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EFFECTS OF LOW ANTINUTRITIONAL FACTORS RAW FULL-FAT SOYBEAN ON BEEF CATTLE FEEDING. *INFRA-VITAM* PERFORMANCE

Silvia Miotello [(1)], F. Tagliapietra [(1)], A. Simonetto [(1)], V. Bondesan [(2)], Lucia Bailoni [(1)]

Original scientific paper

SUMMARY

The aim of this trial was to evaluate the effects of different sources of soybean on the infra-vitam performance of fattening beef cattle. The animals (56 Limousine) were divided, according to BW (287±17 kg), in 4 experimental groups: LAFS (raw full-fat soybean low in antinutritional factors); SBM (soybean meal); TS (toasted full-fat soybean); NTS (non toasted full-fat soybean). The animals were fed a basal diet (TMR) (DM:59.5%; CP:9.3%DM; NDF:33.9%DM; starch:34.9%DM) supplemented as top dressing with different sources of soybeans in order to reach the same amount of additional CP (473 g/d). To obtain isoenergetic diets, calcium soap of palm fat (234 g/d) was also added to SBM group. Animals were weighed monthly, DM intake was calculated daily and two blood samplings were collected. No metabolic disorders or pathological events were observed during the experiment. The daily gains of the first 6 months were not significantly different among the 4 experimental groups (on the average 1.35 ± 0.25 kg/d). DM intake values in the same period were similar (8.57 ± 0.78 kg/d of DM). The soybean supplementation did not affect the metabolic parameters (calculated as differences between the sampling times) except for the γ-glutamyl-transferase (P<0.01), the total plasma protein and globulin (P<0.05). The preliminary results of this experiment can indicate no significant effects of soybean antinutritional factors on the infra-vitam performances of beef cattle during the first fattening period.

Key-words: beef cattle, soybean, antinutritional factors

INTRODUCTION

Soybean seeds and derivates are valuable protein-rich feed ingredients used in beef cattle feeding (Jordan et al., 2006). Similar to other oleaginous seeds, soybean also contains some nutritionally harmful compounds known as anti-nutritional factors (i.e. soybean Kunitz and Bowman-Birk trypsin inhibitors) (Laskowski and Kato, 1980). The high levels of trypsin inhibitors in seeds cause poor digestion of dietary proteins by inhibiting the pancreatic enzymes (Liener, 1994). Cultivars with low anti-nutritional content factors could be used in animal feeding, without requesting physical processes of inactivation such as the toasting (Friedman et al., 1991). However, toasting treatment can affect adverselly the quality of some proteins. In addition, because raw soybean seeds are toasted frequently in large plants (vegetable oil producers), the feed traceability could be critical in the GMO free chain (i.e. organic animal production). The number of farm home-made protein feed production is increasing in Italy, especially in respect to the organic production systems. For these purposes, the availability of low anti-nutritional factors soybean is becoming a nutritional benefit and a operative simplification. The aim of this study was to evaluate the effects of different soybean sources on the infra-vitam performance of fattening beef cattle.

MATERIAL AND METHODS

(1) Dr. Miotello Silvia, PhD. student; Dr. Franco Tagliapietra, Researcher; Dr. Alberto Simonetto, Technician; Prof. Lucia Bailoni, Full Professor - Department of Animal Science, University of Padova, Viale dell'Università 16, 35020 Legnaro, PD, Italy – Tel. +39 049 8272614 – Fax: +39 049 8272633 – Email: silvia.miotello@unipd.it; (2) Dr. Valerio Bondesan, Division of Agriculture and Aquiculture Research - Veneto Agricoltura, Viale dell'Università 14, 35020 Legnaro, PD, Italy – Tel. +39 049 8293734 – Fax: +39 049 8272568 – Email: valerio.bondesan@venetoagricoltura.org

According to BW (287 ± 17 kg), 56 Limousine beef cattle were located in 14 box and divided in 4 experimental groups: LAFS (raw full-fat soybean low in antinutritional factors, cultivar "Hilario", SIS, Bologna, I), SBM (soybean meal), TS (toasted full-fat soybean, mix of different cultivars), and NTS (non toasted full-fat soybean, mix of different cultivars). Each group was fed the same diet during the adaptation period (first 25 days of the experiment) and, subsequently, the experimental diets supplemented with the different sources of soybeans. The four diets were formulated to be isoenergetic and to meet the nutritional requirements of the cattle according to INRA (1988) and NRC (2000). The animals received the basal mixed ration once daily by mixer wagon (8.00 a.m.), and immediately after, the soybean supplementation was added to the diet by top-dressing in order to reach the same amount of additional protein (473 g/d) (Table 1).

