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Effects of dietary sesame oil on growth performance and fatty acid composition of muscle and tail fat in fattening Chaal lambs

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ABSTRACT

This experiment was carried out to study the effect of sesame oil (SO) supplementation on performance and fatty acid composition of meat and tail fat in Iranian Chaal lambs. Eighteen lambs were fed one of the three isocaloric and isonitrogenous diets containing 0 (control), 25 and 50 g SO per kilogram diet in a completely randomized design for 84 days. There were no substantial effects on animal performance and their carcass and non-carcass measurements, except for kidney fat weight which linearly increased ($P = 0.05$) by increasing level of SO. Supplementation of SO was resulted a decrease in the molar ratio of ruminal propionate ($P = 0.01$), whereas the ruminal acetate:propionate ratio ($P = 0.03$), serum total cholesterol ($P = 0.01$) and high density lipoproteins (HDL) were increased linearly ($P < 0.01$). The inclusion of SO up to 50 g/kg in diet linearly decreased concentrations of C15:0 ($P = 0.02$, $P < 0.01$), C16:0 ($P = 0.04$, $P = 0.05$), C16:1 ($P = 0.02$, $P = 0.02$), C17:0 ($P = 0.03$, $P < 0.01$) and C17:1 ($P = 0.02$, $P < 0.01$), and increased concentrations of C18:1 *trans* ($P < 0.01$) and conjugated linoleic acid (CLA) C18:2 *cis*-9, *trans*-11 ($P \leq 0.01$) in both intramuscular and tail fat. Increasing level of SO in the diets had quadratic ($P = 0.05$) effect on C18:0 and linearly increased ($P = 0.05$) polyunsaturated fatty acids (PUFA), and decreased saturated fatty acids (SFA) ($P = 0.03$) as well as atherogenicity index ($P = 0.05$) in tail fat. Our results indicated that increasing level of SO up to 50 g per kg diet may improves tail fat and intramuscular CLA *cis*-9, *trans*-11 in young fattening Chaal lambs without affecting animal performance and with little effect on fat deposition.

1. Introduction

The nutritional modulation of the fatty acid (FA) profile of ruminant edible fats is an important research topic, and modification of tissue and milk fat composition can improve the health characteristics of the fat produced by ruminants (Beaulieu et al., 2002; Bessa et al., 2015). Ruminant edible fats are the primary sources of conjugated linoleic acid (CLA) for

Abbreviations: ADG, average daily gain; BW, body weight; C, control diet; CLA, conjugated linoleic acid; DM, dry matter; DMI, dry matter intake; FA, fatty acid; FAME, fatty acid methyl esters; FCR, feed conversion ratio; HDL, high density lipoproteins; LDL, low density lipoproteins; MUFA, monounsaturated fatty acids; PUFA, polyunsaturated fatty acids; SFA, saturated fatty acids; SO, sesame oil; TC, total cholesterol; TMR, total mixed ration; TG, triglycerides; UFA, unsaturated fatty acids; VFA, volatile fatty acid; VLDL, very low density lipoproteins.

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humans, which has been associated with a wide range of positive health benefits (Bessa et al., 2005; Boles et al., 2005). The biological role of conjugated isomers of linoleic acid such as rumenic acid (C18:2 *cis-9*, *trans*-11) and C18:2 *trans-10*, *cis*-12 have been extensively studied (Castro et al., 2005; Bessa et al., 2015). Among several biological effects, rumenic acid known as an anticarcinogenic isomer of CLA and has been shown a beneficial effect on cardiovascular disease in several animal and experimental models as reviewed by Gebauer et al. (2011).

One of the options of enhancing the beneficial effects of animal products is through dietary manipulation, such as the use of finishing diets supplemented with vegetable oils to improve the concentration of CLA and thus their health benefits (Bolte et al., 2002). Sesame oil is one of the available vegetable oils in some parts of the world. In some regions, this oil is obtained by using a traditional pressing method with high levels of impurities and low cost which is not suitable for human consumption and is available for use in animal diets.

