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Substituição total da soja por grãos de crambe e canola na alimentação de ovinos terminados

Total replacement of the soybean by crambe and canola grains in the feeding of finishing sheep

Reemplazo total de la soya por granos de crambe y canola en alimento para ovejas terminado

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Resumo

Foi proposto verificar o efeito da substituição total da soja por grãos de canola e crambe na dieta de cordeiros mestiços, a fim de avaliar as características químicas, instrumentais e sensoriais da carne dos animais alimentados sob esses grãos. Foram utilizadas 23 amostras do músculo Longissimus lumborum, oriundos de cordeiros SRD (sem raça definida), machos não castrados, com idade média de 70 dias, peso corporal inicial médio de 20,0 ± 4,0 kg. Dos 23 animais utilizados, sete foram destinados para dieta com grão de soja, oito com grão de canola e oito com grão de crambe. O delineamento foi inteiramente casualizado possuindo como fator avaliado à substituição total (100%) do grão de soja moído considerado controle (GSO) pelo grão de canola moído (GCA) e grão de crambe moído (GCR). Os dados da análise sensorial foram submetidos à Análise de Componentes Principais e as análises centesimal e instrumental foram testadas em contrastes ortogonais em relação aos diferentes grãos. A ração fornecida foi na forma de dieta completa, com 75% de concentrado e 25% de volumoso (feno de *Brachiaria brizantha* cv *Piatã hay*). Os resultados apresentaram maior teor de umidade na carne de animais alimentados com canola, bem como nas características instrumentais (perda de cozimento e intensidade do vermelho). Para as demais características, não houve efeito. A análise sensorial mostrou que os provadores preferiam a carne de animais alimentados com

grãos de soja e canola, apontando para o potencial de mercado. Grãos de canola e crambe podem substituir a soja na dieta de cordeiros terminados em confinamento, sem afetar as características centesimais, instrumentais e principalmente sensoriais da carne, contribuindo como uma nova alternativa de grãos na produção animal.

Palavras-chave: Aroma; Carne; Óleo; Ração; Sabor.

Abstract

It was proposed to verify the effect of the total substitution of soy by canola and crambe grains in the diet of crossbred lambs, in order to evaluate the chemical, instrumental and sensory characteristics of the meat of the animals fed under these grains. Twenty-three samples of the Longissimus lumborum muscle were used, from SRD lambs (mixed breed), non-castrated males, with an average age of 70 days, average initial body weight of 20.0 ± 4.0 kg. Of the 23 animals used, seven were destined for soybean diet, eight with canola grain and eight with crambe grain. The design was completely randomized with the factor evaluated as the total replacement (100%) of the ground soybeans considered control (GSO) by ground canola beans (GCA) and ground crambe beans (GCR). The sensory analysis data were submitted to Principal Component Analysis and the centesimal and instrumental analyzes were tested in orthogonal contrasts in relation to the different grains. The ration provided was in the form of a complete diet, with 75% concentrate and 25% roughage (*Brachiaria brizantha* cv *Piatã hay*). The results showed a higher moisture content in the meat of animals fed with canola, as well as in the instrumental characteristics (loss of cooking and intensity of red). For the other characteristics, there was no effect. The sensory analysis showed that the tasters preferred the meat of animals fed with soy and canola grains, pointing to the market potential. Canola and crambe grains can replace soy in the diet of lambs finished in feedlot, without affecting the centesimal, instrumental and mainly sensory characteristics of the meat, contributing as a new grain alternative in animal production.

Keywords: Aroma; Feed; Flavor; Meat; Oil.

