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

Antonio Di Francia, Giuseppe De Rosa, Raffaele Romano, Giulia Esposito & Felicia Masucci

To cite this article: Antonio Di Francia, Giuseppe De Rosa, Raffaele Romano, Giulia Esposito & Felicia Masucci (2009) Use of peas in organic buffalo farming: effects on nutrient digestibility and milk production, Italian Journal of Animal Science, 8:sup2, 405-407, DOI: 10.4081/ijas.2009.s2.405

To link to this article: https://doi.org/10.4081/ijas.2009.s2.405
Use of peas in organic buffalo farming: effects on nutrient digestibility and milk production

Antonio Di Francia¹, Giuseppe De Rosa¹, Raffaele Romano², Fernando Grasso¹, Giulia Esposito¹, Felicia Masucci¹

¹Dipartimento di Scienze del Suolo, della Pianta, dell’Ambiente e delle Produzioni Animali, Università “Federico II”, Napoli, Italy
²Dipartimento di Scienze degli Alimenti, Università “Federico II”, Napoli, Italy

Corresponding author: Antonio di Francia. Dipartimento DISSPAPA, sezione Produzione Animale, Facoltà di Agraria, Università “Federico II”. Via Università 133, 80055 Portici (NA), Italy - Tel. +39 081 2539304 - Fax: +39 081 7762886 - Email: antonio.difrancia@unina.it

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. 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.

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

| Diet      | CC1 | ExpC2 | SE  | Effect (P)   |
|-----------|-----|-------|-----|--------------|
|           |     |       |     | Treatment    |
| Yield kg/d| 9.5 | 9.4   | 0.186|              |
| Fat %     | 8.67| 8.71  | 0.23 |              |
| Protein % | 4.58| 4.55  | 0.053|              |
| Somatic Cell Count | 39,058 | 39,999 | 39,051 | 0.50  | 0.0002 |
| Urea mg/dl| 40.4| 39.0  | 0.079|              |
| 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 k20 min | 1.61 | 1.60  | 0.036| 0.96  | 0.0062 |
| Curd firmness a30 mm | 45.9 | 46.5  | 0.87 | 0.67  | 0.0001 |

1CC 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. 2ExpC 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.
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.

| Fatty acid origin | weight % | Diet | SE | Effect (P) |
|-------------------|----------|------|----|------------|
| De novo           |          | CC   | 24 | 0.0039     |
| 16.0+16.1         |          | ExpC | 24 | 0.0322     |
| Preformed         |          | SE   | 0.47| 0.0001     |

| Fatty acid saturation | weight % | Diet | SE | Effect (P) |
|-----------------------|----------|------|----|------------|
| Saturated             |          | CC   | 70.6| 0.0001     |
| MUFA                  |          | ExpC | 70.5| 0.0001     |
| PUFA                  |          | SE   | 0.43| 0.0001     |

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

| Diet | SE | Effect (P) |
|------|----|------------|
| Fecal Nitrogen excretion | kg/d | 0.0039 | 0.0617 | 0.0001 |
| Organic matter digestibility | 60.3 | 0.80 | 0.43 | 0.0001 |
| Crude protein digestibility | 54.3 | 1.154 | 0.11 | 0.0001 |
| NDF digestibility | 41.4 | 1.13 | 0.47 | 0.0001 |

The research was supported 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. ASPA (1995). Commissione di studio metodologie di valutazione della produzione quanti-qualitativa del latte. Metodi di analisi del latte delle principali specie di interesse zootecnico. Univ. Perugia. Ed., Perugia, Italy. Bertoni, G., Amici, A., Lombardelli, R., Bartocci, S., 1993. Variations of metabolic profile and hormones in blood of buffalo, cattle and sheep males fed the same diets. Proc Intern Symp “Prospects of buffalo production in the Mediterranean and Middle East”, Wageningen, Netherlands. EAAP Publication 62:345-348. Martillotti, F., Antongiovanni, M., Rizzi, L., Santi, E., Bittante, G., 1987. Metodi di analisi per la valutazione degli alimenti. Quaderni Metodologici IPRA, No. 8. 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., 2008a. Peas can replace soybean meal and corn grain in dairy cow diets. J. Dairy Sci. 91:698–703. Vander Pol, M., Hristov, A.N., Zaman, N., Delano, N., Schneider, C., 2008b. Effect of inclusion of peas in dairy cow diets on ruminal fermentation, digestibility, and nitrogen losses. Anim. Feed Sci. Technol., doi:10.1016/j.anifeedsci.2008.08.009.