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Use of peas in organic buffalo farming: effects on nutrient digestibility and milk production

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ABSTRACT - Twenty lactating buffalo cows, organically farmed, were used to examine the effects of including peas in total mixed ration. Two concentrates were formulated to contain, as the main protein sources, either 350 g/kg of soybean cake (CC) or 450 g/kg of peas (ExpC). Cows were blocked into two groups according to parity and previous milk yield and were assigned to one of two dietary treatments: one group was fed a diet with 6 kg/d of CC, whereas the treatment group was fed diet in which 3 kg/d of CC were replaced by an equal quantity of ExpC. Digestibility of the diets and milk yield of the cows were measured. The experimental period covered the whole lactation period. No differences were observed between groups for milk yield and composition, and for digestibility. The main hypothesis tested, that the replacement of soybean cake with peas in buffalo diet would not affect milk yield and composition, was confirmed. This suggested that the partial substitution of soybean cake with peas in diet for buffalo cows can be possible without affect performances.

Key words: Bubalus bubalis, Pea, Milk production, Digestibility.

Introduction - In the production area of the Protected Denomination of origin *Mozzarella di Bufala Campana* there are approximately 250,000 buffaloes and 2,000 farms, only 3 of which are organic farms. This low number could be due, at least in part, to the intensive farming methods used in buffalo farms. Indeed, different farming strategies are required to comply with the organic certification standards. A key feature of organic regulation is that animal diets have to be largely based on locally grown feeds. Peas (*Pisum sativum* L.) are a high quality and cost-efficient source of protein (Masoero *et al.,* 2006) well adapted to Mediterranean condition. This paper examined the effect of dietary inclusion of peas on digestibility, milk yield and quality of buffalo cows, organically farmed.

Material and methods - The study was completed from July 2006 to March 2007 on an organic dairy buffalo farm located in the Sele Plain (SA). The commercial compound concentrate used in farm contained as main protein source 350 g/kg (as fed) of soybean cake (control concentrate - CC). An isonitrogenous experimental concentrate was formulated containing 450 g/kg of extruded peas (experimental concentrate - ExpC). Twenty pregnant multiparous buffalo cows (on average, 604±109 kg of body weight) were blocked by parity (on average, 2.9±1.3 lactations) and milk yield from their previous lactation (on average, 2,116±508 kg), and assigned to one of two dietary group (control and treatment) from 10 d of lactation onwards. Control cows were offered in the milking parlour 3.0 kg of CC, while treatment cows were fed the same quantity of ExpC. All cows were fed total mixed ration (TMR) containing 3.0 kg of CC. The experimental period covered the whole lactation period. Individual milk yield

was measured daily, beginning at calving. Milk samples from each cow were collected at 2-weeks interval and analysed for chemical composition (Milkoscan 605, Foss Electric), urea content (CL 10, Eurochem) and somatic cell count (SCC; Fossomatic 250, Foss Electric). Monthly two additional aliquots of milk were obtained from each cow to determine coagulation parameters by Formagraph (ASPA, 1995) and gaschromatographic profile of fatty acids. Fatty acid composition of the two last months were not determined. Total tract nutrient digestibilities were measured using acid insoluble ash content as an internal marker; grab faecal samples were collected from each cow monthly along with the collection of representative samples of TMR and feeds. Feeds and feces were analysed according Martillotti *et al.* (1997). A repeated measures ANOVA was performed to test the effects of dietary treatment and stage of lactation on milk yield and quality, and nutrient digestibility.

Results and conclusions - The two concentrates showed similar chemical characteristics (CP 24.5 vs. 23.9; NDF 24.4 vs. 24.2%DM; ENL 7.8 vs. 7.4 MJ/kgDM, respectively for ExpC and CC). Only soluble protein (SP) content was slightly higher in ExpC (7.6 vs. 4.2% DM), reflecting the differences between the two protein sources (11.5 vs. 6.0% DM, for extruded peas and soybean cake, respectively). The concentrate offered in milking parlour accounted for proportionately 30% of total protein allowance. Milk yield and composition of control and treatment cows are presented in Table 1.

Table 1. Effect of the type of concentrate on milk yield and composition.

