Effects of two protein sources and energy level of diet on the performance of young Marchigiana bulls.

1. *Infra vitam* performance and carcass quality

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ABSTRACT

The aim of this trial was to evaluate the influence of two protein sources and the energy levels of the diet on growth performance and carcass quality of young Marchigiana bulls. Eighteen weaned young bulls (129 d of age) were equally divided into three groups. Until the slaughter weight (620 kg) was achieved two groups were fed diets with the same protein and energy concentrations, but differing in protein sources (faba bean-FB vs soya bean meal s.e.-SB), and the last group was fed high-energy diets (HE) with both protein sources in the concentrates. Body weight, daily weight gain and biological efficiency of growth at different ages and periods, and feed conversion indexes, were calculated from individual growth curves. Beginning at 180 d of age Group HE showed always significantly (P<0.01) higher body weight and daily weight gain than groups FB and SB. Moreover, group HE reached the slaughter weight and conformation earlier than the other two groups (500 vs 540 d, respectively). The protein sources affected the growth only in the first phase after weaning (body weight at 180 d: 173 vs 186 kg for groups FB and SB, respectively; P<0.01). The highest energy diets appreciably improved growing rate, but worsened feed conversion indexes. Animal and carcass measurements were not influenced either by energy intake or by dietary protein source. Group HE showed the lowest incidence of long bones (6.2 vs 6.7 vs 5.8% of cold carcass for FB, SB and HE groups respectively; P<0.01) and the highest percentage of fat (5.1 vs 4.7 vs 7.1% of cold carcass, for FB, SB and HE groups respectively; P<0.01). As respects the protein sources, only the incidence of long bones resulted significantly different between FB and SB groups (6.2 vs 6.7% of cold carcass, respectively; P<0.05). These data demonstrate that faba beans could be used as alternative sources to soya bean meal s.e., as it did not influence growth rate and feed conversion indexes in the entire experimental period. Nevertheless, immediately after weaning, the association of faba beans with another protein source richer in rumen undegradable protein would be preferable. Moreover the utilisation of high energy feeding planes could improve the growth dynamics of young Marchigiana bulls, although in the final phase it may be suitable to reduce the energy intake in order to decrease fat deposition.

Key words: Marchigiana young bull, Faba bean, Soya bean meal s.e., Energy intake, Growth performance.
RIASSUNTO

EFFETTO DI DUE FONTI PROTEICHE E DI DUE LIVELLI ENERGETICI DELLA RAZIONE SULLE PERFORMANCE DI VITELLONI DI RAZZA MARCHIGIANA.

