# PHYSICOCHEMICAL PROPERTIES, ANTIOXIDANT STATUS AND LIPID PROFILE OF *LONGISSIMUS* MUSCLE IN GOATS FED BLEND OF CANOLA OIL AND PALM OIL

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**Abstract – The physicochemical properties, lipids and antioxidant profile of *Longissimus lumborum* (LL) muscle in goats fed graded level of blend of 80% canola oil and 20% palm oil (BCPO) were examined. Over a fourteen-week feeding trial, twenty four bucks were randomly assigned to diets containing 0, 4 or 8% BCPO, slaughtered and the LL was subjected to 7 d *postmortem* ageing. Neither diet nor postmortem ageing influenced antioxidant enzyme activities, cooking loss and δ-tocopherol. The LL of goats fed 4 and 8% BCPO had greater C18:1 *trans*-11 Vaccenic, C18:3n-3, and C22:5n-3, total carotenoids, α and γ-tocopherol and redness than that of the control goats. Dietary BCPO lowered drip loss and lipid oxidation. Increased *postmortem* ageing decreased oxidative stability. It can be concluded that dietary BCPO enhanced muscle unsaturated fatty acids and quality attributes of LL muscle in goats.**

**Key Words – Drip loss, color, lipid oxidation**.

## I. INTRODUCTION

Recently, the consumption of ruminant meat has been implicated in the incidence of chronic diseases due to the imbalance in its fatty acid (FA) profile [1]. This necessitates the need to modify its FA to support the delivery of healthier and functional ruminant meat that responds to consumer needs. Dietary supplementation of unsaturated fat is an effective strategy for modifying the FA profile of ruminant meat [2]. However, dietary unsaturated fats could predispose the meat to lipid oxidation, which can affect the sensory quality, shelf life and nutritive value of meat [3]. Dietary supplementation of vegetable oils rich in antioxidants could suffice to manipulate the fatty acid profile of ruminant meat, prevent lipid oxidation and provide dietary antioxidants to human [3]. Given the established antioxidant contents of red palm oil and the polyunsaturated fatty acids and antioxidants contents of canola oil, we propose that a blend of red palm fruit oil and canola oil will enhance the beneficial FA in ruminant meat and stabilize such meat against oxidative damage. The objective of this study was to determine the effect of dietary blend of canola oil (80%) and red palm oil (20%) on FA composition, physicochemical properties and oxidative stability of *Longissimus lumborum* muscle in goats.

## II. MATERIALS AND METHODS

Twenty four Boer goats (4-5 months old, initial body weight of 20.54±0.47 kg) were randomly assigned to diets containing on a dry matter basis 0, 4, 8% BCPO and fed for 14 weeks following 2 weeks of adaptation. The animals were slaughtered according to the halal procedure. All analyses were conducted on *Longissimus lumborum* (LL) muscle. Muscle FA was determined by the method reported by Adeyemi *et al.* [4]. Physicochemical properties of LL muscle were determined as described by Sabow *et al.* [5]. Tocopherol and carotenoids were determined by the method of Adeyemi *et al.* [4]. The experiment followed a completely randomized design. The FA data were analyzed by the GLM procedure of SAS. Data obtained for the physicochemical properties, antioxidants and lipid oxidation were subjected to repeated analysis of variance. Means were separated using Tukey HSD test at significance level of $p<0.05$.

## III. RESULTS AND DISCUSSION

The LL muscle in goats did not exhibit differences in the proportion of all saturated fatty acids (SFA) among the diets (Table 1). This finding is consistent with that of Jerónimo *et al.* [2], who observed that various blends of soybean and linseed oils did not alter the short and medium chain FA in the polar, neutral and total lipids of LL muscle of lambs. The LL muscle of goats fed 4 and 8% BCPO had higher ($p<0.05$) C18:1 *trans*-11 Vaccenic, C18:3n-3 and C22:5n-3. This observation could be due to the increased intake of unsaturated FA in the diet of BCPO goats [6]. Similar increase in C18:3n-3 and its long chain derivatives following dietary supplementation of vegetable oil blends have been reported [2]. The increase in the concentration of total carotenoid, α and δ-tocopherol in LL muscle of goats fed 4 and 8% BCPO mirrored dietary antioxidant contents [4]. Both carotenoid and tocopherol are fat-soluble vitamins thus the presence of fat would enhance their absorption and deposition. This finding is consistent with that of Soler-Velasquez *et al.* [7]. The lack of significant effect of dietary BCPO on superoxide dismutase, catalase and glutathione peroxidase might be related to the level of antioxidant vitamins in the muscle. Increase in antioxidant enzyme (AOE) activities was observed in response to oxidative stress caused by high concentrations of dietary unsaturated fatty acids [3]. Thus, the higher vitamin E and carotenoid contents in the LL muscle of goats fed 4 and 8% BCPO substantiates their inability to invoke increase in AOE activities despite the increase in the n-3 PUFA. Dietary BCPO did not affect cooking loss, tenderness, yellowness and lightness of LL muscle. However, the LL muscle of goats fed 4 and 8% BCPO had higher ($p<0.05$) redness and lower drip loss compared to the control goats. This observation could be due to the higher antioxidant content in their muscle, which enhanced oxidative stability of lipid and proteins.

