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Meat Quaity

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Abstract

Few studies of using locally legume grains in lamb nutrition have been studied that their use had no negative impact on meat quality such as fatty acid composition. One of the strategies of increasing functional food availability is to increase polyunsaturated fatty acids, especially the ω-3 series, conjugated linoleic acid (CLA) level and reduce saturated fatty acids in animal products. The CLA isomers appear to be concentrated in intramuscular and subcutaneous fat of meat ruminants and the concentration of c9, t11-CLA being greater than the concentration of t10, and c12-CLA in all tissues. To increase the CLA yield in lamb meat, it is essential to provide lamb an appropriate substrate for the formation of CLA. The provision of source of dietary linoleic acid appears to increase the CLA concentration to the greatest extent. Regarding the recommended daily intake for the appreciation of health benefits in humans (3500 mg/d), this amount of CLA supplied to meat lamb will partially provide the CLA requirement for everyone under certain conditions; deposition of CLA in the tissues using the provision of modest amounts of locally legume grains is more conducive to CLA synthesis rather than high levels of grain.

Keywords: Conjugated linoleic acid; Legume seeds; Meat quality; Nutrition manipulation; Linoleic fatty Acids; Food; Legumes; Breeds; Blood cholesterol; Coronary artery disease; Scientific documentation

Nutrition Manipulation for the Production of High-Quality and Healthy Meat

New nutritional strategies for feeding livestock and poultry focus on the increase of unsaturated fatty acids (especially n-3) and conjugated linoleic fatty acids and the reduction of saturated fatty acids in animal food products [1,2]. To increase the CLA in animal meat, it is essential to provide a suitable base for its formation. Therefore, the inclusion of the source linoleic acid in the ruminant animal diet will be most effective in increasing the concentration of CLA in meat products. Forage foods such as grasses or legumes (alfalfa) are suitable for facilitating the accumulation of CLA and increasing the precipitate and forming it in the tissue of the animals. Therefore, the use of plant sources such as plants in the marine ecosystem and dry areas is one of the first and most important sources of unsaturated fatty acids. Aquatic plants have a special ability to produce fatty acids (18: 3 n-3), which are the building blocks for the production, refinement and non-saturation of a series of fatty acids, which ultimately produce docosahexaenoic acid and eicosapentaenoic acid. These two fatty acids are consumed by fish from aquatic plants and can be used to produce a wide variety of fatty acids, especially in fish oil, in fish tissues [1,2]. Plant sources and dry forages such as clover have a high proportion of unsaturated fatty acids (75–50%), such as alpha linoleic acid, which can be considered as a suitable substitute for the supply of fatty acid in some regions. However, the transfer of this type of fatty acids in ruminant meat depends on two important processes for increasing the level of these fatty acids in fodder (resulting in the animal) and reducing the amount of ruminal bovine fermentation [1]. However, providing a moderate amount of granular material in the diet concentrate instead of high levels leads to more CLA synthesis. Specific breeds of cattle tend to have more fat storage in the muscle and more CLA in the adipose tissue that is suitable for offering to the consumer. CLA levels of muscle can be increased by increasing the consumption of food items such as fresh fodder, silage, rangeland nutrition and the use of vegetable oils and fish oils, all of which have high levels of linoleic acid [3].