1. PERFORMANCE INFRA VITAM E QUALITÀ DELLA CARCASSA

Scopo di questa prova è stato quello di valutare gli effetti della fonte proteica e del livello energetico delle razioni sulle performance di accrescimento e la qualità della carcassa di vitelloni Marchigiani. Diciotto vitelli svezzati (età 129 d) sono stati equamente suddivisi in tre gruppi. Fino al raggiungimento del peso di macellazione (620 kg) i primi due gruppi hanno ricevuto diete isenergetiche ed isoproteiche, con concentrati formulati utilizzando differenti fonti proteiche (favino-FB vs farina di estrazione di soia-SB), mentre il terzo gruppo, HE, è stato alimentato con razioni più energetiche, utilizzando entrambe le fonti proteiche succitate. I parametri di accrescimento (peso vivo, incremento ponderale giornaliero, efficienza biologica di accrescimento alle età e nei periodi, nonché gli indici di conversione alimentare) sono stati calcolati a partire dalle curve di accrescimento individuali. Il gruppo HE sin dall’età di 180 d ha fatto registrare valori di peso vivo e incremento ponderale giornaliero significativamente (P<0,01) più elevati rispetto agli altri due gruppi; ciò ha consentito ai soggetti di questo gruppo di raggiungere il peso e la conformazione di macellazione più rapidamente (età media 500 d) rispetto a quelli dei gruppi FB e SB (età media 540 d). La fonte proteica ha influenzato solo la prima fase di accrescimento successiva allo svezzamento (peso vivo a 180 d: 173 vs 186 kg per i gruppi FB e SB, rispettivamente; P<0,01). Da ciò è emerso che il favino può essere usato come fonte proteica alternativa alla farina di estrazione di soia, in quanto non influenza la velocità di accrescimento né gli indici di conversione alimentare nell’intero periodo sperimentale. Tuttavia, nelle fasi immediatamente successive allo svezzamento sarebbe preferibile associare al favino una fonte proteica più ricca in proteine by-pass. L’adozione di diete con più elevati tenori energetici induce apprezzabili miglioramenti della velocità di accrescimento, ma peggiora gli indici di conversione alimentare. Le misurazioni effettuate sugli animali prima della macellazione e sulle carcasse non sono state influenzate né dalla fonte proteica né dal livello energetico delle razioni. Il gruppo HE ha fatto registrare la più bassa incidenza delle ossa lunghe (6,2 vs 6,7 vs 5,8% carcassa fredda per FB, SB e HE, rispettivamente, P<0,01) e la più alta percentuale di grasso separabile (5,1 vs 4,7 vs 7,1% carcassa fredda per FB, SB e HE, rispettivamente; P<0,01). Relativamente al raffronto fra le fonti proteiche solo l’incidenza delle ossa lunghe è risultata significativamente differente nei due gruppi (6,2 vs 6,7% della carcassa fredda per FB e SB, rispettivamente; P<0,05). In conclusione l’adozione di piani alimentari più energetici migliora le curve di accrescimento dei vitelloni Marchigiani, anche se nell’ultimo periodo sarebbe preferibile ridurre il livello energetico al fine di minimizzare la deposizione di grasso.

Parole chiave: Vitelloni Marchigiani, Favino, Farina di estrazione di soia, Livello energetico, Accrescimento.
due to their carcass conformation and low fat deposition. Recently, the favourable chemical and nutritional characteristics of meat enabled the Marchigiana breed to obtain the “Vitellone Bianco dell’Appennino Centrale” Protected Geographical Indication, PGI (Council Regulation EC No 2081/92), along with the Chianina and Romagnola breeds (Floroni, 2002).

In the intensive livestock of meat bulls, soya bean meal s.e. is largely used. However, the possible risk connected to GMO use in animal breeding has led to the reconsideration of animal production processes with special reference to the use of alternative protein sources (e.g. faba beans, dried peas, lupine seeds, chickpeas) able to replace soy bean. These legumes have agronomic importance because they improve soil fertility and reduce nitrogenous dressing, with positive effects on environmental pollution. Moreover, they need a limited initial investment for their modest requirements of chemical and energetic inputs and their short culture cycle. In particular, due to its climactic conditions, the internal area of Campania Region, has always favoured the faba bean culture.

The aim of this study was to evaluate the influence of dietary protein sources (faba beans vs soya bean meal) and energy levels on livestock consisting of Marchigiana young bulls. In particular, the effects of both factors on growth dynamics and post-mortem performances are reported in this initial paper, while meat quality parameters, chemical composition and fatty acid composition will be discussed in a subsequent study. (Cutrignelli et al., 2008)

Material and methods

Animals and dietary treatments

The trial was carried out on a farm situated at 700 m a.s.l. in Campania Region (Southern Italy). Eighteen weaned young bulls (129 d of age) were equally divided into three groups. Each animal was placed in individual box up to the slaughtering weight (620 kg). Two groups were fed diets with the same protein and energy concentrations and the same forage/concentrate ratios (F/C), but differing in protein source: faba bean (Vicia faba minor L.) vs soya bean meal (Soja hispida). The animals of the third group were fed diets higher in energy than the other two groups and with both protein sources in the concentrates. The groups were named according to the administered protein source: faba bean-FB; soya bean meal-SB and energy level: high energy-HE.

