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Effect of replacing barley by increasing levels of olive cake in the diet of finishing pigs: Growth performances, digestibility, carcass, meat and fat quality

M. Joven, E. Pintos, M.A. Latorre*, J. Suárez-Belloch, J.A. Guada, M. Fondevila

Instituto Universitario de Investigación en Ciencias Ambientales, Departamento de Producción Animal y Ciencia de los Alimentos, Universidad de Zaragoza, Miguel Servet 177, 50013 Zaragoza, Spain

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ABSTRACT

The effect of the solid by-product from the olive oil industry (olive cake) on digestibility, growth performances, and carcass, meat and fat characteristics was studied in sixty Duroc×(Landrace×Large White) gilts, of 69.5 ± 5.02 kg of body weight and 126 ± 3 days of age. Increasing levels of olive cake (0, 50, 100 and 150 g/kg of feed) were included in the diet by replacing the same proportion of barley. Five pens with three pigs per treatment were assayed, considering the pen as replicate. The trial lasted 35 days, and animals were slaughtered with 96.7 ± 7.45 kg of body weight. Daily feed intake increased (P=0.04) and daily gain tended to increase (P=0.06), both quadratically, with olive cake inclusion reaching the maximum values at 100 g olive cake/kg. The daily apparent digestible energy intake also increased quadratically (P=0.04) on increasing dietary olive cake content. The feed conversion ratio was not affected by diet. Also, the apparent organic matter digestibility tended to decrease quadratically (P=0.06) and energy digestibility decreased linearly (P<0.04) as the level of dietary olive cake level increased. The experimental treatment had scarce effects on carcass and meat characteristics; however, the inclusion of olive cake increased quadratically (P=0.04) carcass weight and decreased linearly (P=0.02) fat depth measured at *Gluteus medius* muscle. The experimental treatment did not modify the total polyunsaturated fatty acids proportion of subcutaneous fat but increasing levels of olive cake promoted a linear reduction (P=0.01) of total saturated fatty acid proportion and a linear increase (P=0.02) of total monounsaturated fatty acid percentage, especially that of C18:1 (P=0.01). We can conclude that olive cake might be included up to 100 g/kg in finishing pig diets improving some aspects of growth performances and carcass quality and also providing a healthier fatty acid profile in fat tissues.

Abbreviations: ADFI, average daily feed intake; ADG, average daily gain; aNDFom, neutral detergent fibre; BW, body weight; CP, crude protein; ED, apparent gross energy digestibility; EE, ether extract; FCR, feed conversion ratio; IMF, intramuscular fat; MUFA, monounsaturated fatty acids; OMD, apparent organic matter digestibility; PUFA, polyunsaturated fatty acids; SFA, saturated fatty acids.

* Corresponding author. Tel.: +34 876554168; fax: +34 976761590.
E-mail address: malatorr@unizar.es (M.A. Latorre).

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Table 1
Analyzed chemical composition of the barley and olive cake used in the trial (g/kg, as fresh basis unless otherwise indicated).[a]

	Barley	Olive cake	
		Partially dried	Partially dried and pitted[b]
Gross energy (MJ/kg)	16.3	21.5	22.5
Dry matter	904	932	909
Organic matter	880	908	870
Crude protein	107	49.5	84.8
Ether extract	23.5	69.5	117
Neutral detergent fibre	174	676	545
Acid detergent fibre	57.4	532	427
Acid detergent lignin	10.6	211	188
Fatty acids (g/kg of total fatty acids)			
C14:0	–	–	1.23
C16:0	–	–	104
C18:0	–	–	23.7
C18:1	–	–	679
C18:2	–	–	151
C18:3	–	–	10.2

[a] Analyzed in duplicate samples.
[b] Olive cake included in the experimental feeds.

1. Introduction

The high prices of the main raw materials for animal feeding during last years has carried out an important increase of productive costs in farms. As a consequence, alternative ingredients have been evaluated but they must maintain optimum productive performances in animals and quality in the end product. In this context, some agro-industrial by-products such as olive cake, citrus pulp or grape marc, may be advantageously used. Spain is the greatest producer of olive oil with 2 million cultivated hectares of olive trees and a yearly mean production of 8 million tons of olives and 1.4 million tons of olive oil (Food and Agriculture Organization of the United Nations, 2012). The intensive growing and processing of olives produces large quantities of by-product (approximately 800 kg olive cake/Tm olives; Martín García et al., 2003) which is used in different ways. It can be pressed again for a second oil extraction whose economic value is lower than that obtained from the first extraction. Also, it is used as fuel for boilers. The chemical composition of olive cake varies widely depending on the olive variety, the proportion of its main components (skin, pulp and stone) and the extraction processing of oil (Alcaide and Nefzaoui, 1996). This by-product has been tested in sheep and lambs with a moderate success (Alcaide et al., 2003; Ben-Salem and Znaidi, 2008) because of the high proportion of residual fat. This should not be an inconvenient for porcine diets; however, the high lignin content from the stone limits its use in growing pigs. On the other hand, the proportion in monounsaturated fatty acids (MUFA), especially in oleic acid, could turn it an interesting dietary ingredient because it might modify the fatty acid profile of the pig fat tissues (Rhee et al., 1988; Mas et al., 2010). It has to be taken into account the increasing demand of modern society for healthy meat with less saturated fatty acids (SFA).

The information in the literature about the use of olive cake in swine feeding is really scarce and mainly focused in traditional systems based on autochthonous pigs (Rupić et al., 1997; Hernández-Matamoros et al., 2011) fattened with different feeding and production systems to those used in improved pigs reared indoor. Therefore, the aim of this study was to investigate the effects of replacing barley by increasing levels of olive cake in the diet on growth performances, digestibility and carcass, meat and fat quality of finishing pigs.

2. Materials and methods

2.1. Experimental diets

Fresh olive cake, as by-product of the first extraction of oil from olives (variety Empeltre), was taken from an olive-mill located in the North-Eastern of Spain (Cooperativa San Macario, Andorra, Teruel). Initially, it had high proportions of moisture (approximately 500 g/kg) and stone (rich in lignified fibre). Therefore, for the trial, it had to be partially dried (to 80–90 g moisture/kg) in an oven (at 55 °C for 24 h), shredded using a mixer (50 rpm for 1 h) and sieved by a wire mesh (1.5 mm).

Four experimental diets were formulated in base on increasing levels of olive cake (0, 50, 100 and 150 g/kg feed). The control diet (0 g/kg feed) contained barley and soybean meal as main ingredients and met or exceeded the nutrient levels recommended by Fundación Española Desarrollo Nutrición Animal (2013) for finishing pigs. The other diets were formulated by partial replacing barley with the same proportion of olive cake. All diets were formulated to be isoproteic although neutral detergent fibre (aNDFom) and ether extract (EE) increased with the dietary level of olive cake. The characterization of the chemical composition of olive cake and barley used in the trial is shown in Table 1. In additions, the ingredient composition and the estimated (Fundación Española Desarrollo Nutrición Animal, 2010) and analyzed nutrient composition of diets are presented in Table 2.