± 0.48 4% FCM) housed indoors in individual pens in a four 4x4 experiment were fed four diets 1) AS (33.9%DM, 19.9%CP, 44.01%NDF); 2) ASW (52.4%DM, 19.8%CP, 33.7%NDF); 3) ASSG (50.9%DM, 17.9%CP, 37%NDF), 4) ASDCP (52.5%DM, 16.12%CP, 39.1%NDF) with forage-to-concentrate ratios of 100:0 or 65:35, 67:33 and 64:36 respectively. Intake of AS DM (2.78%BW) was different ($P<0.05$) from the other treatments (average 3.53 ±0.07 %BW). Chewing efficiency (min/g NDF per kg BW $^{0.75}$) decrease ($P<0.05$) as a result of AS substitution or concentrate supplementation without effect ($P>0.05$) of carbohydrate type or dietary level of NDF. Milk, 4%FCM and fat-protein-corrected milk yield was affected ($P<0.05$) by concentrate supplementation. Either milk protein content (g/l) or yield (g/day) were not affected by treatments. Body weight changes appeared related to concentrate supplementation. Supplementation increase total DM intake, decrease forage DM intake and chewing efficiency and increase producing performance without changing milk composition.

***Keywords*:** lactating dairy goats, fat-corrected milk, milk protein, chewing efficiency, alfalfa silage.

Introduction

To achieve high FCM yields, dairy goats should eat energy and protein in an adequate protein to energy ratio. With grass silages the problem is the poor utilization of silage N resulting from its highly degradable CP content, coupled with low concentration of non fiber carbohydrate (NFC). Balancing the rate of supply of N and energy yielding substrates to rumen microorganisms has been proposed to maximize microbial synthesis rate and efficiency (Hutjen 1996). Studies aimed to that objective have produced conflicting results (Beever and Siddons 1986; Sinclair et al 1993, 1995; Kolver et al 1998; Casper et al 1999) and this effect remains not well documented for lactating dairy goats, fed alfalfa based silage diets. Besides, because NFC can negatively affects rumen pH, a minimum amount of fiber is requiered (NRC-1989). Dried citrus pulp (DCP) is high in fermentable fiber (Nocek and Russell 1988). Therefore, even though DCP has a smaller particle size than does AS it could potencially replace a portion of the AS fiber, increasing the dietary energy density while maintaining the NDF concentration (Firkins 1995). The purpose of this study was to assess the performance of Saanen dairy goats to alfalfa silage based diets supplemented with DCP and fast or slowly fermentable carbohydrates and their influence on milk yield, composition and chewing activities.

Material and Methods

The experiment was carried out in a private farm located at Gral. Rodriguez county (Buenos Aires province, Argentina) between June and October of 1999. Sixteen Saanen goats, one to three lactations, 45± 10 days in milk (DIM) and 2.016 kg (± 0.48) 4% FCM average daily yield were randomly assigned to the following experimental diets in four 4x4 Latin Square design.

AS: Alfalfa Silaje

ASW: Alfalfa Silaje + wheat grain (fast degraded)

ASSG: Alfalfa Silaje + sorghum grain. (slowly degraded)

ASDCP: Alfalfa Silaje + dried citrus pulp

The AS was prepared in autumm (May) and stored in a plastic bag (Silotileno®, 200 ft long 235µ thick, Buenos Aires, Argentina). All 16 animals were individually housed indoors. Feeds were delivered in four daily meals: in the 1st and 3rd only AS, while in the 2nd and 4th, AS plus the corresponding concentrate, offered at a daily rate of 1.2% BW. Once per period, chewing activities (rumination plus eating time) were recorded every five minutes during a 24 h period. In the statistical ANOVA corrected by covariance, sources of variance were treatments, animals, periods, squares, square within periods, and interactions. Covariate was milk or 4%FCM yield at 8th week of lactation. Upon detecting significant effects, treatment means were submitted to LSD protected contrasts ($P<0.05$).