In formulating the concentrates for all the diets, barley (Hordeum vulgaris L.) meal was used as it was produced on the farm. As forage a sulla (Hedysarum coronarium L.) hay crowded out by certain graminae and produced on the farm (NDF 54.9% DM; CP 12.7% DM) was administered to FB and SB groups, while a mixed hay (sulla and graminae) with higher protein (13.1% DM) and lower NDF (48.9% DM) concentration than the other one was chosen for HE group. In the age period of 6-14 months in the diet of HE group part of the hay was replaced with beet (Beta vulgaris L.) pulp silage. During ensiling, in order to increase the rapidly fermentable carbohydrates content and optimise preservation, the beet pulps were mixed (7% DM) with barley meal. When beet pulp silage finished (age period 421-500 days), the animals received dried beet pulps up to the end of the trial. Feeding schemes and diets chemical composition are presented in Table 1.

Every two months, samples of each feed were collected to determine the chemical composition (Van Soest et al., 1991; AOAC, 2000). The nutritive value was calculated as net energy of growth (MJ of NEg) as suggested by INRA (1988). Individual feed in-
Table 1. Feeding schemes, chemical composition and nutritive value of the diets fed by the three groups.

| Group | FB     | SB     | HE     |
|-------|--------|--------|--------|
| Age   | days   | 129-180| 181-340| 341-540| 129-180| 181-340| 341-540| 129-180| 181-420| 421-500|
| Hay   | %      | 35     | 45     | 35     | 35     | 45     | 35     | 35     | 37     | 22     |
| Concentrate | "    | 65     | 55     | 65     | 65     | 55     | 65     | 65     | 51     | 78     |
| Beet pulp silage | "    | -      | -      | -      | -      | -      | -      | -      | 12     | -      |
| DMA   | kg/q BW| 2.7    | 2.3    | 2.0    | 2.7    | 2.3    | 2.0    | 3.3    | 2.9    | 2.4    |
| Moisture | %  | 11.7   | 11.7   | 11.6   | 11.2   | 11.2   | 11.2   | 10.7   | 18.4   | 10.7   |
| Crude protein | % DM | 15.6   | 15.2   | 15.5   | 15.1   | 14.8   | 15.4   | 15.4   | 15.8   | 14.6   |
| Crude fibre | "    | 14.8   | 17.8   | 15.6   | 14.8   | 17.9   | 15.5   | 13.8   | 13.9   | 11.6   |
| NDF   | "     | 29.3   | 33.3   | 31.6   | 29.7   | 33.6   | 32.2   | 29.1   | 31.6   | 28.9   |
| ADF   | "     | 19.7   | 23.3   | 20.0   | 19.1   | 22.7   | 19.6   | 16.3   | 18.1   | 16.4   |
| ADL   | "     | 3.6    | 4.4    | 3.9    | 3.4    | 4.2    | 3.7    | 2.2    | 2.9    | 2.0    |
| NEn   | Mj/q DM| 674    | 634    | 672    | 675    | 635    | 675    | 710    | 717    | 777    |

FB: faba bean; SB: soya bean meal s.e.; HE: high energy.
DMA: dry matter administered.
VMS: vitamin and mineral supplementation.
BW: body weight.
NEn: net energy for growth.
Perfomances of young Marchigiana bulls

takes were registered daily to calculate the feed conversion indexes (FCI for dry matter and energy, FCI-DM and FCI-NE\textsubscript{g}, respectively).

**Measurements**

All the animals were weighed at the beginning of the trial, at the age of 6 months and thereafter every two months, until the body weight (BW) of 620 kg fixed in advance as slaughter weight, was reached. At the last weight control, the following measurements were made (ASPA, 1991) on the subjects fasting for 24 hours: height at withers and at pelvis, round circumference, length of rump, body length, depth of chest, width of pelvis and of chest. All animals were slaughtered in an authorized slaughterhouse according to EU legislation (EU Regulation EC No 882/2004).

In order to evaluate the carcass characteristics, the following measurements were conducted (ASPA, 1991) on the hot carcasses: length of carcass, depth of chest, length, width and thickness of leg. Moreover, skin, head, legs, organs and cavitary fat were weighed to calculate hot and cold dressing. “Tare” included blood and all the carcass processing losses.