Resumen

Se propuso verificar el efecto de la sustitución total de la soja por granos de canola y crambe en la dieta de los corderos cruzados, con el fin de evaluar las características químicas, instrumentales y sensoriales de la carne de los animales alimentados con estos granos. Se usaron 23 muestras del músculo Longissimus lumborum, de corderos SRD (raza mixta), machos no castrados, con una edad promedio de 70 días, un peso corporal inicial promedio de

20.0 ± 4.0 kg. De los 23 animales utilizados, siete estaban destinados a una dieta de soya, ocho con grano de canola y ocho con grano de cangrejo. El diseño fue completamente al azar con el factor evaluado como el reemplazo total (100%) de la soja molida considerada control (OSG) por frijol de canola (GCA) y frijol molido (GCR). Los datos del análisis sensorial se sometieron al análisis de componentes principales y los análisis centesimales e instrumentales se probaron en contrastes ortogonales en relación con los diferentes granos. La ración proporcionada fue en forma de una dieta completa, con 75% de concentrado y 25% de forraje (heno Brachiaria brizantha cv Piatã). Los resultados mostraron un mayor contenido de humedad en la carne de los animales alimentados con canola, así como en las características instrumentales (pérdida de cocción e intensidad del rojo). Para las otras características, no hubo efecto. El análisis sensorial mostró que los catadores preferían la carne de animales alimentados con soja y granos de canola, lo que indica el potencial del mercado. Los granos de canola y crambe pueden reemplazar la soya en la dieta de corderos terminados en corrales de engorde, sin afectar las características centesimales, instrumentales y principalmente sensoriales de la carne, contribuyendo como una nueva alternativa de granos en la producción animal.

Palabras clave: Aceite; Alimento; Aroma; Carne; Sabor.

1. Introduction

Several are the facts capable of interfering in the characteristics physical, chemical and instrumental of the ovine meat, as well as, pass to the muscle some sensorial attributes. Breeding and food are the most commonly modified aspects, and their handling is an important justification when testing various food sources.

The demand for gourmet products (differentiated) and for plus properties with potential nutraceuticals has been gaining market, and for the production ovine meat both to attend the consumption and to offer a differentiated and quality product, changes are required in its production system and adjustments of diets that contribute to this. However the flavor and the extent to which the intensity of the flavor is modified depends on the diet provided to the animal, such as forage and grains consumed, seeking better product quality (Gkarane et al., 2018).

Besides committing to produce quality meat, the search for this food has as animal welfare practices are essential. With this, we identified the need to intensify confined production for a better carcass yield, the evaluation of flavor and flavor of the food as a

logistics that allows the production of ovine productive productivity. This kind of raising requires a bigger investment in facilities, food, and labor. One of the ways to make the system feasible is to use formulated feeds with alternative foods available regionally. Most of these alternatives have a high potential for partial or total substitution of corn and soybeans in the formulations, in order to reduce the costs of feed and, thus, the final product, since its average contribution to the costs of production varies from 60 to 90% depending on the operation (Soares, et al., 2012).

Among the different types of possible oilseeds to be fed to ruminants, soybean (Glycine max Merill) stands out for its availability in Brazil and the protein and energy content, however, its production competes with human food. Other oleaginous with potential for use in animal nutrition including in sheep production is canola (Brassica L. napus), which can be included in the diet in grain form or industrial byproducts it has on average of 23-25% protein and 30-50% of lipid. There is still the option for crambe (Crambe H. abyssinica) of the Brassicaceae family, it is an exotic plant in Brazil where it had the beginning of its cultivation in the 90 by researchers from Fundação Mato Grosso do Sul, and the main characteristics, the crambe features a high concentration of protein and oil, knowing that the amount of oil equivalent to ± 35% (MS Foundation, 2010).

Cambre and canola other than soy do not compete directly in human food, since cambre oil is widely used as an industrial lubricant and its oil is not edible. Canola is an original crop of rapeseed (Brassica campestris and Brassica napus) that has a great potential as a protein source (Galdioli et al., 2002), despite having a lower biological value than soybean. These two foods have a satisfactory chemical composition and a lower market value than soy, they have been seen as promising substitutes for soy in animal feed.