Table 1. Ingredient and chemical composition of the experimental diets

Ingredients		**LAFS**	**SBM**	**TS**	**NTS**
Corn silage	*kg*	5.60	5.60	5.60	5.60
Corn meal	"	2.30	2.30	2.30	2.30
Dry sugar beet pulp	"	1.20	1.20	1.20	1.20
Wheat bran	"	1.00	1.00	1.00	1.00
Permanent meadow hay	"	0.30	0.30	0.30	0.30
Vitamin-mineral premix	"	0.25	0.25	0.25	0.25
Raw full-fat soybean low in antinutritional factors	"	1.39			
Calcium soap of palm fat	"		0.23		
Soybean meal	"		1.10		
Toasted full-fat soybean	"			1.39	
Non toasted full-fat soybean	"				1.39
Chemical composition					
Dry Matter	*%*	63.6	63.5	63.6	63.4
Crude Protein	*% DM*	14.2	14.3	14.4	14.4
Lipids	"	5.6	5.6	5.9	6.0
NDF	"	32.9	31.9	32.9	32.4
Starch	"	21.8	21.5	21.8	21.8
Meat Forage Units	*/kg DM*	0.98	0.99	0.98	0.98

The first 25 days of the trial were considered as adaptation period, while during the following days, experimental controls were performed. Animals were weighed monthly and daily gains were calculated. Animal health was daily detected throughout the trial. In order to evaluate DM daily intake, the feed residues of each box for the four experimental groups were weighted daily. Each ingredient of the diets was analyzed for DM, CP, lipids, ash, NDF, starch (AOAC, 2000). The analysis of urease activity was carried out by the NGD method (NGD, 1976) on soybean sources. Individual blood samples of 28 animals (casually choose within the experimental groups) collected at the beginning and two month later the beginning of the experimental period, were taken from the jugular vein before morning feeding. Plasma was immediately separated and analysed with automatic equipment Hitachi 911 (Roche Diagnostics) for protein fraction (total proteins, albumin), urea, glucose, total cholesterol, triglycerides, NEFA, AST, GGT, CK, Ca, P and Mg content.

Data were analysed by GLM procedure of the SAS-STAT (1990). For daily gains and DM intake data, the following split-plot model was used: $y_{ijkl} = \mu + \alpha_i + \beta_j(\alpha_i) + \gamma_k (\alpha\beta)_{ij} + \varepsilon_{ijkl}$; and for metabolic parameters (calculated as difference between two sampling time), the following simple split-plot model was used: $y_{ijk} = \mu + \alpha_i + \beta_j(\alpha_i) + \varepsilon_{ijk}$; where μ = overall mean; α_i =effect of the experimental group; $\beta_j(\alpha_i)$ = effect of box within experimental group; γ_k $(\alpha\beta)_{ij}$ = effect of animal within the interaction (box x experimental group); ε_{ijkl} = residual error.

RESULTS AND DISCUSSION

The chemical composition of the soybean sources included in the diets during the experimental period is reported in Table 2. The nutrients content of feeds were similar to that reported in literature

(Frieddman et al., 1981) and the urease activity can be related to the different heat treatments of the soybean sources.

Table 2. Chemical composition of soybean sources used in the experiment

Items		Raw full-fat soybean low in antinutritional factors	Soybean meal	Toasted full-fat soybean	Non toasted full-fat soybean
Dry matter	*%*	90.1	88.4	89.3	88.2
Crude protein	*% DM*	37.5	47.6	38.7	39.7
Lipids	"	18.0	2.4	20.7	20.2
NDF	"	16.9	12.6	15.5	13.3
Ash	"	5.3	6.9	5.4	5.1
Urease activity	*ΔpH*	2.27	0.18	0.21	2.35

During the trial no serious pathological events or metabolic disorders were observed on the animals of the different experimental groups. Due to tail necrosis, one subject of the LAFS group was excluded to the experiment. Similar results were obtained in previous experiment by Snidaro et al. (2005) using Simmental beef cattle.

