Paper ID: 1249
Theme 2. Grassland production and utilization
Sub-theme 2.5. Validation and dissemination of traditional knowledge

Use of native grassland in small-scale dairy systems in the highalnds of Central Mexico. A case study

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Keywords: Chemical composition, Dairying, Feeding costs, Grazing, Native grassland, **S**mall-scale

Introduction

Small-scale dairy systems in Mexico comprise 78% of specialized dairy farms and provide 37% of national production. They are small farms with herds 3-35 cows plus replacements, and rely on family labour (Posadas-Domínguez *et al*., 2014).

In the highlands, many farms have native grasslands, grazed during the rainy season, and supplemented with other feeds as maize straw, maize grain and maize ears. Native grasslands have not been studied in this context. This is a case study on the use of native grassland in a small-scale dairy farm. The objective was to determine how native grasslands are integrated in feeding milking dairy cows, and the feeding costs involved.

Materials and Methods

The study ran from 30 June – 27 October 2013, in northwest State of Mexico, an altitude of 2,440 m, temperate sub-humid climate, mean temperature of 13.2ºC, frosts from October to February, summer rainy season (May to October), and 800 mm rainfall. The grassland was 9.02 ha, grazed in the rainy season by cattle and sheep for 6 to 8 h/day, for at least 50 years.

A mixed herd of 5 milking Holstein cows, a bull, 3 replacement heifers, 2 male calves and 39 criollo sheep was used. Records were taken for the herd of milking cows, the other livestock considered for calculating stocking rate. Besides grazing, milking cows received 2.6 kg/cow/day of commercial compound concentrate, 2.0 kg /cow/day of ground maize ears (whole with husks), and 4.8 kg/cow/day of ground maize straw. Cows were milked by hand. Total milk yield of the 5 cow herd was recorded daily, and mean weekly yield regressed on week to assess lactation persistency. Milk fat and protein content was determined per cow every four weeks with an ultrasound analyzer. Body condition score (BCS) was recorded every four weeks (1-5 scale).

Herbage mass (HM) was estimated from 12 quadrants (2,00 x 0,25 m) every 3 weeks. Rising plate metre height was recorded every two weeks taking 40 readings in a zigzag pattern. Since HM and grassland height data were not distributed normally, Kruskal-Wallis and Mann –Whitney non parametric tests were used for analysis. DM, CP, NDF ADF, and *in vitro* digestibility were undertaken on grassland hand-plucked and other feeds samples every 3 weeks (Anaya-Ortega *et al.*, 2009).

Economic analysis was undertaken by partial budgets (Dillon and Hardaker, 1980), giving an opportunity costs to the grassland, and home produced ground maize straw and ground ears.

Results and Discussion

Main grass species found were *Bouteloua hirsuta*, *Bouteloua gracilis*, *Cynodon dactylon, Bromus carinatus*, *Pennisetum clandestinum*, *Agrostis spp.*, and *Sporobolus poiretii*. The first three species and the introduced grass *Pennisetum clandestinum* were preferred. There were also pseudo-grasses as *Cyperus spp.* and *Juncus spp.*; and forbs of the genera *Tagetes spp*., *Plantago spp*., *Cirsium spp*., and others. There are oaks (Q*uercus spp*.), pines (*Pinus hartwegii*), and shrubs (*Acacia fanerosa*) in the grassland.

The lowest HM was recorded in Period 1, the beginning of the season, increasing over 3.5 times by Period 2. Continued increasing till Period 5, although with non-significant differences between Periods 2-5 ($P>0.05$). HM was not completely harvested by the herd. Stocking rate was 17.4 animal units (1.93 AU/ ha); with 7 h/day grazing; so accumulated herbage

was not totally consumed. Mean HM was 976.16 kg DM / ha, similar to reports by Echavarría-Chairez *et al*. (2006) who recorded a mean of 811 kg DM/ha; indicating these native grasslands have HM around 1.0 ton DM/ha.

Height showed significant differences between periods ($P<0.05$), staying above 7 cm till week 9. From week 11 there was a reduction, falling significantly in week 17. There was no significant relationship between height and HM ($P>0.05$; $R^2=0.09$).

Chemical composition and *in vitro* digestibility of feeds are shown in Table 1. The nutritive value of grassland decreased in time; due to low grazing intensity shown by increasing HM, which made grasses mature, entering in reproductive phase, limiting vegetative growth of new tillers which might have been stimulated by a higher grazing intensity. Okello *et al*. (2005) describe a similar effect with 10 milking cows grazing 10 ha of native grassland, stating that the low quality of forage was due to rapid growth due to low grazing pressure.

Table 1: Chemical composition and *in vitro* digestibility of rangeland pasture (g/kg DM)

	Period 1	**Period 2**	**Period 3**	**Period 4**	**Period 5**
Crude Protein	121.0	87.6	75.0	76.2	66.5
Neutral Detergent Fibre	588.7	659.6	683.1	702.4	627.2
Acid Detergent Fibre	277.1	320.3	332.8	340.9	302.8
In vitro Digestibility	515.6	454.0	403.6	395.2	356.7

Total milk production of the 5 milking cows was 5,846.54 kg, with a mean daily milk yield of 9.74 kg/cow/day, with 33.0 g milk fata/L and 31.1 g milk protein/L. The lineal regression of weekly milk yield on week was (kg milk/herd/day) = 58.86 – 1.23x, where x is study week ($P <0.05$, $R^2 = 0,89$); a reduction rate of 2.06% per week from the intercept, within normal parameters.

Initial mean BCS was 2.4, ending the grazing season with a mean BCS of 2.9. Milk yields were moderate, so the increase in BCS means surplus energy in the diet.

Table 2 shows amounts offered daily of supplemental feeds, as well as feeding costs calculated per cow/day. Feeding costs were USD $ 0.21/L of milk produced, and paid price was USD $ 0.38/L representing a margin of USD $ 0.17/L of milk and a benefit/costs ratio of USD $ 1.81 over feeding costs.

Table 2. Feeding costs (USD$)

Feed	Cost (USD$/kg*)	Offered feed/cow*	Days of study	Cost/cow (USD$/day)
Ground maize straw	0.14 / kg	4.80 kg	120	$ 0.71
Ground maize ears	0.22 / kg	2.00 kg	120	$ 0.46
Commercial concentrate	0.34 / kg	2.60 kg	120	$ 0.88
Grazing of native rangeland	0.08 / cow/day	---	120	$ 0.08
Feeding cost / cow / day				$ 2.13

* As fed

Grazing native grasslands is a low cost feeding strategy, as shown when comparing other small-scale dairy farms that have introduced grazing irrigated cultivated ryegrass-white clover pastures (Pincay-Figueroa *et al.*, 2013), with a feeding cost of USD $ 0.20 / L of milk, which compares favourable with the USD $ 0.21/L in this study

Conclusion

The grassland had a moderate feeding quality which decreased rapidly. When supplemented with maize straw, maize ears and husks, and commercial compound concentrate, cows were able to sustain a mean milk yield of 9.74 kg/cow/day, and a normal persistency. Cows improved their BCS. Grazed native grassland was a low cost forage, available during the rainy season, resulting in low feeding costs that compare with those from grazing cultivated ryegrass-white clover pastures under irrigation (although with lower yields) with good economic margins.

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