In the literature, we found several studies looking for changes in the diet of ruminants and thus improving the quality of meat. However, most research using crambe and canola aimed to improve the fatty acid composition of meat, among other forms of processing, supply and evaluated parameters (Goes et al., 2019; Nguyen et al., 2018; Goes et al., 2018; Asadollahi et al., 2017; Santos et al., 2009) however, little is known about the effect of these foods on meat quality, instrumental characteristics of chemical composition and sensory parameters of sheep. Therefore, the objective of this study was to evaluate the effect of the total substitution of soy by canola and crambe grains in the diet of confined lambs, evaluating the quality of the meat, instrumental characteristics of the chemical composition (moisture, ash, proteins and lipids) (pH, water retention capacity, loss of cooking, resistance to shear and color) and sensory parameters of sheep fed potential soy substitutes.

2. Methodology

The experiment was conducted at the Experimental Station Sheep Production Department, the Animal Nutrition Laboratory and Meat Technology Laboratory of the Universidade Federal da Grande Dourados - Mato Grosso do Sul, from October until December of 2012. This experiment is according to the rules of the Ethics committee on Animal Use in this institution, as approval number 021/2012 - CEUA / UFGD.

Were used 23 samples of the Longissimus lumborum muscle, coming from UB lambs (undefined breed), uncastrated male with an average age of 70 days, the average initial body weight of 20.0 ±4.0 kg. Of the 23 animals used, seven were designated for a diet with soybean, eight with canola grain and eight with crambe. The experiment lasted 84 days with 14 days of adaptation to the diets, management, and facilities. The other 60 days was to confine itself.

The animals were distributed in a completely randomized design (CRD) having as an evaluation factor the full substitution (100 kg kg-1) of ground soybean as the control (GSO) by the ground canola seed (GCA) and ground crambe (GCR).

The feed was supplied as a complete diet, 75 kg kg-1 concentrate and 25 kg kg-1 roughage (Brachiaria brizantha cv. Piatã) mixed at the time of feeding, divided into two daily meals (8:00 and 16:00) ensuring the voluntary consumption allowing a surplus of 10 kg kg-1 adjusted daily and water ad libitum. Diets were formulated to supply 14 kg kg-1 crude protein (CP) according to NRC (2007) (Table 1).

The chemical composition of ingredients (Table 1) was made for determination of dry matter (DM) method 967.03 (AOAC, 1990) mineral matter (MM) method 942.05 (AOAC, 1990), crude protein (CP) method 981.10 (AOAC, 1990), ether extract (EE) method 920.29 (AOAC, 1990).

Table 1. Values for inclusion in (kg) of the feed ingredients in their natural matter (NM) and chemical composition of the ingredients of sheep diets terminated by the soybean, crambe, and canola.

Food	GSO[2]	GCA[3]	GCR[4]
	Kg Kg^{-1} Natural Matter		
Hay[1]	20.00	20.00	20.00
Ground Soy Bean	18.00	0.00	0.00
Grain ground Canola	0.00	20.00	0.00
Grain ground Crambe	0.00	0.00	26.00
Corn	57.40	55.40	49.40
Soybean meal	2.50	2.50	2.50
Urea	0.10	0.10	0.10
Mineral mixture[7]	2.00	2.00	2.00
The chemical composition of the diet (g kg^{-1} DM[5])			
Crude protein	133.40	154.00	111.70
Ether extract	55.70	85.70	108.50
Mineral mixture	59.80	92.60	55.30
Neutral Detergent Fiber	715.60	709.30	680.70
Acid Detergent Fiber	160.90	176.30	195.70
Carbohydrates totais	751.40	667.70	724.50
Digestible Nutrients Totais[6]	762.00	814.00	780.00

1Hay = Brachiaria cv Piatã; 2GSO = soybeans; 3GCA = Canola grain; 4GCR = Crambe Grain; DM 5 = Dry matter; 6Values equations estimated by the NRC (2007) 7 Mineral= 45 g kg-1 P, 60g kg-1 Ca, , 38,9 mg kg-1 Co, 4120 mg kg-1 S, 1050 mg kg-1 Cu, 1300 mg kg-1 Fe, 1000 mg kg-1 Mn, 9 mg kg-1, 2520 mg kg-1 Zn, 450 mg kg-1 F. Source: Authors.