The production of CLA in the ruminant tissue is such that in the pathway of unsaturated fatty acid biosynthesis, the increase in the activity of the delta-9-dosacharase enzyme occurs and ultimately leads to the production of trans-vaccenic acid, which is the acid of the domestic production source; CLA is in the tissue, so that a linear relationship is obtained between the concentration of CLA and trans-vaccenic acid [3]. According to researches, CLA levels in beef ranged from 2.1 to 5.12 mg/g of fat [4]. The researchers have identified the variation in the concentration of CLA in beef, depending on the system used and the diet [4]. In these reports, the factors affecting the content of CLA in beef have been compared with pasture forage and that the diet contains oil or whole grains, and even the composition of the fatty acid content of the grains and the ratio of the concentrate to the forage are also evaluated. Lanza et al. [5] in their research showed that the replacement of a variety of legumes with soybean meal and corn grain significantly increases the CLA in lamb meat. Scerra et al. [6] in their research examined the effects of some legume seeds on the composition of fatty acids and intramuscular CLA and showed that feeding some legumes over soybean meal saved omega 3, omega 6 and CLA fatty acids in muscle tissue. Abdollah et al. [7] in their study showed that the replacement of beet seed at different levels of 0, 5, 10 and 15% with soybean meal did not affect the characteristics, carcass traits and performance of lambs and it has been replaced without negative effects and has reduced the cost of the diet. At the 10% level, daily gain was higher than other levels and control group.

Chemical composition and fatty acid composition of meat

The results of the chemical composition of the meat samples are reported in findings by Seifdavati & Taghizadeh [8]. The chemical composition of lamb samples fed with different diets showed a significant difference in crude fat and crude protein ($P < 0.01$). Unlike crude fats, the raw protein content of lamb meat was higher in soybean meal diet and slightly higher than in other groups. Although the crude protein content of common vetch was higher than the rest of the seeds, the lower carcase protein could be due to its low digestibility of undigested protein in the rumen, which is based on the results of digestion intestinal experiments from the methods of Gargallo & McNiven et al. [9,10], (for more details, refer to the references [11,12]. However, there was no increase in the digestible protein content of the total gastrointestinal tract between the tested samples either in their raw state or autoclaved, except for common vetch grain. Even with the autoclave of the common vetch grain, its protein was too protected and was not digested. According to the findings of Seifdavati & Taghizadeh [8], the composition of their experimental diets containing bitter vetch seed and soybean meal, had higher C16: and C18:0 fatty acids compared to the diets of common vetch group and chickling vetch group. The diets of common vetch and chickling vetch group were rich in linoleic (C18:2) and linolenic (C18:3) as essential fatty acids, compared to bitter vetch diets and soybean meal diets. However, the total of these two fatty acids was in all their experimental diets ranging from 56.6 to 57.05 grams per gram of methylated fatty acids. The results according to Seifdavati & Taghizadeh [8] among the saturated fatty acids showed a significant difference in the C16:0 content of the meat samples of the groups and soybean meal group was higher in lamb meat group ($P < 0.05$). Also, among the soybean meal groups, the level of palmitic acid C16:0 in lamb meat was higher than soybean meal ($P < 0.01$). The most abundant fatty acid in meat was oleic acid among legumes and its amount was significantly different between treatments ($P < 0.01$). Linolenic acid was higher in common vetch group lamb meat than in dietary containing bitter vetch seed, chickling vetch seed and soybean meal ($P < 0.05$). Similar results for this fatty acid were observed by Lanza Wood & Scerra et al. [2,5,6] for other legumes used in the dietary concentrate section. Generally, linolenic acid in common vetch group lamb meat was higher than in dietary containing bitter vetch seed, chickling vetch seed and soybean meal group ($P < 0.01$). Lamb meat in dietary containing chickling vetch showed higher levels of linolenic acid than lamb meat in soybean meal group ($P < 0.01$). The fatty acid composition of the muscle of the lambs moderately reflects the composition of the fatty acid in the diet. Ruminants, unlike nonruminants, do not store fat in tissues as much as they receive in the diet.