There have been several studies on the effect of different fats of vegetable origin in diets of beef cattle (Beaulieu et al., 2002; Duckett et al., 2002) and fattening lambs (Haddad and Younis, 2004; Castro et al., 2005; Manso et al., 2009) but to our knowledge, the influence of SO supplementation in lamb diets has not been studied and information on the effect of fats of vegetable origin in diets on FA profile of tail fat in fat-tailed sheep are also rare. In a recent study by Maleki et al. (2015) it was also reported that there was minimal variability among breeds in their FA profiles and CLA *cis-9*, *trans*-11 of tail fat in order to genetically manipulate FA profile in meat and tail fat. Hence, investigation on dietary manipulation to improve the FA profile of tail fat and meat is necessary. Many vegetable oils such as soybean, sunflower and linseed oil have been studied to enrich the beneficial FA in meat of ruminants (Kitessa et al., 2009; Roy et al., 2013). The potential of SO as a new supplemental oil in modifying FA composition of meat and tail fat of lambs has not been studied. Therefore, the objective of this study was to investigate the effects of SO (containing 397 g linoleic and 428 g oleic acids per kg of total FA) supplementation on performance, carcass characteristics, some blood metabolites, rumen fermentation, and meat and tail fat FA composition (especially CLA) in fattening Chaal (an Iranian fat-tailed breed) lambs.

2. Material and methods

2.1. Animals, diets, and experimental procedure

The experiment was carried out at research institute of Aminabad which located at south East of Tehran. All of the animal procedures and protocols used in this study were approved by the college of Aburaihan animal care and use committee. Eighteen male Chaal lambs with similar weight (23.7 ± 0.73 kg) and age (139 ± 6 d) from a pure flock under the uniform rearing condition were used in this experiment. Animals were assigned into three groups (n = 6/group) to evaluate three isocaloric and isonitrogenous total mixed rations (TMR) containing 0 (control), 25 and 50 g SO per kg diet (Table 1). Lambs were housed in individual pens with concrete floor. Before initiation of the trial, lambs were gradually adapted over a 14 days period to the experimental condition and control diet. The feeding trial lasted 84 d and the diets were offered in two equal meals at 09:00 and 18:00 h daily with free access to fresh water. Chopped alfalfa hay and barley straw were used in the forage part of TMR. SO was included by partially replacing (isocaloric replacement) barley in diets. The oil was mixed with the concentrate portion of the TMR before being mixed with the forage component. Diets were weighed individually for each lamb. Refusals from each lamb were collected before 09:00 h and weighed. Random grab samples of the diets were taken weekly intervals, combined throughout the trial period, and stored frozen at $-20\,^{\circ}C$ until analysis. Feeders were managed to allow up to 5% of diet per animal to be in excess one hour prior to the next feeding. During the experiment, lambs were observed for health problems and their body weights (BW) were recorded at 2-wk intervals before the morning feedings. Feed was withheld 12 h before initial and final weighing. Average daily gain (ADG) and dry matter intake (DMI) of lambs were measured then feed conversion ratios (FCR) were calculated.

Feed samples were analyzed for dry matter (DM; method No. 934.01), ether extract (EE; method No. 920.39) and crude protein (CP; method No. 981.10) following the procedures of AOAC (1990). Determination of neutral detergent fiber (NDFom) was performed by using Na sulfite, without heat stable amylase and expressed exclusive of residual ash according to Van Soest et al. (1991). Ash-free acid detergent fiber (ADFom) was also determined and expressed exclusive of residual ash. The SO purchased from a commercial source and concentrations of fatty acids in the oil (g/100 g FA) were: C16:0, 8.26; C16:1, 0.15; C18:0, 5.28; C18:1, 42.79; C18:2, 39.69; C18:3, 0.78; C20:0, 0.92 and other fatty acids, 2.13.

2.2. Carcass and non-carcass measurements

At the end of the fattening period, all lambs were slaughtered according to the Muslim (Halal) tradition. Immediately, the non-carcass parts of body (i.e., head, feet, skin, lung and trachea, heart, liver, kidneys, spleen, kidneys and mesenteric fats) were removed and weighed and hot carcass weight of lambs including the fat tail was also weighed. The fat tails of lambs were removed from the hot carcasses and weighed separately. The ratios of fat tail and non-carcass parts were calculated as a ratio of hot carcass weights.