



PROCEEDINGS

16<sup>TH</sup> IFOAM  
ORGANIC WORLD  
CONGRESS

MODENA, 16-20 JUNE 2008

CULTIVATE  
THE FUTURE.



# CULTIVATING THE FUTURE BASED ON SCIENCE

Proceedings of the Second Scientific Conference of the International Society of Organic Agriculture Research (ISOFAR), held - at the 16<sup>th</sup> IFOAM Organic World Congress - in Cooperation with the International Federation of Organic Agriculture Movements (IFOAM) and the Consorzio ModenaBio 2008.

18-20 June 2008 in Modena, Italy.



## VOLUME 2 LIVESTOCK, SOCIO-ECONOMY AND CROSS DISCIPLINARY RESEARCH IN ORGANIC AGRICULTURE

Edited by Daniel Neuhoff, Niels Halberg, Thomas Alföldi, William Lockeretz, Andreas Thommen, Ilse. A. Rasmussen, John Hermansen, Mette Vaarst, Lorna Lueck, Fabio Caporali, Henning Høgh Jensen, Paola Migliorini, Helga Willer.



OFFICIAL SPONSOR



UNDER THE PATRONAGE



# **Pisum sativum as alternative protein source in diets for buffalo cows in middle and late stage of lactation**

Masucci, F.<sup>1</sup>, Di Francia, A.<sup>1</sup>, De Rosa, G.<sup>1</sup>, Romano R.<sup>2</sup>, Varricchio M.L.<sup>1</sup> & Grassi, C.<sup>3</sup>

Key words: *Bubalus bubalis*, Alternative protein source, Peas, Milk production.

## **Abstract**

A study was carried out at an organic buffalo farm in order to examine the effect of feeding peas (*Pisum sativum* L.) as an alternative protein source for buffalo cow diets during middle and late stage of lactation. Two concentrates were formulated to contain, as fed basis, either 350 g/kg of soybean cake (control concentrate, CC) or 450 g/kg of peas (experimental concentrate, ExpC) as the main protein sources. The two concentrates were almost isonitrogenous (on average, crude protein 240 g/kg DM). Twenty buffalo cows were blocked into two groups according to lactation number and previous milk yield and were assigned to one of two dietary treatments from 10° day in milk onwards: control group was offered in the milking parlour 3 kg of CC, while treatment group was offered the same quantity of ExpC. All cows were fed a total mixed ration containing 3 kg of CC. The experimental period was from 100° day in milk onwards. Daily milk yield was not affected by treatment, as well as, milk fat and protein percentages, somatic cell count, urea content, fatty acid composition and clotting properties. Results support the partial substitution of soybean meal with peas in diets for buffalo cows with no negative effects on milk yield and composition.

## **Introduction**

In the Italian traditional areas of buffalo (*Bubalus bubalis*) breeding (Latina province, Sele Plain and Volturno Plain) there are about 2,000 farms, but only 3 are certified organic. One of the several reasons of this low number is the farmers' concern about the standards required in organic regulation, in particular for feed supply. In the organic farms the protein needs of lactating cows are often supplied by soybean (fed as heat-treated seed or cake) which is, however, agronomically suitable only in limited areas of Italy. By contrast, pea (*Pisum sativum*), besides being better adapted to Mediterranean growth conditions than soybean, has good nutritive value and can be used as protein source for ruminant diet (Khorasani et al., 2001; Froidmont and Bartiaux-Thill, 2004; Masoero et al., 2006, Vander Pol et al., 2008) even in organic livestock systems because have no risk of GMO contamination. The aim 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 during the second phase

---

<sup>1</sup> Dipartimento di Scienze del Suolo, della Pianta, dell'Ambiente e delle Produzioni Animali, sezione Produzione Animale, via Università 133, 80055 Portici, Italy, E-Mail masucci@unina.it

<sup>2</sup> Dipartimento di Scienze degli Alimenti, via Università 133, 80055 Portici, Italy.

<sup>3</sup> Veterinary practitioner

of lactation. The results concerning the first 100 days of lactation were published elsewhere (Di Francia et al., 2007).

## Materials and methods

The study was carried out on an organic dairy buffalo farm located in the Sele Plain, Campania Region, Southern Italy, in which a commercial compound concentrate containing (as fed basis) 350 g/kg of soybean cake (control concentrate - CC) was used. An experimental concentrate was formulated to contain as the main protein sources 450 g/kg of extruded peas (experimental concentrate -ExpC). 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 CC, while treatment group was offered the same quantity of ExpC. All cows were fed a standard total mixed ration (TMR) containing 3 kg of CC. Individual milk samples were collected at 2-weeks interval from 100° day in milk onwards and were analysed for chemical composition (Milkoscan 605), urea (CL 10, Eurochem), somatic cell count (SCC; Fossomatic 250). Additional milk samples were taken at 25-day interval and analysed for fatty acid (FA) composition, by using gas chromatography, and clotting properties (Formagraph). The AOAC (1990) methods were used to determine chemical composition of feedstuffs. Mozzarella cheese yield was calculated according Altiero et al. (1989). Data on milk yield and quality underwent analysis of variance for repeated measures (SAS, 1990) with treatment (CC and ExpC) as a non-repeated factor and week of observation and week of observation x treatment as repeated factors. Single cows were the experimental unit.

