Effect of replacing a soy diet with *Vicia faba* and *Pisum sativum* on performance, meat and fat traits of *Cinta Senese* pigs

Francesco Sirtori, Alessandro Crovetti, Anna Acciaioli, Antonio Bonelli, Carolina Pugliese, Riccardo Bozzi, Gustavo Campodoni, Oreste Franci

Dipartimento di Scienze delle Produzioni Agroalimentari e dell’Ambiente, Università di Firenze, Italy

Abstract

The aim of this study was to investigate the effect of diets containing genetically modified organism-free legumes as a replacement of soybean on the basis of performance, carcass composition and quality of local pig meat (*Cinta Senese*). Twenty-four *Cinta Senese* barrows were divided into 3 dietary groups and were each fed with a diet containing different protein sources: soybean meal (SOY), *Vicia faba* (FABA) and *Pisum sativum* (PEA) (8 pigs for each group). The diets were isonitrogenous and isocaloric and contained approximately 14.5% crude protein and 14.8 MJ/kg of digestible energy (on dry matter). Each group was reared outdoors in a paddock of 3500 m². In vivo performances were not different among groups. At slaughter, differences in subcutaneous fat thickness appeared only in the outer layer, at the last thoracic vertebra level, which was lowest in the PEA group. No differences were found in the sample joint composition. With regard to the chemico-physical traits of meat and fat, the FABA group had the highest values of redness in lean and backfat, while the PEA group showed higher moisture and lower fat content in meat compared to the SOY group. Differences in the fatty acid profile of backfat were found only for the C16:1 percentage that was higher in FABA than SOY pigs. In conclusion, *Vicia faba* and *Pisum sativum* could be a good alternative to soybean in the growing-fattening of *Cinta Senese* pigs.

Introduction

The majority of soybean supplies in Europe are imported from non-European countries (Christodoulou et al., 2006), and several farmers have attempted to identify protein source alternatives to soybean to reduce feeding costs (Mordenti et al., 2012). Soybeans are largely genetically modified and, genetically modified organisms (GMO)-free products are difficult to find on the national market and are very expensive. The use of GMO products elicits public concerns due to their health potential risks (Tudisco et al., 2010). Recently, the use of GM soybeans was forbidden by several laws regulating pig-rearing conditions, such as organic production (Council Regulation (EC) No 834/2007; European Commission, 2007). Thus, farmers tried to increase the local production of GMO-free plant proteins (Calabrò et al., 2014).

Often, the products of indigenous breeds of the Mediterranean area, including *Cinta Senese*, are labelled by the Protected Designation of Origin (PDO) [Commission Implementing Regulation (EU) No 217/2012; European Commission, 2012]. Thus, they are under the control of laws that impose rearing and feeding conditions. In the case of *Cinta Senese*, it is strictly forbidden to use soybeans and to add synthetic amino acids (AA).

However, it should be stressed that the use of alternative protein sources have to be well calibrated because they could contain anti-nutritional compounds, such as tannins, which could interfere with the digestive process of food. In recent years, this problem has been partially overcome by using resources with a low content of tannins (Acciaioli et al., 2003; Crepon et al., 2010; Smith et al., 2013). Moreover, it is known that the use of *Pisum sativum* and *Vicia faba* bean in pigs is limited due to their partial deficiency in indispensable AA, such as methionine (Met) and tryptophan (Try) (Smith et al., 2015). Many studies have been performed on the replacement of soybeans with other protein sources in various animal species (Barros et al., 2002; Soren and Sastry, 2009; Chikagwa-Malunga et al., 2009; Mordenti et al., 2012; Calabrò et al., 2014). With regard to swine, previous studies (Prandini et al., 2011; Smith et al., 2013) have demonstrated that specific percentages of *Pisum sativum* or *Vicia faba* may be included in diets without negative effects on pig performance, carcass composition and meat quality. However, these studies were performed mainly on improved pigs with the addition of synthetic AA to balance the AA profile of the diet.