**Table 1** Effect of dietary BCPO on FA composition (% of total FA) and physicochemical properties of LL muscle in goats

| | Level of BCPO[1] | | | | Level of BCPO[1] | | | Storage days | |
|---|---|---|---|---|---|---|---|---|---|
| Parameter | 0 | 4 | 8 | Parameter | 0 | 4 | 8 | 1 | 7 |
| C16:0 | 23.3 | 21.7 | 23.4 | TBARS | 0.2$^{c}$ | 0.1$^{b}$ | 0.06$^{a}$ | 0.26$^{b}$ | 0.55$^{a}$ |
| C16:1n-7 | 2.5 | 2.6 | 2.0 | Carotenoid | 0.12$^{c}$ | 0.23$^{b}$ | 0.40$^{a}$ | 0.23$^{a}$ | 0.12$^{b}$ |
| C18:0 | 20.9 | 20.8 | 20.1 | α-tocopherol | 2.29$^{c}$ | 3.45$^{b}$ | 4.43$^{a}$ | 3.57$^{a}$ | 2.62$^{b}$ |
| C18:1n-9 | 23.7 | 23.4 | 22.9 | γ-tocopherol | 0.66$^{c}$ | 0.75$^{b}$ | 1.02$^{a}$ | 0.75$^{a}$ | 0.67$^{b}$ |
| C18:1*trans*-11Vaccenic | 1.2$^{b}$ | 2.4$^{a}$ | 3.2$^{a}$ | δ-tocopherol | 0.06 | 0.07 | 0.09 | 0.08 | 0.05 |
| CLA cis-9 *trans*-11 | 1.0 | 0.9 | 1.2 | GPX[2] | 90.52 | 81.50 | 72.64 | 84.71 | 75.22 |
| CLA cis-12 *trans*-10 | 0.9 | 1.0 | 1.3 | SOD[3] | 2.29 | 2.63 | 2.83 | 2.62 | 2.14 |
| C18:2n-6 | 12.3 | 12.4 | 13.4 | CAT[4] | 1772.1 | 1700.6 | 1680.4 | 1987.7 | 1801.9 |
| C18:3n-3 | 0.7$^{b}$ | 1.0$^{a}$ | 1.3$^{a}$ | CL | 32.1 | 29.4 | 32.6 | 30.9 | 33.3 |
| C20:4n-6 | 7.3 | 7.0 | 6.4 | DL | 7.0$^{a}$ | 5.6$^{b}$ | 5.1$^{b}$ | 5.9$^{a}$ | 1.5$^{b}$ |
| C20:5n-3 | 1.7 | 1.9 | 1.9 | SF | 1.0$^{a}$ | 1.1$^{a}$ | 0.9$^{a}$ | 1.1$^{a}$ | 0.8$^{c}$ |
| C22:5n-3 | 1.8$^{b}$ | 2.2$^{a}$ | 2.4$^{a}$ | L* | 32.3 | 33.1 | 31.8 | 32.2 | 34.4 |
| C22:6n-3, | 1.0 | 1.1 | 1.2 | a* | 12.9$^{b}$ | 14.3$^{a}$ | 15.5$^{a}$ | 12.6$^{a}$ | 11.0$^{b}$ |
| | | | | b* | 13.2 | 12.9 | 12.4 | 12.3 | 14.0 |

$^{a,b,c}$ means having different superscript along the same row are significantly different ($p<0.05$). [1]Blend of 80% canola oil and 20% palm oil. [1] = blend of 80% canola oil and 20% red palm oil. [2]GPx activity is expressed as nmoles NADPH oxidized /min/mg protein. [3]SOD activity is expressed as Units 50% mg protein. [4]Catalase activity is expressed as nmol. $H_2O_2$/min/mg protein. CL=cooking loss. DL=drip loss. SF=shear force. L=lightness. a*=redness. b*=Yellowness.

## IV. CONCLUSION

The current results demonstrated that dietary blend of 80% canola seed oil and 20% palm oil (BCPO) enhanced the omega 3 FAs, redness and oxidative stability and reduced drip loss of the LL muscle in goats.

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