For the analytical determination of neutral detergent fiber (NDF), acid detergent fiber (ADF) used the method of Van Soest et al. (1991).

The slaughtered were performed after the 16-hour fasting where the animals were referred to the stunning platform by stunning with electric discharge in the atlanto-occipital region, followed by bleeding with an incision in the carotid artery and jugular vein, skinning, and evisceration.

The carcasses were then sectioned and then the loin (*Longissimus lumborum*) left of each animal were dissected, vacuum packed (to prevent oxidation), labeled and frozen in a freezer (-20 °C) for later analysis.

The defrosting process was in temperatures between 4 and 8 °C for a period of 48 hours. Subsequently L. thoracic the gluteus and biceps cuts were separated proximate to perform the analysis, and sensory instruments, respectively.

For the analysis of the chemical composition, and sensory profile of fatty acids, used, the left back of each animal. The determination of the moisture analysis, ash and crude protein were performed according to AOAC (2000) and determining the content and the lipid extraction was performed according to the method of Folch et al. (1957).

For determination of color, shear force and cooking losses of meat used the right of each animal's back. In determining the cooking losses, it was performed by cutting cubes of 25 mm x 25 mm measured with a digital caliper according to Felício methodology (1999). The texture of the meat was measured by sheer force, according to the methodology of Purchas & Aungsupakorn (1983).

The color was determined after thawing (at 4°C refrigerator for 12 h) exposure to the atmosphere, and 30 min before reading (myoglobin oxygenation). The measurement was made using a colorimeter (Minolta CR 10), using the CIE L* system, a*, b*, determining the parameters L* - brightness, a* - red index and b* - yellow index (Miltenburg et al., 1992).

According to the methods and Cañeque Sañudo (2000), water holding capacity (WHC) was obtained by a difference between the weights of the meat sample.

Evaluating the samples sensory methodology applied overall acceptance test analysis (CAA) as Faria & Yotsuyanagi (2002). The panel was composed of 90 persons of both genders. The group has been previously instructed according to the methodology of Stone et al. (1974).

The tests were carried out in individual cabins, under controlled temperature and lighting. In each session were sampled 2 roast beef cubes from each treatment, coded with random three-digit numbers, following the balancing position of the sample proposed by Macfie et al. (1989).

The experimental design was a randomized (DIC) with orthogonal contrasts which were used to determine the effect of the treatments. The initial weight of the animals was used as a covariate in the statistical model when significant. Data for sensory analysis showed homogeneity of variances the Levene test and applied still the Principal Component Analysis (PCA) for a better understanding. Significance was declared when $P < 0.05$.

3. Results

The lamb's meat fed with different oilseeds found no effect (P> 0.05) compared to the average proximate variables (ash, protein and lipid) except for moisture (Table 2), where it presented significant (P> 0.05) on the contrasted treatments grains of canola and crambe.

Table 2. Composition of Longissimus muscle proximate of confined lambs fed with canola, crambe and soybeans grain.

Variable (g kg^{-1})	Soy	Canola	Crambe	CV[1]	P Value *	
					C1[2]	C2[3]
Moisture	701.8	694.6	642.2	7.15	0.0947	0.0217*
Ashes	13.0	12.7	15.7	27.57	0.4903	0.1214
Protein	240.8	242.5	295.9	27.10	0.3730	0.1359
Lipids	64.3	69.9	72.7	13.80	0.1123	0.5584

* = Significant at α = 0.05 probability; CV1 = coefficient of variation (%). C12 (contrast 1) = Soybean x (Canola+ Crambe). C23 (contrast 2) = Canola x Crambe.