The effect of the replacement of soybeans with alternative protein sources in diets for local pigs was tested to study the apparent digestibility and nitrogen balance (Acciaioli et al., 2003), but information on productive performance is lacking. Thus, the aim of this trial was to study the effect of *Pisum sativum* and *Vicia faba* in the replacement of soybeans on the in vivo performance, carcass composition, and meat and fat characteristics of *Cinta Senese* pigs.

Materials and methods

Animal and diet

Twenty-four *Cinta Senese* castrated male pigs were equally distributed among three experimental dietary groups: the control group with soybean meal (SOY) as the main protein source, the second group with *Pisum sativum* (PEA), and the third group with *Vicia faba* (FABA) in complete replacement of soybean meal. Each group was reared outdoors on non-cultivated arable land of 3500 m² (one paddock per dietary group) up to slaughter without other feed sources. At the beginning of the trial, the pigs were approximately 120 d old and weighed and average of 45 kg (SD±10 kg). The diets were isonitrogenous and isocaloric (crude protein: 140 g/kg, digestible energy: 14.8 MJ/kg on dry matter (DM)). Table 1 shows the ingredients and chemical composition of the experimental diets. To compare the true
protein value of the three diets and to simulate the feeding conditions imposed by the PDO label for Cinta Senese pigs, no synthetic AA integration was provided. The diets were used during the entire growing-fattening period and were distributed on the basis of 90 g/kg W^{0.75} (the average metabolic weight of paddock) until a maximum of 2.65 kg/d pro capite. This amount was reached approximately at 90 kg of live weight and it was chosen in order to limit the high adipogenic capacity of the breed. Ration adjustment occurred every three to four weeks when the subjects were individually weighed. The amount of feed supplied for each pen, recorded on daily basis, was 21.39, 21.17 and 21.39 kg DM for FABA, PEA and SOY group, respectively.

Carcass and meat traits

Pigs were slaughtered at the target weight of 135 kg, after approximately 220 days of trial. The slaughtering occurred on two different days, where the experimental groups were equally represented. The carcass weight and backfat thickness at the last thoracic vertebra (LT) and at the Gluteus medius muscle (GM) were recorded. The sample joint (loin portion) was distributed on the basis of 90 g/kg W^{0.75} during the entire growing-fattening period and integration was provided. The diets were used equally represented. The carcass weight and backfat thickness at the last thoracic vertebra (LT) and at the Gluteus medius muscle (GM) were recorded. The sample joint (loin portion) was distributed on the basis of 90 g/kg W^{0.75} during the entire growing-fattening period and integration was provided. The diets were used equally represented. The carcass weight and backfat thickness at the last thoracic vertebra (LT) and at the Gluteus medius muscle (GM) were recorded. The sample joint (loin portion) was distributed on the basis of 90 g/kg W^{0.75} during the entire growing-fattening period and integration was provided. The diets were used equally represented. The carcass weight and backfat thickness at the last thoracic vertebra (LT) and at the Gluteus medius muscle (GM) were recorded. The sample joint (loin portion) was distributed on the basis of 90 g/kg W^{0.75} during the entire growing-fattening period and integration was provided. The diets were used equally represented. The carcass weight and backfat thickness at the last thoracic vertebra (LT) and at the Gluteus medius muscle (GM) were recorded. The sample joint (loin portion) was distributed on the basis of 90 g/kg W^{0.75} during the entire growing-fattening period and integration was provided. The diets were used equally represented. The carcass weight and backfat thickness at the last thoracic vertebra (LT) and at the Gluteus medius muscle (GM) were recorded. The sample joint (loin portion) was distributed on the basis of 90 g/kg W^{0.75} during the entire growing-fattening period and integration was provided. The diets were used equally represented. The carcass weight and backfat thickness at the last thoracic vertebra (LT) and at the Gluteus medius muscle (GM) were recorded.

