Physical and chemical characteristics of lambs fed with different sunflower pie levels

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Abstract – The objective was to evaluate the effect of sunflower pie (SP) inclusion in the diet of lambs, on chemical and physical characteristics of meat. Thirty-six crossbred lambs with initial weight 21.5±0.27 kg were fed with the following experimental diets: 0 (control), 15, 30 and 45% inclusion of SP. Animals were slaughtered with average body weight of 43.6±0.18 kg. Moisture (M), crude protein (CP), ether extract (EE) and ash were determined in meat. The color was obtained by spectrophotometric colorimeter intensities with values for lightness (*L), redness (*a**) and yellowness (*b**). Cooking loss (CL) was performed by difference in weight before and after cooking, and shear force (SF) was measured in texturometer TA.XT2i. The experimental design was completely randomized and data were submitted for regression analysis. The pH values, CL and SF were not affected by SP levels, while the values of *L** and EE increased linearly with the increasing level of SP. There was a linear reduction in muscle moisture with the increasing levels of SP without changes in the values of CP and ash. The inclusion of SP in the feeding of sheep increased the intramuscular fat and decreased in moisture content.**

Key Words – nutrition, coproduct, meat

I. INTRODUCTION

Lamb meat is increasingly present in consumer table, gaining space due to its distinctive flavor. It must compete with traditional meats as pork, beef or poultry, by differentiation in quality [1]. The manipulation of nutritional and sensory quality of meat by the use of tools for animal nutrition have gained importance in recent years, as it is possible to obtain different meat products.

The growing demand for food that efficiently nurture each animal category, proposes the use of alternative foods that provide good animal performance and that reflect positively on characteristics of final product, in the case of lambs, meat [2,3].

The sunflower pie (SP) is an industrial byproduct that can be used in lamb feeding as an alternative source of protein and fat, and contains significant amounts of fiber. Byproduct of oil extraction from the seeds of sunflower, SP has high content of polyunsaturated fatty acids, mainly oleic and linoleic fatty acids and good acceptability by animals [3,4].

There are many studies evaluating the use of seeds of oilseeds and oils in diet of sheep and their influence on meat characteristics, but there are few studies that evaluated the use of the coproduct extraction rush of sunflower oil, this being sunflower pie. This study evaluated the effect of different inclusions of sunflower pie from agribusiness in the diets of lambs in feedlot, on the physical and chemical characteristics of the meat.

II. MATERIALS AND METHODS

The test was conducted in the Department of Animal Experiment, Department of Animal Science, Federal University of Lavras in the period of April-November 2013. All experimental procedures were approved by the Ethics Committee on Animal Use of Federal University of Lavras (protocol n° 105/12).

Thirty-six crossbred lambs with initial weight 21.5 ± 0.27 kg were divided among the following experimental diets: 0% (control), 15%, 30% and 45% of sunflower pie levels (Table 1). The diets were isocaloric and isonitrogenous (2.1 Mcal/kg dry matter (DM) and 18.0 % crude protein (CP), respectively), with roughage:concentrate ratio of 20:80.

The animals were weighed weekly until they reached average body weight (BW) of 43.6 ± 0.18 kg and age of 115 ± 4.9 days, when they were slaughtered. After 24 hours of cooling at 4°C, carcasses were weighed (22.3 ± 0.96 kg)

and *Longissimus dorsi* (0.660 ± 0.04 kg) were collected, vacuum-packaged and frozen at -20°C for later analysis.

Table1 Nutritional composition of the diets

Nutrient	Sunflower Cake (%)			
	0	15	30	45
DM (%)	94.9	95.3	95.4	95.7
CP (%)	18.1	18.4	17.7	17.4
EE (%)	3.0	5.0	7.0	8.9
NDF (%)	35.0	38.0	41.1	44.1
NFC (%)	37.1	32.2	27.3	22.5
ME (Mcal/kg)	2.8	2.7	2.7	2.6

DM: dry matter, CP: crude protein EE: ether extract, NDF: neutral detergent fiber, NFC: non-fibrous carbohydrates, ME: metabolizable energy

The samples of *Longissimus dorsi* were thawed at 4°C (overnight) for physical and chemical analysis. After bloom for 30 min at room temperature, color measurements were performed using a Minolta CM-700 (Konica Minolta, Japan). A total of 3 readings were taken on each steak and averaged to obtain lightness (*L**), redness (*a**) and yellowness (*b**). On the same samples, pH was measured using a Jenco 6009 meter with temperature compensation and an Ionode IJ42 spear electrode, with the electrode inserted into the muscle *L. dorsi*. The electrode was calibrated in buffers at pH 4.0 and 7.0.