After 9 days of tendering at 4±1°C, the right side of each animal was dissected. Meat, long bones and bones not included in the commercial cuts were weighed in order to calculate their incidences on cold carcasses.

For the classification of the commercial cuts of meat into first and second quality the following schema was used:

Meat of 1\textsuperscript{st} quality - posterior fourth: strip loin, tenderloin, top side, thick flank, rump, top beef, eye round and leg of beef; anterior fourth: shoulder clod, blade filet, regular roll and middle rib;

Meat of 2\textsuperscript{nd} quality - posterior fourth: shank and cap of rump; anterior fourth: shank, clod, chuck, flank steak and brisket.

The pH in *Longissimus thoracis* (LT), *Semitendinosus* (ST), *Semimembranosus* (SM) and *Caput longum triceps brachii* (CLoTh) muscles were measured within 1 h from death and at the end of tendering by a Hanna pH-meter (mod. HI 9025) equipped with an electrode FC 230C. From each right side a sample cut corresponding to the 10\textsuperscript{th} rib was taken (Lanari, 1973). In particular the exsection was made along the cranial borders of the 10\textsuperscript{th} and 11\textsuperscript{th} ribs (at the dorsal 3\textsuperscript{rd} of the first one) to include the corresponding trait of the 10\textsuperscript{th} rib, half of the body of the 10\textsuperscript{th} vertebra and partially the 11\textsuperscript{th} ones. The spinous processes of the 8\textsuperscript{th}, the 9\textsuperscript{th} and the 10\textsuperscript{th} vertebra were partly taken. In the sample cut part of the following muscles were included: *spinalis, spinalis thoracis, semispinalis thoracis, ilio-ocostalis thoracis, transversospinalis, serratus dorsalis caudalis, latissimus dorsi*, and *longissimus thoracis*. The sample cuts were dissected to calculate the incidence (%) of separable muscles, bones and fat. The cranial border of the longissimus thoracis surface was measured and the area was calculated by Autocad 2000 (Omura, 1999).

**Statistical analysis**

The parameters referred to living animals (body weight-BW, daily weight gains-DWG, biological efficiency of growth-BEG = DWG/BW\textsuperscript{75} and feed conversion indexes-FCI) were calculated from the data of the individual curves of growth as suggested by Pilla *et al.* (1987) and Pilla (1991). In order to evaluate the equation type (allometric vs quadratic) better able to describe the curves of growth of young bulls, the REG procedure (SAS, 2000) was utilised. Live, slaughtering and dissection data were statistically processed to determine the differences between the protein sources using the GLM procedure (SAS, 2000). In order to compare the energy levels, a planned comparison among
the groups (FB+SB vs HE) was estimated using orthogonal contrasts.

**Results and discussion**

No refusals occurred during the whole experimental period, consequently dry matter intakes corresponded to the dry matter administered (DMA; Table 1). Table 2 shows the average parameters of individual growth curves for each group obtained by measurements at different ages. In order to obtain the individual growth curves, the quadratic function \[ \text{weight} = a + (b \times \text{age}) + (c \times \text{age}^2) \] was chosen because this model gave higher determination coefficients than the allometric function, in contrast with Pilla (1991), but in accordance with Giorgetti et al. (1995) on Chianina young bulls, and Di Lella et al. (1998) on buffalo young bulls.