Table 1. Characteristics of the diets.

| Ingredient, % | FABA | PEA | SOY |
|---------------|------|-----|-----|
| Corn          | 20   | 14  | 35  |
| Barley        | 45   | 42  | 40  |
| Vicia faba    | 22   | -   | -   |
| Pisum sativum | -    | 31  | -   |
| Soybean meal  | -    | -   | 12  |
| Wheat bran    | 12   | 12  | 12  |
| Premix        | 1    | 1   | 1   |

Chemical composition, % of DM

|                | FABA | PEA | SOY |
|----------------|------|-----|-----|
| Crude protein  | 14.4 | 14.7| 14.0|
| Ether extract  | 3.0  | 2.2 | 2.7 |
| Crude fibre    | 6.4  | 5.8 | 5.3 |
| N-free extract | 72.3 | 73.6| 74.8|
| Ash            | 3.9  | 3.7 | 3.5 |
| Lys            | 0.74 | 0.67| 0.71|
| Met            | 0.21 | 0.23| 0.27|
| Thr            | 0.56 | 0.60| 0.59|
| Try            | 0.16 | 0.17| 0.19|
| DE, MJ/kg DM   | 14.67| 14.86|14.97|

Table 2. Effect of diet on individual in vivo performance and carcass traits.

|                | FABA | PEA | SOY | RSD | P    |
|----------------|------|-----|-----|-----|------|
| Pigs, n        | 8    | 8   | 8   |     |      |
| Initial live weight, kg | 45.25 | 44.31 | 44.12 | 10.54 | 0.97 |
| Final live weight, kg   | 133.4| 136.4| 138.2| 16.59| 0.85 |
| ADG, kg          | 0.404| 0.422| 0.432| 0.05 | 0.58 |
| Dressing percentage | 80.85| 80.52| 80.41| 2.16 | 0.91 |
| Backfat thickness, cm | GM total | 4.90 | 4.49 | 4.76 | 0.70 | 0.51 |
|                   | GM outer layer | 2.19 | 2.31 | 2.31 | 0.45 | 0.82 |
|                   | GM inner layer  | 2.71 | 2.18 | 2.45 | 0.56 | 0.19 |
|                   | LT total         | 4.99 | 4.63 | 4.97 | 0.50 | 0.38 |
|                   | LT outer layer   | 2.17 | 1.61 | 2.28 | 0.53 | 0.04 |

FABA, Vicia faba; PEA, Pisum sativum; SOY, soybean; Lys, lysine; Met, methionine; Thr, threonine; Try, tryptophan; DM, dry matter; DE, digestible energy; Premix supplied per kg of concentrate: vitamin A, 12,000 U; vitamin B1, 1.5 mg; vitamin B2, 4 mg; panthenic acid, 15 mg; vitamin B6, 4 mg; biotin, 0.2 mg; folic acid, 0.5 mg; vitamin B12, 0.02 mg; vitamin PP, 25 mg; vitamin D3, 1800 U; vitamin E, 60 mg; vitamin K3, 2 mg; Cu, 0.8 mg; Zn, 100 mg; Se, 0.15 mg. Determined as sum of the tabulated values of the ingredients.

24 hours after slaughtering, the following physical determinations were performed on the LL: i) colour measurement (lightness (L*), redness (a*) and yellowness (b*)) using a Minolta Chromometer CR-200 on the cut surface after 1 h of rest at 4°C according to Boccard et al. (1981); ii) water-holding capacity (WHC), which was evaluated as: free water using the filter paper press method (Grau and Hamm, 1952), drip loss on a meat slice that was stored horizontally for 48 h at 4°C, and cooking loss by boiling the meat sample in a water-bath until the centre temperature reached 75°C; and iii) Warner Bratzler shear force using the Instron 1011 apparatus on raw and cooked meat using a V-shaped blade at a crosshead speed of 100 mm/min on two cylindrical meat sample (Boccard et al., 1981). The maximal forces for the cylindrical cores are averaged to obtain one value per sample.

On the LL and PM, the following chemical analyses were performed according to AOAC methods (2000): i) moisture by hophosphilising to a constant weight; ii) intramuscular fat as ether extract; and iii) protein using the Kjeldahl method.