Among the instrumental determination of sheep meat (Table 3) was no effect (P> 0.05) on pH, shear force, and yellow light intensity of Longissimus muscle of confined animal fed with canola, crambe and soy grain. However, was observed that the cooking losses (PPC) were higher (P <0.05) when comparing treatments to crambe and canola grains.

The water retention capacity in the Longissimus muscle found no difference (P> 0.05), but these values are higher than those reported by Faustman et al. (2010), of 54.46 % and 60 %.

Table 3. Composition of Longissimus muscle instrumental lambs fed with soybeans canola and crambe grain.

Variables					P Value*	
	Soy	Canola	Crambe	CV[1]	C1[2]	C2[3]
pH[4]	5.65	5.63	5.63	0.75	0.2583	0.9548
WRC [5] (g kg^{-1})	772.55	787.0	791.3	5.95	0.4536	0.8603
Cooking losses (g kg^{-1})	344.7	348.7	396.8	11.65	0.0960	0.0153*
Shear force (kgf)	1.90	1.81	2.42	38.25	0.5572	0.1285
Luminosity	39.97	38.15	40.02	10.22	0.6411	0.3741
Red intensity	16.74	16.95	15.36	8.60	0.3181	0.0207*
Yellowness	8.15	8.05	8.07	17.56	0.8918	0.9788

* = Significant at α = 0.05 probability; 1CV= coefficient of variation (%). 2C1 (contrast 1) = Soybean x (Canola + Crambe). 3C2 (contrast 2) = Canola x Crambe. 4pH: hydrogen potential. 5WRC = Water retention capacity. Source: Authors.

The average shear force exhibited by the animal sirloin samples (Table 3) indicated that the meat of the present study animals can be considered soft, according to values presented by Bulent et al. (2010), pointing out that the age at slaughter may interfere in shear force.

The L* parameter measured color (brightness level) and b* (yellowness) showed no differences (P> 0.05) between diets. However, for the red content (a*) was a different effect (P <0.05) when comparing the crambe and canola grains. (Table 3).

The data from the socioeconomic survey and sensory attributes were grouped into seven factors and although only 76.27 % of the information used was sufficient to evaluate the total number of samples analyzed (Table 4). From type seven to debt, a 15 % tipping, resulting in a decrease of the accumulated variance among the variables, that is, decreased ± 15 % of the explained value. Reducing the size to five variables, ie a measure that increases the number of variables for the variables that make up factor seven, increases the variance Cumulative values % and their eigenvalues, but as total values of inverse behavior, decrease their asymmetry in relation to the total and the level of risk protection by the correlations. The list of occurrences of the data set, we can expect that the proportion of 75 % of its data is equal to that of the data, the remaining 25 % of the components being less than the random variation. The last three years and four do not explain at least 70 % (percentage required for a good response) of the data variance, are the most stable clusters of the analysis.

Table 4. Eigenvalues and percentage of the total and cumulative variance for grouped factors in its main components on the socioeconomic and sensory evaluations performed on lambs fed canola grain, crambe and soybeans.

Factors	Eigenvalues	Total variation	Cumulative Variance (%)
1	2.58	19.92	19.92
2	1.54	11.88	31.18
3	1.48	11,45	43.26
4	1.33	10.24	53.51
5	1.06	8.21	61.73
6	0.95	7.33	69.06
7	0.93	7.20	76.27

Source: Authors.

Observing that the values on the commonality of factors (Table 5), performed generally of low and medium quality on the explanation of the data. The correlations showed emphatically explaining some variables of sensory analysis.

The one factor explains 19.92% of the total variance having a correlation with variables connected preferably by meat from animals fed canola and soybean, as well as with the purchase of meat preferably of above (Table 5).

Table 5. Correlation coefficients (r) between the variables related to a socioeconomic questionnaire and grouped factors on the evaluations performed on lambs fed canola grain, crambe and soybeans.

