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Theme 2. Grassland production and utilization
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Effect of supplementation of dairy cows under cut and carry or grazing of irrigated cultivated pastures in small scale dairy systems in the highlands of central Mexico

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Introduction

Small-scale dairy systems in Mexico represent over 78% of dairy farms and produce 37% of the nation's milk, and have an important role in reducing rural poverty. Small-scale dairy systems are defined by having herds of 3 to 35 cows plus replacements, and rely mostly on the family for labour. In the central highlands, many small-scale dairy farms base the feeding of herds on irrigated cultivated pastures of ryegrass (*Lolium multiflorum*, *L. perenne)* – white clover (*Trifolium repens*), mostly under cut-and-carry by hand with scythes, straws, and large amounts of commercial compound concentrates that result in high feeding costs and low economic sustainability (Fadul-Pacheco *et al*., 2013). One option to optimize the use of resources in these systems is to change the use of grasslands to intensive grazing that result in lower feeding costs when compared to cut-and-carry strategies. Also, the high protein content of pasture may meet requirements for moderate yields by dairy cows, so that commercial concentrates may be substituted by lower protein, lower cost supplements like ground maize grain and remove the straws of the diets.

Materials and Methods

The work took place in the municipality of Aculco, in the northwest of State of Mexico, with an altitude of 2,440 m, temperate sub-humid climate, mean annual temperature of 13.2 ºC, frost from October to February, a summer rainy season (May – October), and 800 mm rainfall. An on farm experiment in seven participating small-scale dairy farms evaluated cut-and-carry (C) and grazing (G) of irrigated ryegrass (*Lolium perenne* and *L. multiflorum*)/white clover (*Trifolium repens*) pastures, and either 5.0 kg/cow/day of commercial compound concentrates (CC) or 5.0 kg/cow/day of ground maize grain (MG) as supplements (fresh basis).
Six farmers participated with four milking cows each and one farmer with two groups of four milking cows; in a 2X2 factorial experiment within a split-split plot design with cow groups as experimental units. The experiment lasted 12 weeks. Milking is twice daily by hand or portable milking machines (2 farmers) and milk is sold uncooled to local buyers. Feeds were analyzed following standard procedures for dry natter (DM), organic matter (OM), crude protein (CP), neutral detergent fiber (NDF), and acid detergent fiber (ADF). NHA was determined under grazing using exclusion cages and cutting 0.5 quadrants every 21 days and similar quadrants before cut and carry. Milk yield was recorded weekly with a spring balance, and expressed also as ECM. Milk urea nitrogen (MUN) was determined to assess the protein status of cows. Mean results per cow group were subjected to analysis of covariance, with milk yield analyzed as the covariate. Economic analysis was undertaken with partial budgets.

Results and Discussion

The net herbage accumulation (NHA) was of 38 kg DM/ha/d and of 68 kg/ha/d in G and C, respectively. Mean grassmetre height was 6 cm in G and 20 cm in C, respectively. There were no differences between pastures ($P>0.05$) in DM, OM, Ash and NDF, but there were significant differences ($P<0.05$) in CP and ADF (Table 1). There were no differences ($P>0.05$) in milk yield, ECM, milk fat, live weight or feeding costs, but there was a trend for higher milk protein under grazing ($P<0.10$) due to a high content of CP in G (169 g/kg DM) than in C (130 g/kg DM) and a higher body condition score ($P<0.05$) under CCC (Table 2). Results indicated that grazing, in addition to reducing the toil for the farmers of the cut and carry management, sustains MY and improves milk protein content (Auldist *et al.*, 2013). Numerically, there was a higher milk fat content, although non-significant ($P>0.05$), for supplementation with maize grain

particularly in the G treatment indicating a possible positive synergy (Granzin, 2004). An additional aspect of MG supplementation is that with lower protein intakes, dairy cows become more efficient in protein metabolism, and excrete less Nitrogen into the environment. Feeding costs per kg of milk were 10% (15% for ECM) higher under cut and carry but no statistical differences were observed (P>0.05). These results are in line with earlier findings that grazing results in lower feeding costs, increases profitability and economic efficiency of farms, and enhances their economic sustainability.

Table 1. Chemical composition of feeds

Composition (g/kg DM)	Herbage in G	Herbage in C	PS[2]	MG	CC	SS[2]	Oat Hay
DM[1]	183	188	NS	900	902	NS	867
OM	869	872	NS	966	904	**	916
CP	169	130	**	63	190	**	61
NDF	510	538	NS	133	273	**	564
ADF	229	275	**	21	93	**	314

G= Grazing; C= Cut and Carry; PS= Pasture significance; MG= Ground Maize Grain; CC= Commercial concentrate; SS= Supplement significance

[1] Dry Matter expressed in g/kg of Fresh matter.

[2]NS, P>0.05; * P<0.05.; a, b, c Values within a row with different superscripts differ significantly at *P*<0.05.

Table 2. Cow performance, milk composition, and feeding costs

	Feeding strategy				Main plot						Split plot		Interaction					
	GCC	GMG	CCC	CMG	p		s		p*s		W		p*W		s*W		p*s*W	
					SEM	p	SEM	p	SEM	p	SEM	p	SEM	p	SEM	p	SEM	p
MY (kg/cow.d)	17.65	16.49	18	17.74	8.07	NS	8.07	NS	5.71	NS	0.22	NS	0.18	NS	0.18	NS	5.48	NS
ECM (kg/cow.d)	16.24	15.92	16.63	16.35	5.72	NS	5.72	NS	4.04	NS	0.24	**	0.20	NS	0.20	NS	3.90	NS
Milk Fat (g/kg)	33.61	37.62	33.96	34.19	6.96	NS	6.96	NS	4.92	NS	0.53	NS	0.43	**	0.43	NS	4.82	NS
Milk Protein (g/kg)	32.18	32.95	31.92	31.29	0.74	*	0.74	NS	0.53	NS	0.12	NS	0.10	NS	0.10	NS	0.55	NS
MUN (mg/dL)	16.22	14.33	13.31	10.86	5.17	NS	5.17	NS	3.65	NS	0.83	**	0.68	NS	0.68	NS	3.84	NS
LW (kg)	483	482	515	491	101.83	NS	101.83	NS	72.01	NS	3.01	NS	3.48	NS	3.48	NS	65.96	NS
BCS	1.97[b]	1.94[b]	2.09[a]	1.8[c]	0.07	NS	0.07	**	0.05	*	0.03	**	0.04	NS	0.04	NS	0.07	*
€/kg MY	0.13	0.13	0.14	0.13	0.07	NS	0.07	NS	0.05	NS	0.00	NS	0.00	NS	0.00	NS	0.05	NS
€/kg ECM	0.14	0.13	0.16	0.15	0.06	NS	0.06	NS	0.04	NS	0.00	NS	0.00	NS	0.00	NS	0.04	NS

[1] Standard error of the mean; [NS] P>0.10; * P<0.10; ** P<0.05

GCC= Grazing with Commercial Concentrate; GMG= Grazing with Ground Maize Grain; CCC= Cut and Carry with Commercial Concentrate; CMG= Cut and Carry with Ground Maize Grain

Conclusion

Small-scale dairy farmers could use local resources (MG) with implementing grazing practices for lowering of feeding costs, increasing profitability and economic efficiency of farms, and enhancing their economic sustainability.

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