**Performance infra-vitam**

The protein source did not affect any parameters (Table 3) except the BW at 180 d of age (P<0.01). This difference is probably due to the higher non-protein nitrogen (NPN) concentration of the faba bean than the soya bean meal (about 12 vs 1.3% of CP, respectively, according to Bovera et al., 2001). Indeed, in the months immediately following the weaning it is preferable to administer diets with higher rumen undegradable protein content because at this age the rumen is not yet perfectly functional and microbial protein synthesis is less efficient. Furthermore, for the same reason, the animals in this period are probably unable to neutralise possible anti-nutritional factors of faba beans, such as proteinase inhibitors, phytic acid and tannins (McDonald et al., 2002). As respects the influence of the replacement of soya bean meal s.e. with legumes seeds, the literature results are contrasting. Moss et al. (1997) found no significant effects on weight gain and feed intake when soya bean meal was replaced on an isonitrogenous basis by lupin seeds in diets for growing bulls (BW from 182 to 243 kg); similar results are reported by Kwak and Kim (2001) on Korean native bulls (BW from 247 to 427 kg) utilising two different concentrations (15 and 30%) of flaked lupin. Instead, according to our results, Murphy and McNiven (1994) found significantly higher weight gain in growing steers (BW from 235.2 to 343.7 kg) fed soybean meal vs raw or roasted lupin although the differences were not significant in the finishing phase (final BW 503.4 kg).

Group HE always showed significantly (P<0.01) higher BW than FB and SB groups.

| Table 2. Average parameters of individual growth (y = a + bx +cx²) curve of the three groups. |
|---------------------------------------------------------------|
| **Group** | **a** | **b** | **c** | **R²** |
|-----------|-------|-------|-------|--------|
| FB        | 24.22 | 0.702 | 0.0007 | 0.992  |
|           | (13.82)| (0.09)| (0.00014) |        |
| SB        | -2.90 | 0.980 | 0.0003 | 0.982  |
|           | (21.42)| (0.14)| (0.00002) |        |
| HE        | -57.30| 1.402 | -0.0001 | 0.976  |
|           | (32.90)| (0.22)| (0.00003) |        |

FB: faba bean; SB: soya bean meal s.e.; HE: high energy.
Value in parenthesis indicates standard error.
Table 3. Means and standard deviation of *infra-vitam* performance at ages and periods for the three groups.

| Age (d) | Body weight (kg) | BEG at the age (WG/kg\(^{0.75}\) BW) | Significance | FB vs SB | HE vs FB+SB | FB vs SB | HE vs FB+SB | FB vs SB |
|---------|------------------|-----------------------------------|--------------|----------|-------------|----------|-------------|----------|
| 129     | 127 ± 1.8        | 131 ± 5.9                         | 128 ± 5.1    | ns       | ns          |          |             |          |
| 180     | 173 ± 4.5        | 186 ± 7.6                         | 189 ± 6.6    | **       | **          | 19.6 ± 1.5| 21.1 ± 2.3  | 21.0 ± 3.0| *        | ns       |
| 340     | 343 ± 12         | 364 ± 21                          | 396 ± 21     | **       | ns          | 14.9 ± 1.0| 14.5 ± 0.7  | 15.4 ± 0.8| ns       | ns       |
| 500     | 550 ± 23         | 564 ± 31                          | 627 ± 41     | **       | ns          | 12.6 ± 1.4| 11.7 ± 1.1  | 12.1 ± 1.0| ns       | ns       |
| 540     | 612 ± 30         | 625 ± 35                          | -            | ns       |             | 12.2 ± 1.5| 11.2 ± 1.2  | -         | -        | ns       |

| Period (d) | Daily weight gains (kg) | BEG in the periods (WG/kg\(^{0.75}\) BW) | Significance | FB vs SB | HE vs FB+SB | FB vs SB | HE vs FB+SB | FB vs SB |
|------------|-------------------------|-----------------------------------------|--------------|----------|-------------|----------|-------------|----------|
| 129-180    | 0.89 ± 0.11             | 1.03 ± 0.15                            | 1.20 ± 0.12  | **       | ns          | 20.9 ± 2.4| 23.2 ± 3.3  | 27.1 ± 2.5| **       | ns       |
| 180-340    | 1.06 ± 0.05             | 1.13 ± 0.10                            | 1.29 ± 0.10  | **       | ns          | 16.9 ± 0.6| 17.2 ± 0.9  | 18.8 ± 0.9| **       | ns       |
| 340-500    | 1.32 ± 0.13             | 1.28 ± 0.01                           | 1.44 ± 0.14  | **       | ns          | 13.7 ± 1.2| 12.9 ± 0.9  | 13.5 ± 0.9| **       | ns       |
| 340-540    | 1.35 ± 0.15             | 1.30 ± 0.12                           | -            | ns       |             | 16.8 ± 1.6| 15.8 ± 1.2  | -         | -        | ns       |
| 129-500    | 1.14 ± 0.06             | 1.13 ± 0.10                           | 1.34 ± 0.11  | **       | ns          | 16.1 ± 0.6| 16.2 ± 0.8  | 17.7 ± 0.9| **       | ns       |
| 129-540    | 1.18 ± 0.07             | 1.18 ± 0.09                           | -            | ns       |             | 15.7 ± 0.6| 15.7 ± 0.7  | -         | -        | ns       |