Variables	Factors						
	1	2	3	4	5	6	7
kind of consumption carnea	0.14	-0.16	0.04	0.39*	0.33*	0.12	0.70*
Consumption frequency meat	0.01	-0.53	-0.12	-0.11	0.22	0.38*	0.29*
Place of purchase	-0.24	0.00	0.09	0.21	0.63*	0.17	0.16
Already consumed lamb	0.28	0.21	0.01	0.27	0.09	0.17	0.21
Preference lamb meat (ACA) [1]	0.37*	0.29*	0.29*	0.00	0.21	0.12	0.00
Satisfaction scale	0.24	0.02	0.09	0.40*	-0.45	-0.01	0.35*
Purchasing preference	0.37*	0.35*	0.17	-0.10	0.23	0.36*	-0.03
Preference lamb (ACR) [2]	0.16	0.10	-0.64*	0.11	0.13	-0.10	-0.21
Satisfaction scale	0.11	-0.31	0.04	0.46*	-0.19	0.55*	-0.19
Purchasing preference	0.28	0.16	-0.57	0.20	0.02	0.10	-0.03
Preference lamb (AS) [3]	0.38*	-0.44	0.03	-0.14	0.14	-0.15	0.07
Satisfaction scale	0.17	-0.03	0.30*	0.47*	0.10	-0.32	-0.34
Purchasing preference	0.43*	-0.28	0.02	-0.05	0.20	-0.39	0.06

1ACA: fed canola, 2ACR: Fed Crambe, 3AS: Fed soybeans. (*) Variables that showed correlations (r) significant within each factor. Source: Authors.

It was observed that 30% of the analysts liked andvery much meat obtained from the diet based on canola and soya beans (Table 6). However, by observing the flesh of animals that consumed diet crambe grain-based only 19.40% of the tasters had a preference for this product, which confirms the r = -0.64 linked to the seven factors of the group regarding infringement the product of these animals. These percentages reflected directly in preference to purchasing these consumers were 74.49 and 60.20% chose to acquire coming from diet products based on canola and soybean, respectively.

Table 6. Relative frequency of comments on the preference and hedonic scale purchase of the product lamb grains fed canola, crambe, and soybeans.

Description	Hedonic scale				Refusal to purchase	
	1	2	8	9	Yes	Not
Lamb meat fed with Canola	3.1	31.6	2.0	1.0	74.49	25.51
Lamb fed crambe	4.1	15.3	3.1	5.0	51.02	48.98
Lamb meat fed with soybean	7.1	23.5	3.1	6.0	60.20	39.80

Source: Authors.

There was from the analysis of the first three major factors a tendency for predilection in satisfaction of tasters for meat obtained from animals fed with canola-based diet.

Table 7. Attributes determined in relation to the scale of satisfaction of tasters compared to meat from sheep fed with grains of canola, crambe, and soybeans.

Satisfaction scale	Attributes				
	Appearance	Odor	*Flavor*	Succulence	Softness
Lamb meat fed with Canola	6.12	1.02	57.15	8.16	27.55
Lamb fed crambe	7.14	5.10	58.16	10.20	19.40
Lamb meat fed with soybean	10.20	12.25	55.10	7.15	15.30

Source: Authors.

The five-factor is released on the issue of purchase, regardless of the predilection of meat or more consumed. This item has been structured with the main points of purchase of meat and can thus see that about 60% of the tasters centered their views and prefer to buy meat at the supermarket.

4. Discussions

The determination of moisture is an important measurement and routinely used in food analysis since it is related to the quality, stability, composition, may also affect the storage, packaging, and processing of the meat product. Its influence extends from the meat quality, juiciness, texture, color, and flavor, as in the processing that it will suffer. Furthermore, the water present in the muscle exerts influence on carcass and meat sensory characteristics as moisture retained in the muscle and affect the characteristics mentioned above interfere with

softness, important sensory evaluation (Francisco et al., 2015).