During the first 25 days of the experiment (adaptation period), the daily gains were, as expected, very different among box and experimental groups ($P<0.05$). During the first six months of the experimental period no statistically significant differences of daily gains were observed among the experimental groups (Table 3). Daily gain was 1.35 kg/d on average. This value is very close to those reported by other authors for Limousine young bulls fattened in intensive farms in the Veneto region (Cozzi and Gottardo, 2005). Snidaro et al. (2005) found similar daily gains (1.26 *vs.* 1.24 kg/d) in Simmental beef cattle fed a basal diet supplemented with soybean meal or raw full-fat soybean low in antinutritional factors.

Table 3. Average daily gains of the experimental groups during the trial

Days in trial	**LAFS**	**SBM**	**TS**	**NTS**	S.E.	*P*
• 26 to 53	1.15	1.28	1.32	1.30	0.10	ns
• 54 to 90	1.35	1.15	1.05	1.26	0.08	ns
• 91 to 116	1.43	1.48	1.35	1.45	0.10	ns
• 117 to 141	1.30	1.35	1.30	1.32	0.08	ns

DM intake of the experimental groups was similar (on average 8.57 ± 0.78 kg/d). A linear increase of DM intake was observed during the experiment for all groups. The DM intake values of this experiment are in harmony with the results obtained by Cozzi and Gottardo (2005) on Limousine bulls during the finishing period in intensive rearing system.

In Table 3 some plasma parameters are reported. The average values at the beginning of the trial were in harmony with the data reported by Bertoni and Piccioli Cappelli (1999). The soybean supplementation did not affect the metabolic parameters, calculated as differences between the second and first samplings, except for the γ-glutamyl-transferase, (GGT, $P<0.01$) and the total plasma protein ($P<0.05$). GGT variation of LAFS group was higher in respect to NTS group and intermediate values were observed for SBM and TS groups. Total protein and total globulin variations were the highest in TS and lowest in SBM group and intermediate in LAFS and NTS groups. No differences between beef cattle fed soybean meal or raw full-fat soybean low in antinutritional factors were reported in metabolic parameters by Snidero et al. (2005).

Table 3. Plasma parameters of the animals expressed as average value at the beginning of the trial (T_0) and as difference between the second and first sampling (ΔT)

Item	LAFS		SBM		TS		NTS	
	T_0	ΔT	T_0	ΔT	T_0	ΔT	T_0	ΔT
Total protein, *g/l*	71.9	$+1.6^{ab}$	74.0	-5.5^{a}	69.3	$+3.8^{b}$	76.6	-1.0^{ab}
Total globulin, *g/l*	37.6	$+4.0^{ab}$	39.7	-3.0^{a}	34.8	$+5.5^{b}$	42.1	-0.6^{ab}
Urea, *mmol/l*	2.9	+0.5	3.4	-0.0	2.5	+0.8	3.2	+0.0
Glucose, *mmol/l*	5.1	-0.2	5.3	-0.0	5.4	-0.3	5.4	-0.3
Cholesterol, *mmol/l*	2.47	+0.26	2.46	+0.57	2.14	+0.34	2.12	+0.34
NEFA, *mmol/l*	0.21	-0.01	0.16	+0.01	0.16	+0.03	0.13	+0.01
AST, *U/l*	81.5	+17.0	75.2	+4.5	81.3	+16.2	83.9	+5.6
GGT, *U/l*	14.7	$+7.2^{B}$	12.7	$+3.3^{AB}$	14.5	$+3.5^{AB}$	16.0	$+1.2^{B}$
CK, *U/l*	275	-47	177	+3	329	-125	198	+255

^{A,B} $P<0.01$; ^{a,b} $P<0.05$

CONCLUSION

The preliminary results of this experiment can indicate the absence of significant effects of the soybean antinutritional factors on the infra-vitam performances of beef cattle during the first fattening period. Further considerations on the effects of different soybean sources inclusion in beef cattle fattening will be explained at the end of the experimental period based on results of the performance during the whole fattening phase and post-mortem data.

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