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SUPPLEMENTATION OF DAIRY COWS UNDER ALFALFA GRAZING CONDITIONS WITH GROUND CORN

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Abstract

Two trials were carried out during the Autumn of 1991 and 1992 to investigate the effects of corn supplementation on lactational performance of dairy cows under alfalfa grazing. Forty two multiparous Holstein cows with 30-60 days in milk were used in a randomized continuous design with covariance analysis. The treatments were 0.0, 3.5 and 7.0 $kg.day^{-1}$ of corn grain supplementation (T1, T2 and T3 respectively) in 1991 and 0.0, 3.0, 6.0 and 9.0 $kg.day^{-1}$ (T1, T2, T3 and T4 respectively) in 1992. Six cows per treatment were used divided in 3 cows per grazing paddock. Dry matter (DM) intake (DMI) was estimated weekly for each group of cows. The pasture allowance was between 22-26 kg $DM.cow^{-1}.day^{-1}$. Pasture and grain DMI were 16.6 and 0.0, 13.5 and 3.2, 13.3 and 6.1 $kg.cow^{-1}.day^{-1}$ (T1, T2 and T3 respectively) in 1991; 16.8 and 0.0, 15.7 and 2.1, 14.0 and 4.1, 12.2 and 6.3 $kg.cow^{-1}.day^{-1}$ (T1, T2, T3 and T4 respectively) in 1992. The substitution rate was 0.66 kgDM pasture per kgDM corn. There was a lineal effect of supplementation on milk production the responses were 0.936 (1991) and 1.173 (1992) kg milk $kgDM^{-1}$ corn. However, non significant effects ($P>0.05$) on fat content (32.8 and 31.9 g. kg^{-1} milk) and protein contents (30.7 and 30.7 g. kg^{-1} milk) in milk during both years (1991 and 1992 respectively) were observed.

Keywords. alfalfa, grazing, supplementation, corn, milk yield, milk composition

Introduction

Concentrate feeds in Argentina were used to supplement low production pastures during the winter time and/or drought periods (Monti and Telechea, 1965). Actually, they are also fed under grazing to balance diets and/or to increase stocking rate. A recent study (INTA-Sancor, 1995, unpublished data), indicated that the main concentrate feeds in this country are corn and sorghum grains, and as by-products cotton seeds and wheatbran. Supplements are included from 10 to 30% in an average yearly diet, the hays and silages together no more than 30%, being alfalfa pastures the base forage component with a proportion of 40 to 90%.

The supplementation of grazing dairy cows with concentrates is a complex subject which has not been clearly evaluated. Many factors has been extensively analized (Viglizo, 1981; Leaver, 1985; Castillo and Gallardo, 1995). However, to evaluate profits of a supplemention strategies, at least, substitution rate (kg reduction in herbage DMI per kg increase in grain DMI), short-term effects (kg milk per kg grain) and residual or long term-effects (kg full lactation per kg grain supplemented) must be considered (Broster and Broster, 1984). The aim of this study was to evaluate the effect of corn grain supplementation with dairy cows under alfalfa grazing conditions on intake, milk yield and milk composition.

Material and Methods

Experimental procedure. During 10 weeks and after the pick of lactation, 42 Holstein multiparous dairy cows (6 per treatment) were used in two experiments during the Autumns of 1991 and 1992, at the Experimental Station Rafaela INTA, Argentina. The feeds used in both experiments were an alfalfa pasture and different levels of ground corn (treatments), as follow: 0.0, 3.5 and 7.0 kg corn.day^{-1} (T1, T2 and T3 respectively) in 1991 and 0.0, 3.0, 6.0

and 9.0 kg corn.day^{-1} (T1, T2, T3 and T4 respectively) in 1992. Supplements were offered twice daily during milking, except in 1992, T4 (9.0 kg corn.day^{-1}), which was divided in three equal meals, two of them were supplied during milking and one at mid-day during grazing. The cows were permanently held at pasture in a strip-grazing system with one paddock per treatment, which was divided by electrical fences in two sub-plots (3 cows each). Herbage allowance was estimated to be 1.5 times the daily DM intake (DMI). Alfalfa DMI was obtained weekly by difference considering total DM offered and refusal (post-grazing) by taking 5x1 m (5m^2) cut of fresh alfalfa. Pasture DMI was obtained by difference between offered and refusal and divided by the number of cows in each sub-plot. Daily milk production and milk samples in proportion to yield (0.1g.kg^{-1}) were taken twice a week in each animal.

Chemical analyses. Four corn grain samples in total along with 6 alfalfa pasture samples per experiment were taken for: DM (105 ºC for 48 hours), crude protein content (CP, Kyeldhal N*6.25), neutral detergent fibre content (NDF), acid detergent fibre content (ADF), *in-vitro* dry matter digestibility (IVDMD, Tilley and Terry, 1963) and ash content (550ºC 16 hours). Fibre fraction (NDF, ADF) was determined according to Van Soest *et al.* (1991). Milk composition (fat, protein and non protein nitrogen contents) was determine by standard methodologies according to the International Dairy Federation (FIL - IDF).

Experimental design and statistical analyses A continuous design with covariance adjustment was used to examine milk yield and composition. In the third and fourth week post-calving average daily milk production was used as a covariate and one daily milk sample per week for component analysis in each cow. Subsequently, the cows were allocated in each treatment according to previous records of milk production. After three weeks of adaptation, experimental measurements for short-term effects were carried out for 12 weeks. The analyses

were undertaken using the General Lineal Model procedure of SAS (1989). The overall means obtained were adjusted means or LS means by SAS.