The sheep muscle has a microstructure in its robe with little porosity forming a kind of capillary network allowing water retention in its structure. Therefore, it can be considered that the capillary network of connective tissue surrounds the fibers of the animals treated with canola grain and crambe retains less ($P<0.05$) moisture that animals are fed with the soybean which tends to retain more ($P>0.05$) percentage of humidity, consequently improves the qualitative and sensory aspects of meat.

By working with lambs fed on forage to concentrate ratio of 60:40, Ibihi et al. (2018), humidity values obtained for fresh beef of 0.75 g kg-1, values close to the percentage of humidity to the fresh beef animals in this study were feedlot finished with different grains.

Moisture, quickly released by chewing and intramuscular juice which is released by the serum, is responsible for one form of succulence, the other is by the stimulant effect of fat on the salivary flow. The last is responsible for the final sensation of dryness in the flesh of young animals without or with low fat. The meat of good quality is more succulent due, in part, to the content of intramuscular fat, being considered one of the determinants of succulence (Monte et al., 2012). In the chewing process, moisture is released, and it is also considered a determinant of juiciness and intramuscular fat (Henchion et al., 2014). Although the lipid content did not obtain a difference ($P>0.05$), the humidity related to its significance could be related to the fat content deposited in the muscle, since with diets containing higher energy densities (oilseed grains effects) common finding of increased intramuscular fat deposition. In the muscle, since with diets containing higher energy densities (oilseed grains effects) common finding of increased intramuscular fat deposition.

Evaluating the humidity difference between cooking losses compared to roast raw meat Monte et al. (2012) found that moisture differ ($P<0.01$) among the treatments studied, a lower value for the roast beef (0.570 g kg-1) compared to fresh beef (0.740 g kg-1), a fact justified by the high temperature (170 °C) for the preparation of the meat, causing losses cooking 0.352 g kg-1.

Cooking is a process carried out with heat transfer, providing food with physical, chemical and structural changes. The nutritional value of meat, including levels of protein, fat, ash and dry matter, can be changed according to the forms of heat transfer, the temperature, the duration of the process and the cooking medium to which it will be subjected. This occurs due to the loss of nutrients and water during the process (Pinheiro et al., 2008).

The weight loss per cooking is characterized as an important parameter of evaluation

of the quality of the meat. It is associated with yield in the preparation for consumption and influences the juiciness of the meat. There was an effect (P>0.05) on the characteristic losses by cooking, where values of 0.348 g kg-1 were found for meat from animals fed with canola and 0.396 g kg-1 for meat from animals fed with crambe (Table 3). Of water was lost during the cooking process 34 to 39%, both by evaporation and by dripping. According to Pardi et al. (2001), the fat present in the meat is solubilized by heat, which is also recorded as a baking loss, but in this study, no differences were found in the lipids present in muscle fibers. Hopkins (2011), reported that higher PPCs in sheep meat resulted from higher amounts of fat present in tissues, possibly because in addition to moisture, some of the fat in the meat is lost through thermal processing.

Seabra (2016) found an increasing quadratic effect for meat from the animals that had the inclusion of canola and crambe seeds in their diets during the days of storage of the products, where the median values ± 32.86% were found to diet of animals fed with canola grains and ± 36.21% for animals consuming diet crambe grains, respectively. Peixoto et al. (2011) evaluated the lamb meat from different genotypes and found values for PPC 32.02% and 35.05%, similar to those found in diets with crambe and canola in this study.

According to Bressan et al. (2007), sheep meat the presents average values from 31.36 to 38.0 for L * values close to that found in this work, and 3.34 to 5.65 for b * values lower than found in this work.

