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Faba bean in dairy cow diet: effect on milk production and quality

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ABSTRACT – Two consecutive trials were carried out to test flaked faba beans as a partial substitute for soybean meal (SBM) in the diet of Reggiana breed dairy cows. In both trials a "Control" concentrate (12% dehulled SBM) was compared to a "Faba" concentrate (7.5% dehulled SBM; 10% flaked faba beans). Forages fed to animals included hay (mixed grass and alfalfa) plus green mixed grass in trial 1, hay only in trial 2. Concentrate intake, faecal scores, milk yield and quality were similar between feeding groups. The milk urea content was lower in the "Faba" group ("Control" *vs.* "Faba": 34.6 *vs.* 32.9mg/dl in trial 1, P<0.1; 27.4 *vs.* 23.4mg/dl in trial 2, P<0.01). The plasma urea was different only in trial 2 ("Control" *vs.* "Faba": 3.9 *vs.* 3.0mmol/l, P<0.01). The inclusion of faba beans within the allowed limit of the Parmigiano-Reggiano Consortium for diet formulation could represent a feasible opportunity for a partial substitution of SBM.

Key words: Faba beans, Dairy cow, Milk quality, Parmigiano-Reggiano Cheese.

Introduction – The protein sources commonly used in concentrate feeds for dairy cows are few and include mainly soybean meal (SBM), sunflower meal, canola meal and full-fat soybean. The need for alternative protein sources to SBM, partially or totally substituted in dairy cows and other farmed animals diets, is dated and it has two main reasons: a partial limit to SBM imports from extra-EU Countries which represents a negative voice of the commercial balance; and a limit to the presence of GMO in the food chain, which a growing part of consumers rejects, especially when "typical/traditional foods" are considered (Mordenti *et al.*, 2007). For instance, the Consortium of the Parmigiano-Reggiano (PR) cheese stated many times its interest for the cultivation and use of GMO free feeds; inside the PR Consortium, the National Association of Reggiana Cattle Breeders (ANABORARE) is particularly interested, since its regulation does not allow the use of GMO feeds. Among the possible protein sources, peas (*Pisum sativum*) and faba beans (*Vicia faba*) were successfully used in dairy cows (Masoero *et al.*, 2006; Mordenti *et al.*, 2007); they show lower protein and higher starch content than SBM, and are similar to barley for starch rumen fermentability (Masoero *et al.*, 2006). A first step of our researches showed the feasibility of a partial substitution of SBM with flaked pea in the diet of Reggiana lactating cows (Volpelli *et al*., 2009). In this paper we studied the effects of a partial substitution of SBM with flaked faba beans.

Material and methods – Two consecutive trials were carried out in farm conditions in a Reggiana breed dairy farm located in a plane area in Northern Italy. The milk produced is transformed into PR cheese. In trial 1 (8 weeks, October-December) the forage component was made of green forage (about 50%) and hay (35% mixed grass and 15% alfalfa), whereas only hay was used in trial 2 (9 weeks, January-March).The daily amount of concentrate intake was recorded individually. Since cows were kept in the same fence it was not possible to monitor the individual forage dry matter intake. Two concentrates were used in both trials (Table 1): a standard concentrate being in use in the farm (Control) and an experimental concentrate (Faba) in which a part of the SBM and of the corn meal were substituted by

10% (maximum allowed by the Rules for PR cheese production) of steam-flaked faba beans. The chemical composition of the two concentrates was similar (i.e. on DM basis: crude protein 16.0 and 16.4%; NDF 20.6 and 19.5; UFL/kg 1.03 and 1.07).

Table 1. Ingredients (%) of the experimental concentrates.

	Control	Faba
Corn meal	36	32.5
Wheat bran	17	17
Wheat flour shorts	15	15
Flaked faba beans	-	10
Soybean meal, dehulled	12	7.5
Corn gluten feed	6	6
Beet pulp dehy	5	3
Sugar cane molasses	3	3
Salts and vitamins	6	6