This is because ruminal microorganisms hydrolyze glycerides and subsequently cause hydrogen to combine with unsaturated fatty acids derived from dietary feeds [13,14]. Therefore, ruminants have more ratios of saturated to unsaturated fatty acids compared to nonruminants. The reduction of palmitic acid and stearic acid in lamb meat with diets containing chickling vetch and common vetch, respectively, compared with other diets, showed the potential of these two diets to reduce harmful effects on health ($P < 0.01$). These two acids can be responsible for increasing total cholesterol and low-density lipoprotein in the plasma and increasing the risk of human health [1,14]. In sheep and lamb meats, the ratio of these two fatty acids is more similar. There is a small variation in the ratio of fatty acids present in different body parts of the lamb. An alternative strategy to improve health indicators of humans in relation to consumption of lamb meat is reducing the level of stearic acid in the tissue by increasing the activity of the enzyme, stearoyl-CoA desaturase-Δ9, although the response of the animal to this manipulation is often relatively small [15]. In terms of fatty acid content, sheep meat is rich in saturated and poor fatty acids from unsaturated fatty acids, which is thought to be harmful for humans [15]. Despite the initial hypothesis [16], the effects of dietary lipids on human health, there were some issues and ambiguities in the concepts of saturated fatty acids that led to an increase in blood cholesterol and coronary artery disease. In a meta-analysis of Hunter et al. [17] on available scientific documentation from 2000 onwards, it resulted in a systematic review of all previous findings on the concepts of saturated fatty acids. The researchers, in a review with contributions from scientists, focused on the topic that the effect of stearic acid as saturated fatty acid on the risk of vascular disease in the heart depends on the fact that this fatty acid is to be replaced with other saturated fatty acids, trans-fatty acids, fatty acids with a double bond and fatty acids with multiple bonds or with sugary substances. One of the goals and main concern of advanced livestock nutrition research is the study of the possible nutritional manipulation of fatty acid composition of the lamb meat to reduce the concentration of saturated fatty acids and increase the concentration of fatty acids (C18:1, C18:2, C18:3), as cholesterol-lowering serum [14,15]. However, in the study by Seifdavati and Taghizadeh [8], the concentration of palmitic saturated fatty acid in soybean and bitter vetch group meat was higher than other experimental groups ($P < 0.01$). The higher levels of these two fatty acids (palmitic and stearic acid) in the soybean and bitter vetch group meat can be attributed to the higher levels of these two fatty acids in their diets than those of diets containing chickling vetch and common vetch.

The level of oleic fatty acid was lower in raw chickling vetch group than in other experimental groups. The amount of oleic fatty acid in the intramuscular fat was higher than that of the ration levels in the meat of all groups. Fortunately, farm animal cells are capable of synthesizing oleic acid and its derivatives from stearic acid. Oleic acid is obtained by unsaturation or loss of hydrogen in stearic acid. In farm animals especially ruminants, secretion of the Δ9-desaturase enzyme make stearic acid easily into oleic acid [18]. But linoleic acid in lamb fat was much less than its dietary fat [8]. This indicates that biohydrogenation is a major part of the rumen [19]. Larger amounts of linoleic acid in the fat of lamb in the chickling vetch group are likely to correlate with the high level of this acid in the chickling vetch group compared to the rest of the group. Among the remaining groups, the amount of linoleic acid in the fat of lamb meat was higher than soybean meal group. The internal biosynthesis of linolenic acid is shown in the studies of Zhou & Nilsson [20]. This acid is a precursor to omega-3 fatty acids that have a wide range of biological activities with beneficial effects on human health [21-23]. Linolenic acid level, similar to linoleic acid in lamb fat, was less than its dietary fat, indicating a major part of its transformation and hydrogenation in the rumen [19].

Conclusion

Higher CLA values in the muscle tissue of intensively finished lambs are not easily explained. To increase the CLA yield in lamb meat it is essential to provide lamb an appropriate substrate for the formation of CLA. The provision of source of dietary linoleic acid appears to increase the CLA concentration to the greatest extent. Dietary forage such as grass or legume hay appears to facilitate the establishment of the micro-flora that enhances the formation and deposition of CLA in the tissues; also, the provision of modest amounts of grain is more conducive to CLA synthesis rather than high levels of grain. Regarding the recommended daily intake for appreciation of health benefits in humans (3500 mg/d), this amount of CLA supplied to meat lamb will partially provide the CLA requirement for everyone under conditions of this study.

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