Effect of *Pisum sativum* as protein supplement on buffalo milk production

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SUMMARY - A study was carried out at an organic buffalo dairy farm in order to investigate the effect of feeding protein peas (*Pisum sativum* L.) as an alternative protein source for buffalo cow diets. Two concentrates were formulated to contain (as fed basis) either 350 g/kg of soybean cake (SC) or 450 g/kg of peas (PC) as the main protein sources. The two concentrates were formulated to be almost isonitrogenous (on average crude protein 240 g/kg DM). Two groups of 10 buffalo cows were used in a 100-day lactation study (from 10 days in milk onwards). Cows were blocked into two groups according to lactation number and previous milk yield and were assigned to one of two dietary treatments: control group was offered in the milking parlour 3 kg of SC, while treatment group was offered the same quantity of PC. All cows were fed a total mixed ration containing 3 kg of SC. Daily milk yield was not affected by treatment, as well as, milk fat and protein percentages, somatic cell count, urea content and fatty acid composition.

INTRODUCTION - In the organic buffalo (*Bubalus bubalis*) dairy farms the protein needs are mainly supplied by soybean (heat-treated seed and cake). Nevertheless, in the Mediterranean regions this oilseed is often difficult to cultivate in organic systems and this contrasts with the one of the principles of organic farming that is to produce all feeds in site. Grain legumes, e.g. pea (*Pisum sativum*), faba beans (*Vicia faba*) and lupines (*Lupinus* spp.) can complete cereals in animal feed and are well adapted to Mediterranean growth conditions. Besides being a valuable protein source, these grain legumes benefit the farming system via biological nitrogen fixation. Peas, in particular, are a high quality and relatively cheap source of protein, used in monogastrics and ruminant feed (Moschini et al., 2005; Masoero et al., 2006). The objective of this study was to evaluate the effect of partial replacement of soybean cake with extruded peas in lactating buffalo cow diets on milk production and quality over the first 100 days of lactation.

MATERIALS AND METHODS - The study was completed on a organic dairy buffalo farm located in the Sele Valley (southern Italy), in which a commercial compound concentrate containing (as fed basis) 350 g/kg of soybean cake (soybean cake concentrate -SC) was used. An experimental concentrate was formulated to contain as the main protein sources 450 g/kg of extruded peas (peas concentrate -PC). The two concentrates were almost isonitrogenous and were organically produced. Twenty 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 treatments from 10 d of lactation onwards: control group was offered twice a day in the milking parlour 1.5 kg of SC, while treatment group was offered the same quantity of PC. All cows were fed once a day (starting at 7.30) a standard total mixed ration (TMR) containing 3 kg of SC, offered ad libitum (5% of expected orts). The control and treatment cows were kept together, fed and managed in the same manner, and housed in the

same barns. The experimental period was 100 days. Individual daily records of milk production were used to derive lactation curves. Milk samples from each cows were collected at 2-weeks interval and were analysed for fat, protein, lactose, non-fat solid (Milkoscan 605, Foss Electric, Sweden), urea (CL 10, Eurochem) content, somatic cell count (SCC; Fossomatic 250, Foss Electric, Sweden). Additional milk samples were taken at 25-day interval and were analysed for fatty acid composition. The AOAC (1990) official methods were used to determine chemical composition of feedstuffs. Fatty acids were analysed by means of a trans-estherification reaction using capillary gas chromatography. Data on milk yield and quality underwent analysis of variance for repeated measures (SAS, 1990) with treatment (SC and PC) as a non-repeated factor and week of observation and week of observation x treatment as repeated factors. Cow was the experimental unit.

RESULTS AND CONCLUSIONS - PC concentrate compared to the SC had similar chemical characteristics (i.e. crude protein -CP, NDF and ENL) except for the higher soluble protein (SP) content (Table1). Milk traits and fatty acid composition of the two feeding groups are presented in Table 2. For all variables tested, the interaction week of observation x treatment was not significant. The effect of week of observation, except for cryoscopic point and pH, was always significant, due to the modifications of milk composition as the lactation progressed. Although the protein solubility was different among the diets, milk yield was not affected by the substitution of concentrates. Moreover, the level of milk urea in PC group was comparable to that of SC group, although the higher SP content of PC could have affected this variable. Probably, 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. No statistical differences were noted among the two feeding groups for fat, lactose and protein percentages. Although an impressive difference in SSC was observed between PC and SC diet, it was not statistically significant. In dairy cows a number of studies have investigated the effects of the substitution of soybean with peas (Corbett et al., 1995; Petit et al., 1997; Khorasani et al., 2001; Froidmont and Bartiaux-Thill, 2004; Masoero et al., 2006), with contradictory results perhaps due to the confounding effects of ration composition, level of peas inclusion and technological treatments. No differences were observed among feeding groups on milk fatty acid composition. The fat percentages of two protein source were very different (1.0 vs 9.1% for peas and soybean cake respectively) and this would have affect the milk fatty acid composition. However, the two concentrates had a similar fat content (Table 1) and probably the level of the pea inclusion was below the threshold to allow changes for fatty acid composition. It is noticeable that the average conjugated linoleic content of milk fat was higher than the maximal values generally reported for dairy cow. 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. These data suggest that peas can partially substitute for soybean meal as the main protein source in diets of buffalo cows in early lactation without adverse effects on production and quality. The lack of negative effects on buffalo milk production makes peas an attractive GMO free protein feed when approaching the problem of the choice of a protein source alternative to soybean in diet formulation for buffalo cows raised in organic farms.

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Table 1. Chemical composition of the two concentrates and of the total mixed ration (TMR)

		Concentrate		TMR
		SC[1]	PC [2]	
Dry matter	(g/kg)	892	909	530
Organic Matter	(g/kg DM)	920	918	922
Crude protein	"	239	245	93
Soluble protein	"	42	76	33
Fat	"	63	75	21
Starch	"	219	214	138
NDF	"	242	244	519
ENL	(MJ/kg DM)	7.4	7.8	5.2

[1]SC concentrate containing soybean cake as main protein source and based on: maize grain, dehydrated whole maize plant, soybean cake (35%), faba bean (4%), dehydrated alfalfa meal, wheat bran, barley, maize gluten meal, sodium bicarbonate, calcium carbonate, dicalcium phosphate, sodium chloride. [2]PC concentrate containing extruded peas as main protein source and 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.

Table 2. Milk traits and fatty acid composition of two feeding groups

		Diets		SE
		PC[1]	SC[2]	
Milk yield	kg/d	11.7	11.4	0.89
Fat	%	7.84	7.56	0.28
Protein	"	4.49	4.59	0.08
Lactose	"	4.9	4.9	0.04
Somatic cell count	"	50,590	36,875	7,901
Cryoscopy index		-0.533	-0.534	0.0008
pH		6.81	6.82	0.067
Urea	ml/dl	37.0	37.4	0.9
Fatty acid composition (wt%)				
C4		2.35	2.51	0.16
C6		2.04	2.14	0.16
C8		1.27	1.32	0.07
C10		2.63	2.62	0.17
C12		3.29	3.13	0.18
C14		11.6	11.2	0.29
C16:0		34.8	32.3	0.5
C16:1		2.12	1.87	0.06
C18:0		10.7	12.3	0.27
C18:1		22.1	23.3	0.56
CLA		0.93	0.85	0.05
C18:2		2.29	2.30	0.05
C18:3		0.99	1.07	0.02