In trial 1, thirty-eight cows were used and divided in two homogeneous groups for average daily milk yield (Control and Faba: 25.2±4.8 and 25.3±6.6 kg/d), days in milk (89.4±57.2 and 89.6±51.9), parities (3.7±2.1 and 3.5±1.2) and milk protein content (3.28±0.26 and 3.22±0.26%). Two sub-groups of 15 homogeneous cows each were sampled for milk composition (fat, protein, casein, urea on individual samples: infrared analysis, Milkoscan Model FT120, Foss Electric, DK; rennet coagulation characteristics on pooled samples: tromboelastographic method, Formawin 32, Foss Electric, DK), blood urea and faecal scores (day 0, 26, 47 and 54 on trial). In trial 2 forty cows were allotted to two homogeneous groups for average daily milk yield (Control and Faba: 23.2±6.5 and 23.2±6.6kg/d), days in milk (108.3±49.0 and 108.7±38.3), parities (3.7±1.4 and 3.7±2.2) and average milk protein content (3.27±0.26 and 3.21±0.24). Two sub-groups of 15 homogeneous cows each were sampled for the same data reported above (day 0, 21, 35 and 56 on trial). Milk yield was individually recorded on a daily basis throughout the two trials. Response variables from both trials that were measured over time were subjected to ANOVA using the repeated statement in the mixed procedure of SAS (2001) in a completely randomize design where the experimental unit was cow. Significance was declared at $P<0.05$ and a trend at $0.05<P<0.1$

Results and conclusions – Table 2 reports data collected throughout the two trials. The presence of the faba beans in the concentrate did not affect the concentrate intake suggesting no negative effects on palatability. Faecal scores were also similar in the cows of the two groups. Milk yield and composition in both trials were not affected by the use of faba beans in the diet, and their values were normal for Reggiana breed. Mordenti *et al.* (2007) observed a reduction of DM intake and milk yield, accompanied by an increase of fat and casein in vat milk, in more productive dairy cows fed faba bean and pea (10+10%). In trial 1, a trend ($P<0.1$) could be observed towards a lowering of urea in the milk of the cows fed Faba diet; the difference was greater in trial 2, where a significant lowering of milk urea ($P<0.01$) was accompanied by a parallel decrease in blood urea. In the first research carried out in our project (Volpelli *et al.*, 2009), the use of flaked pea caused an increase of milk and blood urea, which might be interpreted as an increase of ammonia in rumen due to a lack of effect of steam-flacking on pea protein degradability. In this research, the decrease of urea when feeding faba beans, greater when the forages of the diet did not include the highly degradable protein of green grass, may indicate that steam-flacking partially decreased the degradability of faba beans protein. The results of the two researches, although yet to be confirmed, seems to indicate a different effect of steam-flacking in comparison with other heat treatments, and the different response of the two legumes (Aguilera *et al.*, 1992). Table 2 also reports the rennet coagulation characteristics of pooled milk collected during the two trials. Although no statistical analysis could be performed on these data, it is noticeable that the milk coagulation trend was similar for the two groups; also the derived quality indexes (not reported), which are used to predict the cheese-making aptitude, were equal for Control and Faba milk, and in two cases better for the second.

The inclusion of flaked faba beans in diets for Reggiana dairy cows did not produce negative effects on milk yield and composition. It can thus be stated, from results of our and other researches, that both pea and faba beans represent a feasible opportunity for a partial substitution of SBM in diet formula-

tion. Our researches are currently continuing with the use of both the protein sources at the same time, within the allowed limit of the Parmigiano-Reggiano Cheese Consortium, thus allowing the complete substitution of SBM.

Table 2. Effects of the two different concentrates on data collected throughout the two trials.

		Control	Faba	SEM
Trial 1				
Concentrate intake/cow	kg/d	7.87	7.81	0.270
Faecal score		2.64	2.69	0.066
Milk yield	kg/d	22.21	22.38	0.568
Milk composition: Fat	%	3.90	3.93	0.159
Protein	"	3.47	3.39	0.037
Casein	"	2.72	2.67	0.030
Urea	mg/dl	34.58 [a]	32.93 [b]	0.649
Blood urea	mmol/l	5.76	5.75	0.171
Clotting time "r" (avg. ±SD)	min	12.40±0.93	12.48±1.43	-
Curd firming time "k_{20}" (avg. ±SD)	"	2.58±0.99	2.82±1.28	-
Curd firmness "a_{30}" (avg. ±SD)	mm	47.64±8.65	39.27±10.82	-
Trial 2				
Concentrate intake/cow	kg/d	7.68	7.64	0.134
Faecal score		2.62	2.58	0.067
Milk yield	kg/d	20.18	20.20	0.403
Milk composition: Fat	%	3.77	3.56	0.102
Protein	"	3.43	3.37	0.028
Casein	"	2.69	2.65	0.022
Urea	mg/dl	27.36 [A]	23.44 [B]	0.517
Blood urea	mmol/l	3.87 [A]	2.99 [B]	0.070
Clotting time "r" (avg. ±SD)	min	11.25±1.23	10.92±2.51	-
Curd firming time "k_{20}" (avg. ±SD)	"	3.10±0.09	2.87±1.11	-
Curd firmness "a_{30}" (avg. ±SD)	mm	41.93±5.56	30.59±3.57	-

[a, b]=P<0.1; [A, B]=P<0.01.

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