Results and Discussion

Chemical composition and the estimated DMI of feeds are presented in Table 1.

The analysis indicate a normal quality for both feeds (Gaggiotti *et al.*; 1996), with relatively lower CP content for alfalfa and corn and a higher fibre content for alfalfa in 1992 compared to 1991. Dry matter intakes were as expected, however, higher refusal of corn were observed in 1992 when compared with 1991, probably related to differences in the pasture quality. The substitution rate (SR), calculated considering both experiments, was explained by the following equation:

$y = -0.66x + 16.6$, Adj.R-sq = 0.32, ($P<0.01$)

Where: y = alfalfa ($kgDM.day^{-1}$) and x = corn ($kgDM.day^{-1}$)

Table 2 shown the effect of corn on milk yield and composition. There was a significant response in milk production, from 22.7 to 28.4 kg ($P<0.08$) in 1991, and from 19.1 to 26.6 kg $milk.day^{-1}$ ($P<0.01$) in 1992. The immediate effects were lineal and the following equations were determined:

1991: $y = 0.936 x + 23.4$, Adj.R-sq = 0.13

1992: $y = 1.173 x + 19.5$, Adj.R-sq = 0.41

Where: y = milk ($kg.day^{-1}$) and x = corn ($kgDM.day^{-1}$)

These results agrees with trials carried out at Wisconsin University (D.Combs, personal communication) and Leaver (1985). Milk composition was not affected by the treatment, except NPN contents, which was significantly ($P<0.01$) decreased in more than 10% from T1 to T4 in 1992. Components yield were consistent with milk yields, without significant differences in NPN yield.

A simple regression analysis was done based on full lactations (adjusted to 305 day) to estimate long term responses including both experiments data, as follow:

$y = 5728 + 1.9\ x$, Adj. R-sq = 0.54, ($P<0.06$)

Where: y = milk (kg.full lactation^{-1}) and x = corn (kg.day^{-1})

Intersection (more than 5700 kg. lactation^{-1}) is close to a ten years report in Argentina with dairy cows grazing alfalfa pastures with low concentrate inputs (Andreo *et al*., 1992). The slope, which represent the residual effect (1.9 kg milk. kg^{-1} corn. day^{-1}) agrees with other studies discussed by Broster and Broster (1984).

Short-term effects of corn grain supplementation under alfalfa grazing condition increased milk yield, fat and protein yield, with no effects on fat and protein contents. Important long-term effects were also observed considering full lactations.

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Table 1 - Chemical composition (g.kg^{-1} DM, except were stated) and dry matter intake of feeds (kg.cow^{-1}. day^{-1})

Year	1991			1992		
Chemical composition	alfalfa	corn	...	alfalfa	corn	...
DM (g.kg^{-1} fresh)	187	909	...	190	879	...
CP	255	90	...	189	72	...
NDF	493	122	...	598	164	...
ADF	336	100	...	455	63	...
IVDMD	688	855	...	568	888	...
Ash	102	12	...	nd	14	...
Dry matter intake [§]	alfalfa	corn [‡]	total	alfalfa	corn	total
T1[†]	16.6±2.0	...	16.6	16.8±2.7	...	16.8
T2	13.5±1.6	3.2±0.0	16.7	15.7±2.9	2.1±0.3	17.8
T3	13.3±1.6	6.1±0.0	19.4	14.0±2.7	4.1±0.5	18.1
T4	...	...	...	12.2±2.1	6.3±0.6	18.5

§ mean ± sd

‡ marginal refusal of grain were observed in 1991

† T1, T2 and T3 represented 0.0, 3.5 and 7.0 kg.day^{-1} of corn grain supplemented in 1991 and 0.0, 3.0, 6.0 and 9.0 kg.day^{-1} including T4 in 1992

Table 2 - Effect of corn grain supplementation on milk yield and composition with dairy cows grazing alfalfa pastures

Years	1991					1992					
Treatments †	T1	T2	T3	s.e.d.	P=	T1	T2	T3	T4	s.e.d	P=
Milk yield ($kg.day^{-1}$)	22.7	27.7	28.4	2.28	0.08	19.1	22.7	24.4	26.6	1.80	0.01
Milk composition ($g.kg^{-1}$)											
Fat	33.8	32.7	31.8	0.35	0.44	32.9	31.5	31.4	31.8	0.53	0.81
Protein (N*6.38)	30.6	30.8	30.8	0.30	0.97	30.1	30.9	31.2	30.7	0.29	0.67
Non protein nitrogen	0.37	0.34	0.33	0.051	0.15	0.33	0.31	0.30	0.29	0.003	0.01
Component yield ($g.day^{-1}$)											
Fat	726	921	926	2.9	0.08	624	706	762	839	1.4	0.01
Protein (N*6.38)	694	842	873	2.5	0.09	574	694	760	819	1.5	0.01
Non protein nitrogen	9.09	9.44	9.42	1.165	0.95	6.28	7.02	7.45	7.61	0.596	0.15

† T1, T2 and T3 represented 0.0, 3.5 and 7.0 $kg.day^{-1}$ of corn grain supplemented in 1991 and 0.0, 3.0, 6.0 and 9.0 $kg.day^{-1}$ including T4 in 1992