## Results

ExpC concentrate compared to the CC had similar chemical characteristics (g/kg DM): crude protein 245 vs. 239; NDF 244 vs. 242; ENL 7.8 vs. 7.4 MJ/kg DM). Only soluble protein (SP) content was slightly higher in ExpC (76 vs. 42), reflecting the differences between the two protein sources (115 vs. 60, for extruded peas and soybean cake, respectively). For all variables presented in Tables 1 and 2, the effect of week of observation was always significant, due to the modifications of milk composition as the lactation progressed, whereas no significant effect of the interaction week of observation x treatment was found. Daily milk yield was not affected by treatment, as well as, milk fat, lactose and protein percentages. Moreover, the level of milk urea in treated group was comparable to that of control group. Although an impressive difference in SSC was observed between the two dietary groups, it was not statistically significant. Milk pH was almost identical in the two treatments, as were the clotting properties and the mozzarella cheese yield (Table 1). No differences were observed between the groups for milk FA composition (Table 2).

## Discussion

In dairy cows a number of studies have investigated the effects of the substitution of ration composition, level of peas inclusion and technological treatments. Although the two protein sources differed for SP content, no differences were found for milk yield and milk urea content between the dietary groups.

**Tab. 1: Milk traits, cheese yield and clotting proprieties for the dietary groups**

		Diets		SE
		CC <sup>1</sup>	ExpC <sup>2</sup>	
Milk yield	kg/d	6.4	5.9	0.17
Fat	%	9.5	9.9	0.40
Protein	"	4.7	4.5	0.073
Lactose	"	4.6	4.5	0.05
Somatic cell count		40,813	93,615	18,183
Milk Urea	ml/dl	45.0	40.6	1.20
pH		6.70	6.68	0.037
Mozzarella Cheese yield (%)		27.2	28.0	0.53
Rennet clotting time (min)		20.4	19.9	1.25
Curd firming time 20 mm (min)		1.7	1.7	0.10
Curd firmness 30 min (mm)		41.1	41.8	2.68

<sup>1</sup> CC control concentrate 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. <sup>2</sup> 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.

**Tab. 2: Fatty acid composition (wt%) of milk for the dietary groups**

		Diets		SE
		CC <sup>1</sup>	ExpC <sup>2</sup>	
Butyric		2.31	2.50	0.15
Caprinic		2.02	2.14	0.12
Capronic		1.30	1.32	0.056
Myristic		11.4	11.2	0.21
Palmitic		34.1	32.6	0.39
Stearic		10.8	12.1	0.21
Oleic		22.7	23.3	0.39
Linoleic		2.59	2.71	0.079
Linolenic		1.07	1.06	0.025
CLA		0.96	0.87	0.04
Total Short Chain FA		8.28	8.58	0.41
Total Medium Chain FA		53.3	51.2	0.59
Total Long Chain FA		38.5	40.2	0.60
Mono Unsaturated FA		25.6	25.7	0.36
Poly Unsaturated FA		3.66	3.78	0.09

soybean with peas (Froidmont and Bartiaux-Thill, 2004; Masoero et al., 2006; Vander Pol et al., 2008), with contradictory results perhaps due to the confounding effects of. 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. As expected, clotting properties and mozzarella cheese yield were similar between the two dietary treatments, because milk protein and fat contents of the two groups were almost identical. Milk protein and fat percentages, in fact, are the essential factors that affect firming time, curd firmness and cheese yield (Altiero et al., 1989; Martin and Coulon, 1995). Although the fat percentages of two protein sources were very different (15 vs. 100 g/kg DM for peas and soybean cake, respectively) milk FA composition was not affected by dietary treatment, due to the fact that the level of the pea inclusion which was below the threshold to allow changes for FA.

## Conclusions

Peas can partially substitute for soybean meal as the main protein source in diets of buffalo cows in late stage of lactation without adverse effects on production and quality. The lack of negative effects on milk yield makes peas an attractive GMO free protein feed in diet formulation for buffalo cows raised in organic farms.

## Acknowledgments

Research funded by Regione Marche, Project EQUI.ZOO.BIO.

## References

- Altiero, V., Moio, L., Addeo, F., 1989. Previsione della resa in mozzarella sulla base del contenuto in grasso e proteine del latte di bufala e tecnica lattiero casearia, *Sci. Tec. Latt. Cas.* 40: 425-433.
- AOAC, 1990. *Official Methods of Analysis*, 15th ed. Association of Official Analytical Chemists, Washington, DC, USA.
- Di Francia, A., De Rosa, G., Masucci, F., Romano, R., Borriello, I., Grassi, C., 2007. Effect of *Pisum sativum* as protein supplement on buffalo milk production. *Ital. J. Anim. Sci.* 6 (Suppl 2- Part 1): 472-475.
- Froidmont, E., Bartiaux-Thill, N., 2004. Suitability of lupin and pea seeds as a substitute for soybean meal in high-producing dairy cow feed. *Anim. Res.*, 53: 475-487.
- Martin, B., Coulon, J.B., 1995. Facteur de production du lait et caractéristiques des fromages. I. Influence des facteurs de production sur l'aptitude à la coagulation des laits de troupeaux. *Lait* 75, 61-80.
- Masoero, F., Moschini, M., Fusconi, G., Piva, G., 2006. Raw, extruded and expanded pea (*Pisum sativum*) in dairy cows diets. *Ital. J. Anim. Sci.*, 5:237-247.
- Vander Pol, M., Hristov, A.N., Zaman S., Delano N., 2008. Peas can replace soybean meal and corn grain in dairy cow diets. *J. Dairy Sci.*, 91:698-703