Both layers of subcutaneous fat were analysed for: i) colour parameters according to the previously described method; ii) total lipid content (using a modified method of Folch et al., 1957); and iii) fatty acid profile of total lipids using the modified technique of Morrison and Smith (1964). Fatty acids methyl esters were prepared by esterification and analysed by gas chromatography using a Varian 430 apparatus (Varian Inc., Palo Alto, CA, USA) equipped with a flame ionisation detector. Fatty acid separation occurred in a Supelco Omegawax TM 320 capillary column (30-m length; 0.32 mm internal diameter; 0.25 µm film thickness; Supelco, Bellafonte, PA, USA). The chromatographic conditions were an initial temperature of 160°C, which was
then increased by 2°C/min until the temperature reached 220°C. One microlitre of sample in hexane was injected with the carrier gas (helium) at a constant flow of 1.5 mL min⁻¹ and at a split ratio of 1:20. The detector temperature was set at 260°C. The chromatograms were recorded using computing integrator software (Galaxie Chromatography Data System 1.9.302.952; Varian Inc.). The FAs were identified by comparing the retention time of the FAME with the standard Supelo 37-component FAME mix (Supelco) and were quantified through calibration curves using nonadecanoic acid (C19:0) (Supelco) as an internal standard. These results were expressed as the percentage of total fatty acids.

Statistical analysis

Data were analysed using the GLM procedure (SAS, 2007) with ANCOVA using the diet and slaughter day as discrete effects and the slaughter weight as a continuous effect. For the chemical composition of the muscle and fatty acid profile of subcutaneous fat, the effect of the muscle and layer, respectively, was added to the statistical model. Student’s t-test was used to test the differences between the least square means. The statistical significance was established at P<0.05.

Results and discussion

The in vivo performance of the three experimental groups were similar. No significant differences were found for average daily gain (ADG) (Table 2), which was similar for all dietary groups, as confirmed by the achievement of the same slaughter weight of pigs. This result is consistent with other findings, which showed the lack of differences in growth performance of pig fed with diets containing Pisum sativum or Faba bean vs soybean meal, both with a low (Mordenti et al., 2012) or high inclusion rate (Stein et al., 2006; Chrenková et al., 2011; Prandini et al., 2011; Smith et al., 2013) always balanced for essential AA. In contrast, Partenen et al. (2003) proposed a limit of 20% of faba bean inclusion in the diet because a higher concentration resulted in a decrease in ADG in the growing period. Indeed, a high inclusion of Pisum sativum and Faba bean in diets has been associated with reduced pig performance due to anti-nutritional factors, such as tannins (Gatel, 1994) and to deficiency in essential AA (Sundrum et al., 2000), but other studies (Shelton et al., 2001; Prandini et al., 2011; Mordenti et al., 2012) have proposed that the performances were penalised only during the growing period due to AA deficiency and anti-nutritional factors that are more effective in young compared to older pigs. In fact, if the entire growing-fattening period is considered, no differences among protein sources were generally observed when employing diets that were artificially balanced for essential AA LL(Partenen et al., 2003; Stein et al., 2006; Newman et al., 2011; Prandini et al., 2011). The present results obtained with diets that were not supplemented for crystalline AA confirmed the general nutritional equivalence of the three protein sources, at least in the diets so formulated. Remarkably, the protein content

| Table 3. Effect of diet on sample joint composition. |
|---------------------------------|------|------|------|------|------|
| Diet          | FABA | PEA  | SOY  | RSD  | P    |
| Sample joint, kg | 2.066 | 2.119 | 2.100 | 0.173 | 0.83 |
| Total subcutaneous fat, % | 44.69 | 46.61 | 46.89 | 2.65  | 0.22 |
| Outer layer     | 18.60 | 19.72 | 18.77 | 1.94  | 0.47 |
| Inner layer      | 26.99 | 26.89 | 28.12 | 2.89  | 0.33 |
| Intermuscular fat, % | 39.59 | 39.91 | 38.45 | 2.85  | 0.59 |
| Total lean, %   | 8.16  | 8.48  | 7.38  | 0.88  | 0.06 |
| LL              | 25.33 | 25.89 | 25.92 | 2.38  | 0.86 |
| Other lean      | 5.90  | 5.54  | 5.15  | 0.98  | 0.34 |
| Bone, %         | 9.48  | 8.85  | 8.68  | 1.60  | 0.32 |