FB: faba bean; SB: soya bean meal s.e.; HE: high energy.  
BEG: biological efficiency of growth.  
*: P<0.05; **: P<0.01; ns: not significant.
Moreover, the diets adopted allowed group HE to reach the slaughter weight and good carcass conformation earlier (500 vs 540 d of the other two groups). As a consequence the DWG in the different periods were influenced by the feeding scheme (HE vs FB+SB; P<0.01). Furthermore, the higher nutritive intake determined significantly higher BEG values even if the differences were significant only at the age of 180 d. These results agree with Pilla et al. (1987) which recorded a positive correlation between BEG in the periods and energy value of the diet, and a negative correlation between BEG and metabolic weight (BW75) on Charolaise, Limousine, Marchigiana, Piemontese, Romagnola and Friesian young bulls. The improvement of infra vitam performance due to the higher energy intakes was found also by several authors (Giorgetti et al., 1995; Steen, 1995; Keane and Allen, 1998; Sami et al., 2004).

As observed by Moss et al. (1997), feed intake and consequently feed conversion were never influenced by protein source.

The conversion indexes of DM and energy during the whole experimental period (129 - 500 d) of group HE were significantly (P<0.01) higher than those of the other two groups (FCI-DM: 7.63 vs 6.83 and 6.79 kg DM/kg WG; FCI -NEg: 59.2 vs 45.7 and 47.5 MJ/kg WG, for HE vs FB and SB, respectively), probably due to the lower efficiency of energy utilisation caused by fat deposition (Vermorel et al., 1976).

The somatic measurements recorded in vivo at age of slaughter were not influenced by dietary protein source; the energy intake affected the width of chest (49.0 and 49.6 vs 52.2 cm in group FB and SB vs HE, respectively; P<0.05).

Carcass measurements

No significant differences among the groups were found for carcass measurements, with the exception of the width of leg (35.8 and 36.2 vs 43.2 cm; P< 0.01) and the thickness of leg (25.4 and 26.3 vs 29.5; P<0.05), for FB and SB vs HE, respectively. In each case the carcass measurements of this trial ranged into the interval indicated by Keane (2003) for European/North American breeds.

No differences were found in dressing out, organs and tare incidence on net weight.

Protein source influenced neither body and carcasses conformations nor dressing out, confirming that faba beans could be used as an alternative protein source to soya bean meal s.e. in the intensive livestock of meat bulls.

As expected (Table 4), group HE showed a significantly (P<0.01) lower incidence of long bones. The first quality cuts were slightly lower for group HE (55.3 vs 58.1 and 57.8%, for HE vs FB and SB, respectively), probably due to the higher quantity of fat removed by the cuts. In fact, the animals of group HE showed a significantly (P<0.01) higher fat incidence. All these data confirm the hypothesis that the utilisation of diets with high energy concentration during the last period of growth produced a higher fat deposition. Also for these parameters our results contrast with those of Fiems et al. (2002) who found no differences due to energy intake. Concerning the comparison between the two protein sources, only the incidence of long bones showed a significant difference (6.2 vs 6.7 for FB and SB, respectively; P<0.05).

The pH values of the tested muscles indicated a correct process of acidification (Figure 1), as indicated by Warriss (2000): the slaughter values were always lower than 7.0 and the dissection values always higher than 5.5. No significant differences were found as function of the feeding schemes for each tested muscles.