Cooking loss (CL) was measured as the difference of the weight before and after cooking on a grill, until the internal temperature of the steaks reached 72ºC. The shear force was measured in samples used to assess CL, where six slices of 1.0 cm^2 were taken, cutting parallel to the longitudinal axis of the muscle fibers with the aid of a mold and sheared in a texturometer TA.XT2i (Stable Micro System Inc.) with Warner – Bratzler V-shaped cutting blade.

Uncooked samples of the muscle *L. dorsi* were lyophilized and moisture (M), crude protein (CP), ether extract (EE) and ash, were determined following the AOAC (1990). CP was quantified by the Kjeldahl method, the EE was extracted by Soxhlet method and ash in the oven at 600ºC.

The experimental design was completely randomized, with four treatments and nine repetitions. Data were submitted for regression analysis, using do PROC REG do SAS.

III. RESULTS AND DISCUSSION

The pH values were not affected by different levels of SP inclusion in the experimental diets(Table 2). The values observed indicate that glycogen levels available [5] in muscles at slaughter were satisfactory to allow optimal final pH.

Table 2 Physical characteristics of the *Longissimus dorsi* of lambs fed with control and different sunflower pie levels

Item	Sunflower Pie (%)				SE	*P*
	0	15	30	45		
*L**[a]	37.6	37.2	37.9	38.8	0.89	0.005
*a**	21.6	21.2	20.9	20.8	1.41	0.17
*b**	13.2	13.1	13.2	13.5	0.09	0.87
pH	5.57	5.57	5.60	5.57	0.04	0.80
CL	21.5	21.9	20.2	20.8	2.59	0.30
SF	3.8	4.0	3.5	3.9	0.67	0.60

[a] $\hat{y} = 36.87 + 0.41x$ ($R^2 = 0.21$)

*L**: luminosity, *a**: redness, *b**: yellowness, CL: cooking loss (%), SF: shear force (kgf), SE: standard error of the mean.

The pH is directly related to the color, tenderness and water holding capacity of the muscle; when post mortem pH values are higher than 6.0, this may be indicative of Dark, Firm and Dry (DFD) meat. In the present study, there were no differences in the values of shear force, and the average value obtained for each treatment was according with the recommendations for meat to be considered soft [6]. These results are in agreement with Santos-Silva [7], who found no variations in pH and meat tenderness when lambs were fed with sunflower seed. No differences were observed for cooking loss (CL) among experimental diets.

The *a** and *b** values were not affected by sunflower pie level, however lightness (*L**) showed a linear increase with the inclusion of the coproduct in the diets (Table 2). This result may be associated with increasing intake of ether extract (EE), obtained with the inclusion of sunflower pie in the diets, which presented about 15 % EE in its chemical composition. The inclusion of industrial byproduct in the diet resulted in increasing levels of EE in muscle (Table 3), which is the component that has the highest effect on lightness when compared to other chemical compounds of meat [8]. Fat plays a fundamental role in the production of lamb, as production efficiency,

precocity, cuts, tenderness and juiciness of the product are related to the amount and location of fat deposition.

In all treatments the *L** values remained above 34, not featuring dark flesh [9]. *b** values did not vary in relation to the contents of sunflower pie, being *b** directly correlated with the presence of carotenoids derived from the diets[10], which may indicate the presence of these organic compounds in sufficient amounts in all experimental diets.

Table 3 Chemical characteristics (% muscle) ribeye of lambs fed with control and sunflower pie levels

	Sunflower Pie (%)				SE	*P*
	0	15	30	45		
M[a]	73.1	72.9	72.6	72.1	0.44	<0.001
CP	21.1	20.9	19.8	21.9	1.71	0.74
EE[b]	4.5	4.5	5.0	5.4	0.41	<0.001
Ash	1.2	1.2	1.2	1.2	0.08	0.31

[a] $\hat{y} = 73.55 - 0.34x$ ($R^2 = 0.44$)

[b] $\hat{y} = 4.09 + 0.29$ x ($R^2 = 0.39$)

M: moisture, CP: crude protein, EE: ether extract, SE: standard error of the mean

There was no significant difference in the crude protein (CP) in meat (Table 3). This result may be due to the fact that the protein is a major organic component of the meat, which additionally undergoes less variation [11], with levels around 20% in fed, as observed in this study (20.97%). For contents of ash in the meat there are no variations among treatments, then this result does not confirm the premise that in terms of chemical composition, ash exhibit behavior inversely proportional to the EE in meat [12]. Moisture reduction was observed in the muscle, as a function of increasing coproduct inclusions, which can be explained by the increased deposition of intramuscular fat, confirmed by significant increase in the meat content of EE (Table 3).

IV. CONCLUSION

The use of sunflower pie in feeding of lambs in confinement increases the deposition of intramuscular fat and reduces moisture content.

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