FABA, Vicia faba; PEA, Pisum sativum; SOY, soybean; RSD, residual standard deviation; PM, Psoas major muscle; LL, Longissimus lumbarum muscle.

| Table 4. Effect of diet on physical traits of meat and fat. |
|---------------------------------|------|------|------|------|------|
| Diet          | FABA | PEA  | SOY  | RSD  | P    |
| Drip loss, % | 2.17  | 1.84  | 1.77  | 1.34  | 0.82 |
| Cooking loss, % | 25.56 | 24.45 | 24.98 | 2.91  | 0.75 |
| Free water, cm³ | 11.1  | 12.5  | 11.9  | 1.49  | 0.22 |
| Shear force on raw meat, kg | 7.70  | 8.24  | 7.63  | 1.50  | 0.68 |
| Shear force on cooked meat, kg | 10.21 | 11.06 | 9.54  | 3.31  | 0.66 |
| pHmin          | 6.06  | 6.44  | 6.50  | 0.25  | 0.47 |
| pHmax          | 5.77  | 5.88  | 5.69  | 0.16  | 0.08 |
| L*             | 46.49 | 46.08 | 48.28 | 2.69  | 0.25 |
| a*             | 12.24 | 10.41 | 10.88 | 1.22  | 0.02 |
| b*             | 3.69  | 2.95  | 3.93  | 1.28  | 0.30 |
| Hue            | 0.29  | 0.27  | 0.34  | 0.07  | 0.21 |
| Chroma         | 12.79 | 10.82 | 11.62 | 1.53  | 0.05 |
| Outer layer of backfat | 1.0        | 1.95  | 2.00  | 0.05  | 1.00 |
| Other lean      | 3.10  | 2.61a | 1.89b | 0.68  | 0.01 |
| Chroma         | 4.31  | 4.02b | 3.33b | 0.69  | 0.04 |
| Inner layer of backfat | 1.0        | 1.95  | 2.00  | 0.05  | 1.00 |
| Other lean      | 3.80  | 3.00  | 3.93  | 0.89  | 0.43 |
| Chroma         | 3.57  | 3.60  | 3.45  | 0.75  | 0.28 |

FABA, Vicia faba; PEA, Pisum sativum; SOY, soybean; RSD, residual standard deviation; LL, Longissimus lumbarum muscle; L*, lightness; a*, redness; b*, yellowness. aValues within a row with different superscripts differ significantly at P<0.05.
of these diets can be considered to be high for the requirements of *Cinta Senese*, as highlighted by recent findings (Sirtori et al., 2010).

The carcass characteristics were similar among groups, except for backfat thickness (of outer layer at the last thoracic vertebra), which was lower for the PEA diet. No differences in carcass traits were found by other authors when the soybean meal was replaced with field peas (Stein et al., 2006) or faba beans (Prandini et al., 2011; Smith et al., 2013).

Furthermore, the sample joint composition (Table 3), which should represent the entire carcass composition, was not affected by dietary treatment. Also Stein et al. (2006), using diets fortified with crystalline AA to meet the ideal protein profile, found no effect of replacement of soybean with field peas on the lean meat content of carcasses. However, the present results demonstrated that *Pisum sativum* and *Faba bean* could replace soybean meal, without any inclusion of crystalline AA, to obtain a similar carcass composition in *Cinta Senese* pig.