In Figure 2 the sample cut dissection
Parameters are reported. It is important to underline that the sample cut measurements were contradictory and conflicted with the data obtained from total carcass dissection. The results of the sample cut dissection (Figure 2) indicate a significant (P<0.05) difference between groups FB and SB in meat incidence (69.4 vs 66.9, for FB and SB, respectively); while no differences were found between groups at carcass dissection. Moreover, sample cut of SB group showed in the meantime the smallest meat incidence and the highest LT area (Table 4). Besides, group HE showed at total carcass dissection a significant higher fat incidence, while this parameter did not differ at sample cut dissection.

**Conclusions**

These previous results show that the faba bean could be used as an alternative protein source to soya bean meal s.e. as it did not affect the growth rate (body weight, daily weight gain and biological efficiency of growth) or the feed conversion indexes during the whole experimental period, and offers decided agronomical, economical and healthy advantages. Nevertheless, in the first period after weaning the faba bean reduced the growth rate, probably due to the higher concentrations of NPN and anti-nutritional factors. It might be useful in this period to use this protein source associated with other richer in rumen undegradable

### Table 4. Means and standard deviation of measurements at the dissection in the three groups

| Group                        | FB         | SB         | HE         | Significance |
|------------------------------|------------|------------|------------|--------------|
| Slaughter weight kg          | 590 ± 9    | 606 ± 18   | 624 ± 24   | *            |
| Net weight %                 | 549 ± 10   | 570 ± 27   | 592 ± 28   | *            |
| Hot dressing out %           | 63 ± 3     | 63 ± 3     | 64 ± 2     | ns           |
| Net hot dressing out %       | 68 ± 3     | 67 ± 3     | 68 ± 2     | ns           |
| Net cold dressing out %      | 65 ± 3     | 65 ± 3     | 66 ± 2     | ns           |
| Meat of 1st quality % cold carcass | 58.1 ± 1.3 | 57.8 ± 1.3 | 55.3 ± 2.0 | ns           |
| Meat of 2nd quality %        | 20.6 ± 1.7 | 19.6 ± 1.2 | 20.8 ± 1.8 | ns           |
| Long bones %                 | 6.2 ± 0.3  | 6.7 ± 0.3  | 5.8 ± 0.4  | **           |
| Other bones %                | 6.7 ± 1.6  | 7.1 ± 0.7  | 6.5 ± 0.7  | ns           |
| Fat %                        | 5.1 ± 0.5  | 4.7 ± 0.8  | 7.1 ± 1.0  | **           |
| Tare %                       | 3.3 ± 0.7  | 3.9 ± 0.4  | 3.4 ± 1.7  | ns           |
| Meat/bone %                  | 6.2 ± 0.9  | 5.6 ± 0.5  | 6.2 ± 0.5  | ns           |
| Sample cut %                 | 0.44 ± 0.08| 0.48 ± 0.07| 0.44 ± 0.10| ns           |
| LT area cm²                  | 84.0 ± 5.0 | 88.4 ± 4.8 | 86.2 ± 4.9 | ns           |

FB: faba bean; SB: soya bean meal s.e.; HE: high energy.
LT: longissimus torachis.
*: P<0.05; **: P<0.01; ns: not significant.
Figure 1. Means and standard deviation of pH values at slaughtering and dissection in the three groups.

FB: faba bean; SB: soya bean meal s.e.; HE: high energy.
LT: longissimus thoracis; ST: semitendinosus; SM: semimembranosus; CLoTb: caput longum triceps brachii.

Figure 2. Means and standard deviation of meat, fat and bone incidences (% of sample cut) and meat/bone ratio.

FB: faba bean; SB: soya bean meal s.e.; HE: high energy.
*: P<0.05 FB vs SB.
protein. The administration of high energy diets appreciably improved the growing rate even if it caused a worsening of the feed indexes due to higher fat deposition in the last breeding phase, as observed at slaughter. Nevertheless, it should be noted that young bulls fed high energy diets reached their final weight 40 days before those of the other two groups, suggesting that, even if a cost analysis was not calculated, this practice may be considered more suitable.

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