		Diet		SE	Effect (P)	
		CC[1]	ExpC[2]		Treatment	Time
Yield	kg/d	9.5	9.4	0.186	0.87	0.0001
Fat	%	8.67	8.71	0.23	0.90	0.0001
Protein	%	4.58	4.55	0.053	0.18	0.0001
Somatic Cell Count		39,058	43,051	39,999	0.50	0.0002
Urea	mg/dl	40.4	39.0	0.079	0.54	0.0001
Cheese yield	%	25.7	25.4	0.25	0.51	0.0001
Rennet clotting time r	min	17.1	16.9	0.33	0.85	0.0001
Curd firming time k_{20}	min	1.61	1.60	0.036	0.96	0.0062
Curd firmness a_{30}	mm	45.9	46.5	0.87	0.67	0.0001

[1]CC control concentrate based on: maize grain, dehydrated whole maize plant, soybean cake (35%), faba bean, dehydrated alfalfa meal, wheat bran, barley, maize gluten meal, sodium bicarbonate, calcium carbonate, dicalcium phosphate, sodium chloride. [2]ExpC Experimental concentrate based on: extruded peas (45%), maize grain, dehydrated whole maize plant, faba bean (4%), dehydrated alfalfa meal, wheat bran, barley, maize gluten meal, soybean cake, sodium bicarbonate, calcium carbonate, dicalcium phosphate, sodium chloride.

As expected, most measured parameters markedly changed with advancing lactation. There was no overall treatment or treatment by time interactions effect on milk yield and composition. Rennet coagulation properties and mozzarella cheese yield (Altiero *et al.*, 1989) did not differed between the two groups. Although, the fat percentages of two protein sources were very different (1.5 vs. 10.0 % DM for peas and soybean cake, respectively), milk FA composition was not affected by dietary treatment (Table 2). According to Bertoni *et al.* (1993) buffaloes could have a more efficient control of urea renal excretion allowing a better rumen recycling of plasma urea. This could explain why the higher SP content of peas did not impair milk production and did not increase milk urea level. Another possible explanation is that the protein solubility and the non structural carbohydrate degradability of the two diets were adequate to satisfy the requirements of buffalo cows and to reduce the loss of N from the rumen. As lactation advanced, the proportion of de novo (sum of 4:0 to 14:1) fatty acids increased whereas pre-formed fatty acids (sum ≥17:0) decreased. Mixed origin (sum of 16:0 to 16:1) fatty acids showed less regular changes with time. Apparent total tract digestibilities did not differ between diets, although the fecal N excretion tended

Table 2. Effect of the type of concentrate on origin and saturation of milk fatty acids.

		Diet		SE	Effect (P)	
		CC	ExpC		Treatment	Time
Fatty acid origin	weight %					
De novo		24.0	24.2	0.47	0.92	0.0005
16.0+16.1		36.9	35.1	0.31	0.162	0.0001
Preformed		39.1	40.7	0.45	0.36	0.0001
Fatty acid saturation	weight %					
Saturated		70.6	70.5	0.43	0.95	0.0001
MUFA		25.6	25.5	0.27	0.91	0.0001
PUFA		3.84	4.00	0.059	0.83	0.0001

to be higher for treatment group (Table 3).

Vander Pol *et al.* (2008 a and b) observed that the partial substitution of soybean meal and corn grain with field peas in dairy cow diets tend to reduce total tract nutrient digestibilities, but not affect fecal N loss. Nutrient digestibility significantly improved throughout lactation. Apparent total tract digestibility coefficient for CP was lower (P<0.0001) in early (43.9%) compared to the late stage of lactation (61.1%). Overall no significant effects of substitution of soybean cake with peas were observed, even though the low level of peas inclusion could have affected these results.

Table 3. Effect of the type of concentrate on total fecal Nitrogen excretion and nutrient digestibilities.

		Diet		SE	Effect (P)	
		CC	ExpC		Treatment	Time
Fecal Nitrogen excretion	kg/d	0.158	0.166	0.0039	0.0617	0.0001
Organic matter digestibility		60.3	59.1	0.80	0.43	0.0001
Crude protein digestibility		54.3	52.3	1.154	0.11	0.0001
NDF digestibility		41.4	40.1	1.13	0.47	0.0001

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