Few significant differences among the three dietary groups were found on the physical properties of meat (Table 4). Shear force, pH and WHC, evaluated as drip loss, cooking loss and free water, were similar in all diets. Also Chrenková et al. (2011), Mordenti et al. (2012) and Partenen et al. (2003) found no effect on drip loss of diets containing *Pisum sativum* or *Faba bean* in replacement of soybean, whereas Stein et al. (2006) recorded decreasing drip loss values as the inclusion of *Pisum sativum* in diet increased.

For colour data, differences were found only for the a* parameter, the FABA group showed the most red meat, and the FABA and PEA groups showing a higher value of a* on the outer layer of backfat compared to SOY. As consequence, in the meat chaorm showed higher value in FABA than in PEA group, and in outer layer of backfat SOY had higher value of Hue and lower of Chroma than FABA group. This result was inconsistent with Partenen et al. (2003), who found a decrease in the colorimetric parameters of meat with an increase in the substitution of soybean with faba. Moreover, Stein et al. (2006) found darker and redder meat in pigs fed with field peas than in pigs fed with soybean meal. Furthermore, Partanan et al. (2003) reported that the colour of the meat was related to the pH of meat after slaughtering and, probably, the limited differences in colour parameters found in the present trial could be related to the similarity of pH in meat.

With regard to chemical composition (Table 5), the PEA group was supplied meat with a higher moisture and lower ether extract content than the SOY group. Comparing pigs that were fed a soybean-free diet containing 10% of peas vs pigs fed soybean, Trombetta et al. (2009) found no significant differences in the chemical composition of *Seminembranosus* muscle. The lack of differences between the FABA and SOY diets is consistent with the study of Mordenti et al. (2012), where the inclusion of only 5% faba beans was tested. Regarding the comparison between muscles, the LL showed a lower moisture and higher ether extract content than the PM, which is consistent with the findings of Pugliese et al. (2013) on the same muscles. For the fatty acid profile of backfat (Table 6), significant differences were found exclusively for C16:1, that was higher in SOY than in the FABA group. Trombetta et al. (2009) also found low effect of the pea on fatty acid profile of intramuscular fat, while Mordenti et al. (2012) found no effect of faba on acidic profile of subcutaneous fat. Prandini et al. (2011) compared faba bean and pea with respect to soybean and found a lower linoleic and higher linolenic acid content in peas than in the soybean group. With regards to the layer effect, the outer layer of backfat showed lower SFA and higher monounsaturated and polyunsaturated fatty acids (MUFA and PUFA) contents with respect to the inner layer, which confirmed other results on the *Cinta Senese* breed (Pugliese et al., 2009, 2013). As reported by these authors, it is probable that the inner layer of subcutaneous adipose tissue has larger de novo lipogenesis, and consequently, the PUFA of feed origin are diluted with more endogenous fatty acids than in the outer layer (Koch et al., 1968; Christie et al., 1972; Geri et al., 1988).

### Table 5. Effect of diet on chemical composition of muscles (% on wet basis).

| Diet | Muscle | RSD | P   |
|------|--------|-----|-----|
| FABA |        |     |     |
| PEA  |        |     |     |
| SOY  |        |     |     |
| LL   |        |     |     |
| PM   |        |     |     |
| Diet | Muscle |     |     |
| FABA |        |     |     |
| PEA  |        |     |     |
| SOY  |        |     |     |
| LL   |        |     |     |
| PM   |        |     |     |
| Moisture | 72.94 | 72.96 | 71.19 | 71.55 | 73.37 | 0.76 | 0.04 | <0.01 |
| Protein | 22.86 | 21.78 | 21.56 | 21.92 | 21.54 | 0.71 | 0.47 | 0.07  |
| Ether extract | 4.15 | 3.64 | 4.61 | 5.00 | 3.27 | 0.93 | 0.03 | <0.01 |
| Ash | 1.11 | 1.14 | 1.22 | 1.11 | 1.21 | 0.17 | 0.16 | 0.06  |

**FABA**, *Vicia faba*; **PEA**, *Pisum sativum*; **SOY**, soybean; **LL**, Longissimus lumborum; **PM**, Psoas major muscle; **RSD**, residual standard deviation.