In general, the consumer's first contact with the product is the visual presentation in which color and appearance stand out. Each product has a desired appearance and color that, associated with people's reactions, can be accepted or rejected (Oliveira, 2016). Costa et al. (2011), describes that color plays an important role in the sensory quality of the meat and stands out as the main factor of consideration when buying. Typically, the color of the meat is determined by the concentration of total myoglobin (a protein involved in muscle oxygenation processes) and by the relative proportions of this pigment in muscle tissue, which can be found in the form of reduced myoglobin with purple coloring, oxymyoglobin of bright red color and metmyoglobin, usually brown.

There were differences (P>0.05) for the red content (a *), it has several hypotheses due to decline to the meat of the animals receiving crambe grain in the diet, animals may be slaughtered by young or anti-nutritional factors crambe grain. According to Dhanda et al. (2003); Kannan et al. (2003) and Santos et al. (2008) found the more intense color, i.e., higher deposition and concentration of the pigment in the Longissimus muscle myoglobin in older sheep or with greater weights. According to Gois et al. (2017) the meat presents a more

intense color with the animal's development, since the concentration of myoglobin pigment in the Longissimus muscle increases with age.

It is notable that the color is the most obvious freshness and quality index for the consumer. Usually, dark meats are rejected by the buyer, which links these to the old meat or derived from mature animals, so hard flesh. However, this association is not always true, for animals slaughtered with little glycogen reserves do not reach pH low enough to produce normal colorings, regardless of age and softness. Several factors can determine the effective drop in pH, among these we highlight the power, race, and age of the animal (Garcia et al., 2013).

For sensory analysis, the process of multivariate analysis of factors extraction as main components is presented the most appropriate for the original variables according to Zanqueto & Pizzolato (2006). Grouped factors have the task of explaining the correlations between the original variables where the analysis of each factor is usually made on the basis of presented correlations between the factor and the variables that compose it. To find the variance of ± 76.27% explained for seven factors extracted from the accumulated variance in relation to the total sample variance (Table 4). From the fifth factor, the increase in rates of representation of data variance is smaller and take values that contribute less to the analysis, as described by Hair et al (2005). This usually happens because it is untrained which increases the variety of results, and the samples are of a product considered enigmatic in their sensory characteristics.

In the case of odor and flavors characteristic of ovine meat, these can be originated from substances present in the foods that make up the animal diet, being deposited in the tissues through ingestion of them (Costa et al., 2009). The lipids present in the meat, which are mostly saturated, when oxidized, can cause changes in taste, color, and odor, affecting the consumer's acceptance of this product and although sheep meat generally does not have a high content of unsaturated lipids is also susceptible to the process of oxidation, mainly by the presence of metallic ions such as iron and non-heme (Lima Junior et al., 2013). This corroborates the description by Fausttman et al. (2010), which confirms that lipid oxidation contributes to the formation of unpleasant flavors (off-flavors), consequently influencing the quality of the final product.

Seabra (2016), when evaluating the presence of fatty acids in different periods of storage of meat from sheep fed with canola, crambe and soybean grains, found the presence of behenic acid (C22:0) only in sheep meat from the animals that received a diet containing crambe, what characterizes a transformation or biohydrogenation in the rumen coming from other fatty acids. However, the fatty acid in question may be responsible for imparting odor

and taste that would be of less interest to the testers since, in their composition, they are ± 5% erucic acid and ± 3 mg / g glucosinolate. Nevertheless, the meat of the animals that fed the crambe grain had a higher concentration of monounsaturated fatty acids (C18:1), or even the total lipid content because it was slightly above the 5% stipulated to be meat lean, according to Menezes Junior et al. (2014), these facts may have transmitted the different and not pleasant taste and smell to this product as described by the panel of tasters.

5. Final Considerations

The meat of animals that received the diet with soy beans and canola, showed greater preference by the tasters in the sensorial analysis, presenting potential for the market. It can be seen that canola and crambe grains completely replace soybeans in the diet of confined lambs, without major changes in the qualitative and sensory characteristics of the meat. Therefore, new work with oilseed grains to replace soybeans should be carried out with the aim of improving producer and consumer acceptability and contributing as a new alternative for grains in animal production.

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