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Effect of physical form of whole ear corn silage (coarse vs wet milled) included at high dietary levels (30 vs 40% dry matter) on performance of heavy finishing pigs

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ABSTRACT

The aim of the trial was to compare two dietary levels of whole ear corn silage (ES), fed in two physical forms (coarse or after wet milling), on growth, slaughter traits and stomach development of heavy finishing pigs. Fifty six "Italian Large White × Italian Duroc" (about 5 months of age and 78–80 kg of live weight (LW) were divided into pairs homogeneous and were kept in 28 pens (1.2 × 3 m, partially-slatted) equipped with two separate troughs to avoid competitions for feeding and with free access to water. Four dietary treatments resulted from the combination of two ES inclusion levels (300 and 400 g/kg dry matter (DM), ES30 and ES40, respectively) and two physical forms of the silage (coarse and wet milled). Seven pairs of pigs were randomly assigned to each dietary treatment and the animals were slaughtered at an average LW of 163.0 kg (±1.9 kg). The coarse ES had particles longer than the milled silage (4.4 vs 2.7 mm) and when it was fed to pigs the pH of fecal samples were lower (P<0.01) than that from pigs fed the milled ES, at both dietary inclusion levels (6.00 vs 6.20 for the ES30 diets and 5.97 vs 6.14 for the ES40 diets). There were no significant differences in organic matter total tract digestibility, average daily gain, DM intake and gain:feed ratio among the dietary treatments (0.81, 764 g/d, 77.1 g DM/kg $LW^{0.75}$, 0.266 g/g DM, on average, respectively). The ES40 diets reduced the *Longissimus dorsi* thickness (56.4–59.8 vs 62.7–64.1 mm, P<0.011) and increased the stomach weight (0.0040 vs 0.0038 of the LW, P<0.05), while the coarse dimension of silage particles increased the DM content of the material in the stomach (from 142–171 to 179–183 g/kg DM, P<0.045) and the surface of the pyloric region (from 214–216 to 225–232 cm^2, P<0.029). The two dietary inclusion levels and physical forms of ES do not differentiate growth and slaughter traits of the heavy finishing pigs. However, the coarse form of the silage modifies the development of the stomach by increasing the internal surface of the pyloric region as a possible consequence of a longer retention time in the stomach.

Abbreviations: ADG, average daily gain; AIA, acid insoluble ash; BT, backfats; CATTD, coefficient of apparent total tract digestibility; CLP, carcass lean percentage; CP, crude protein; DM, dry matter; DMI, dry matter intake; EE, ether extract; ES, whole ear corn silage; LD, *Longissimus dorsi*; LW, live weight; NDF, neutral detergent fiber; OM, organic matter.

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1. Introduction

Whole ear corn silage (ES) consists of kernels, cobs and husks and is harvested with a forage chopper, equipped with a kernel processor and a snapper head. This silage is rich in starch, but is not commonly used in fattening pig diets since it is considered to be too fibrous (i.e. about 20% NDF on DM basis) and also because its coarse form could cause clogging problems to the automatic feed delivery systems.

However, given that ES can supply diets with both starch and fiber, it could represent an appropriate ingredient to fulfill the recent pig welfare issues (EFSA, 2007, 2012), which prescribe the presence of fiber also in fattening diets. Moreover, ES is a farmland grown feed resource, which increases farm sustainability by limiting off-farm feeds transports and drying energy consumptions. In Italy (Bosi and Russo, 2004) the fattening period is prolonged until the pigs reach a slaughter weight of 160–170 kg, which is the standard required for the ham cured production system (i.e. "prosciutto"). We observed that inclusion of ES in diets at low or medium rates (150–300 g/kg DM) for the Italian heavy finishing pigs production (i.e. LW > 80 kg) probably exerts a positive dietary effect, due to its long gastric retention time and coarse particle size which could promote the satiety of animals and limit the direct contact of gastric acids with the stomach mucosa (Mason et al., 2013). In fact, it is known that low fiber diets with small particle size lead to a more fluid gastric chime and a risk for the gastric mucosa integrity (Millet et al., 2010, 2012a, 2012b; Mößeler et al., 2010, 2014). On the contrary, providing pigs with coarse and fibrous materials (e.g. straw provided in racks) has been demonstrated effective to reduce oesophago-gastric ulcers in heavy fattening pigs (Di Martino et al., 2013).

In our previous research with heavy pigs (Zanfi et al., 2014) we showed that ES included up to 300 g/kg DM had not adverse effect on animal performance, when compared with traditional soy–corn based diets at the same level of fiber content (e.g. NDF of 150 g/kg DM). In the present paper we present the results of another experiment carried out on finishing Italian heavy pigs, where we further increased the dietary inclusion of ES (400 g/kg of DM) to be compared with the dietary level already tested previously (300 g/kg of DM). The effects of silage particle size reduction, when ES is fed in coarse physical form or after a wet milling, were also investigated.

2. Materials and methods

All animals were cared for in accordance to the guidelines on animal welfare in animal research of the Italian Legislative decree No. 116/1992 (Italian Ministry of Health, 1992).

2.1. Feeding trial

Fifty six "Italian Large White × Italian Duroc" pigs (about five months of age and 78–80 kg LW) consisting of equal numbers of gilts and barrows were divided into pairs, homogeneous for LW and sex (one gilt and one barrow) and kept in 28 pens (1.2 × 3 m, partially-slatted). Each pen had free access to water and was equipped with two separate troughs to avoid competitions for feeding.

The experimental diets contained same amounts of barley, wheat, soybean and supplement (231, 100, 90 and 179 g/kg DM, respectively) and differed for ES and corn meal contents (300 and 250 g/kg DM, respectively, in diets ES30 and 400 and 150 g/kg DM, respectively, in diets ES40). ES was included in chopped form (without any treatment) or after wet grinding (by a farm mill with a 2 mm grind). The diets were prepared daily by adding ES to a compound feed, appropriately formulated. Overall, the four dietary treatments resulted from the combination of two ES inclusion levels (300 and 400 g/kg DM) and two physical forms (coarse and wet milled). Seven pairs of pigs were randomly assigned to each dietary treatment.

During the first days of the experiment the animals received (5 d) a compound feed supplemented with antibiotics (575 and 200 mg/kg of amoxicillin and colistin, respectively), and subsequently were adapted to the experimental diets (5 d). During the trial the daily DM intake (DMI) was restricted to about 77.1 g/kg $LW^{0.75}$ and rations were fed in equal portions at 08.00 and 16.00 daily. The trial started at a LW of 87.6 ± 6.1 kg. Every two weeks the pigs were weighed to monitor the average daily gain (ADG) and feed samples were collected.

Samples of feces were collected when animals reached an average LW of 150.4 ± 6.9 kg, immediately after the excretion (two samples from each pen per day over two consecutive days) and were immediately stored at −20 °C for the subsequent analysis.

2.2. Slaughtering traits, meat analysis and stomach measures

The animals were slaughtered at an average LW of 163.0 kg (±1.9 kg) by electrical stunning and then were exsanguinated. The carcasses were weighed and then dissected into commercial cuts. Hams, loins (muscle *Longissimus dorsi*, LD) and backfats (BT) were weighted before cooling. Backfat and LD thickness (BT and LDT, respectively) were measured before cooling at 8 cm to the side of the central line of the carcass between the third and the fourth last ribs (European Commission, 2001) using a Fat-O-Meater equipped with a probe of 6-mm diam. and a photodiode (SFH 950/960 Type; Siemens, Munich, Germany).