### Table 6. Effect of diet on lipid content (%) and fatty acid profile (% of total fatty acids) of both layers of subcutaneous fat.

| Diet | Layer | RSD | P   |
|------|-------|-----|-----|
| FABA |       |     |     |
| PEA  |       |     |     |
| SOY  |       |     |     |
| Outer |       |     |     |
| Inner |       |     |     |
| Diet | Layer |     |     |
| FABA |       |     |     |
| PEA  |       |     |     |
| SOY  |       |     |     |
| Outer |       |     |     |
| Inner |       |     |     |
| Total lipids | 76.51 | 77.52 | 77.67 | 76.93 | 77.53 | 4.02 | 0.69 | 0.58  |
| C14:0 | 1.14 | 1.19 | 1.20 | 1.21 | 1.15 | 0.08 | 0.07 | <0.01 |
| C16:0 | 24.45 | 24.98 | 24.74 | 24.01 | 25.44 | 0.82 | 0.21 | <0.01 |
| C18:2 | 7.55 | 7.21 | 7.59 | 8.22 | 6.68 | 0.50 | 0.07 | <0.01 |
| C20:1 | 1.11 | 1.11 | 1.08 | 1.10 | 1.09 | 0.10 | 0.49 | 0.90  |
| C20:2 | 0.32 | 0.30 | 0.30 | 0.35 | 0.26 | 0.04 | 0.14 | <0.01 |
| C20:4n6 | 38.88 | 39.34 | 38.97 | 37.16 | 40.96 | 1.71 | 0.72 | <0.01 |
| C18:1 | 49.71 | 49.49 | 49.40 | 50.38 | 48.69 | 1.53 | 0.84 | <0.01 |
| C18:2 | 5.75 | 5.72 | 5.79 | 8.22 | 6.68 | 0.50 | 0.07 | <0.01 |
| C18:3 | 0.21 | 0.20 | 0.22 | 0.24 | 0.18 | 0.03 | 0.13 | <0.01 |
| C20:0 | 0.16 | 0.16 | 0.14 | 0.14 | 0.17 | 0.02 | 0.14 | <0.01 |
| C20:1 | 1.11 | 1.11 | 1.08 | 1.10 | 1.09 | 0.10 | 0.49 | 0.90  |
| C20:2 | 0.32 | 0.30 | 0.30 | 0.35 | 0.26 | 0.04 | 0.14 | <0.01 |
| C20:4n6 | 52.94 | 52.82 | 52.80 | 53.88 | 51.83 | 1.53 | 0.96 | <0.01 |
| SFA | 8.18 | 7.84 | 8.22 | 8.96 | 7.21 | 0.55 | 0.12 | <0.01 |
| MUFA | 3.21 | 3.20 | 3.22 | 3.24 | 3.18 | 0.03 | 0.13 | <0.01 |
| PUFA n3 | 7.97 | 7.64 | 8.00 | 8.71 | 7.03 | 0.53 | 0.12 | <0.01 |

**FABA**, *Vicia faba*; **PEA**, *Pisum sativum*; **SOY**, soybean; **RSD**, residual standard deviation; **SFA**, saturated fatty acids; **MUFA**, monounsaturated fatty acids; **PUFA**, polyunsaturated fatty acids. Fatty acids lower than 0.1% are not tabulated but were considered in the sum of the respective category. **Values** within a row with different superscripts differ significantly at P<0.05.
Conclusions

The uniformity of mean in vivo performances and the lack of relevant differences in carcass and meat quality obtained with the three diets indicated that Vicia faba and Pisum sativum could be a good alternative to soybean meal in the growing-fattening period for the Cinta Senese breed, which enables the formulation of diets adequately balanced, even in compliance with the rules of some of the rearing systems that prohibit AA supplementation or the use of GMO products. Moreover, for Cinta Senese the use of these alternative protein sources could be excellent to integrate pasture in the woods during the fattening period, as both acorn and chestnut are well-known to be deficient in protein content.

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