Result and Discussion

Table 1 contains the diets forage-to-concentrate ratios and chemical composition. Concentrate DMI was different (P<0.0001) between treatments (0.643, 0.655 and 0.684 kg DM, for sorghum, wheat and DCP). Silage DMI was different between treatments (P<0.03) with an average of 1.253 kgDM/day and extremes of 1.206 kg (ASDCP) to 1.308 kg (AS). Resulting F:C ratios were 64:36 (ASDCP); 65:35 (ASW) and 67:33 (ASSG). Total DMI of AS was lower (P<0.0001) than the other treatments which did not differ among them (P>0.05). As a %BW, total treatment DMI were 2.78% (AS), 3.45% (ASDCP), 3.56% (ASW) and 3.59% BW (ASSG). A summary of the main results is shown in Table 2. Concentrate supplementation increases (P<0.002) milk yield, 4% FCM and fat-protein corrected milk yield (Van Arendonk et al 1991), but concentrate-type effect was not detected (P>0.05). Milk fat content of AS was 13.8% higher (P<0.03) than other treatments which all in any case were lower than 3.5%. Yield of 4% FCM followed the same pattern as milk yield did. Not only AS was the less producing diet but also the only one which induces animal BW losses (-96.6 g/day; P<0.03). Neither milk protein content nor yield were affected by treatments. However fat and protein corrected milk (FPCM) yield turned up significant affected (P<0.05) by treatments. The Sorghum diet produced the same 4%FCM and FPCM yields as the other sources of carbohydrates did allowing in addition the highest animal B.W. gain. Rumination and total chewing time, but not eating time were affected (P<0.05) by suppl mentation regardless of the carbohydrate type. With Saanen x Marota goats, Kawas et al (1991) found similar rumination time (339 to 363 min/day), 22% higher eating time and almost equal total chewing time (561 vs. 574 min/day). Regarding chewing efficiency, average of this study (16.7 min/g NDF/kg $BW^{0.75}$) was lower than that of Kawas et al (1991) report. Unexpectedly, chewing efficiency was the same for all concentrates and lower than that of AS diet regardless of the different ($P<0.001$; Tables 1 and 2) levels of dietary NDF. In this work, the average rumination time represented 66% of total chewing time, while rumination time for AS diet required 74% of the total time. Unlike other reports (Kawas et al 1985), partition of chewing activities into rumination and eating was affected by the presence of but not for concentrate type. However, because the ASDCP diet has required more time ($P<0.05$), it can be assumed a higher saliva production and better regulation of rumen environment. Total chewing time per unit of NDF adjusted for kg $BW^{0.75}$ decreased ($P<0.005$) due to concentrate supplementation. Alfalfa Silage based diets supplemented with different types of carbohydrates keeping a F:C ratio of 65:35, deliver enough energy to optimize dairy goats performance allowing a 0.1% BW gain daily and to efficently use silage nitrogen.

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Table 1 - Diets chemical composition, % DM basis**.**

	DIETS (Forage to Concentrate ratios)			
	AS	ASDCP	ASW	ASSG
Component	(100:0)	(64:36)	(65:35)	(67:33)
DM	35.88	52.49	50.93	52.41
CP	**14.89**	**16.12**	**17.90**	**19.80**
NDF	43.90	39.10	37.00	33.70
ADF	27.32	23.70	19.90	20.60
Hemicel.	16.56	15.40	17.20	13.10
Ash	11.72	9.66	8.22	8.30

Table 2 - Influence of carbohydrate type on milk yield, milk composition, body weight changes and chewing activities of Saanen goats fed alfalfa silage based diets.

ITEM	DIETS and (Forage:Concentrate) ratios				
	AS (100:0)	ASDCP (64:36)	ASW (65:35)	ASSG (67:33)	S.E. (Pooled)
Nº of does	4	4	4	4	
Milk, l/day	1.43 **a**	1.69 **b**	1.68 **b**	1.63 **b**	0.09
Milk fat, g/l	41.12 **a**	35.05 **b**	36.11 **ab**	36.95 **ab**	1.86
Milk fat, g/day	57.4	56.59	60.77	60.46	0.22
4% FCM[1], l/day	1.43 **a**	1.53 **b**	1.58 **b**	1.56 **b**	0.023
Milk proteín, g/l	32.627	32.328	31.240	33.116	0.78
Milk proteín, g/day	0.0484	0.0563	0.0521	0.0548	0.012
FPCM[2], l/day	1.477 a	1.606 b	1.577 b	1.586 b	0.093
BW changes, g/day	**-**96.6 **a**	38 **b**	22.1 **b**	97.5 **c**	13
CHEWING ACTIVITIES, min/day					
Rumination time	441 *a*	378 *ab*	350 *b*	356 *b*	2.8
Eating time	156	182	157	180	30
Total chewing time	597 *a*	560 *ab*	507 *c*	536 *b*	2
CHEWING EFFICIENCY					
min/kg total DM Intake	421 *a*	302 *b*	273 *b*	278 *b*	6
min/kg forage DM intake	458 *ab*	470 *a*	420 *b*	418 *b*	10
min/g NDF consumed per $kgBW^{0.75}$	20.4 *a*	15.4 *b*	16.0 *b*	15.0 *b*	1.8

a,b,: Means in the same row with different subscript differ significantly (*a*, P<0.05 or **a**, P<0.003), [1] 4% fat corrected milk, [2] fat-protein corrected milk..