



Acta Scientiarum. Animal Sciences

ISSN: 1807-8672

Editora da Universidade Estadual de Maringá - EDUEM

Alves, Karine Regina; Silva, Leandro das Dores Ferreira da; Ribeiro, Edson Luis Azambuja;
Guerra, Geisi Loures; Paiva, Fernando Henrique Pereira de; Henz, Éderson Luis
Carcass characteristics, meat quality, feeding behavior of Nelore heifers fed diets containing sunflower pie
Acta Scientiarum. Animal Sciences, vol. 38, no. 2, 2016, April-June, pp. 183-190
Editora da Universidade Estadual de Maringá - EDUEM

DOI: <https://doi.org/10.4025/actascianimsci.v38i2.30183>

Available in: <https://www.redalyc.org/articulo.oa?id=303159348010>

- How to cite
- Complete issue
- More information about this article
- Journal's webpage in redalyc.org

EDUEM
redalyc.org

Scientific Information System Redalyc

Network of Scientific Journals from Latin America and the Caribbean, Spain and Portugal

Project academic non-profit, developed under the open access initiative



Carcass characteristics, meat quality, feeding behavior of Nelore heifers fed diets containing sunflower pie

Karine Regina Alves¹, Leandro das Dores Ferreira da Silva^{2*}, Edson Luis Azambuja Ribeiro², Geisi Loures Guerra¹, Fernando Henrique Pereira de Paiva¹ and Éderson Luis Henz¹

¹Programa de Pós-graduação em Ciência Animal, Universidade Estadual de Londrina, Londrina, Paraná, Brazil. ²Departamento de Zootecnia, Universidade Estadual de Londrina, Rod. Celso Garcia Cid, Pr-445, Km 380, Cx. Postal 6001, 86051-990, Londrina, Paraná, Brazil. *Author for correspondence. E-mail: leandro@uel.br

ABSTRACT. The aim was to evaluate the feeding behavior, carcass characteristics and meat quality of Nelore heifers fed sunflower pie replacing cottonseed meal. They were used 30 heifers with average initial weight of 274 kg $\pm$ 28 kg and average age of 24 months, confined for 76 days. The design was completely randomized with five treatments (0, 150, 300, 450 and 600 g kg⁻¹ DM) and six replicates per treatment. By completing 24 hours after slaughter, it evaluated muscle conformation and degree of finish made the *Longissimus dorsi* at the 13th rib. A representative sample between the 10th and 12th ribs was collected for evaluation of the physical components of carcasses. As well as the other variables, the hot carcass weight, dressing percentage, carcass length and rib eye area were not influenced by different pie levels in feed. The mean percentage of muscle, bone and fat from the carcass were 53.45; 16.14 and 29.46%, respectively, similar among treatments. Therefore, the use of up to 600 g kg⁻¹ of sunflower pie replacing cottonseed meal as the main protein source, did not affect the carcass characteristics and meat quality of Nelore heifers.

Keywords: ribeye area, softness, marbling, carcass yield.

Características de carcaça, qualidade da carne, comportamento ingestivo de novilhas Nelore alimentadas com rações contendo torta de girassol

RESUMO. O objetivo foi avaliar o comportamento ingestivo, características de carcaça e a qualidade da carne de novilhas Nelore, alimentadas com torta de girassol em substituição ao farelo de algodão. Foram utilizadas 30 novilhas, com peso médio inicial de 274 kg $\pm$ 28 kg e idade média de 24 meses, confinadas por 76 dias. O delineamento foi inteiramente casualizado com cinco tratamentos (0; 150; 300; 450 e 600 g kg⁻¹ MS) e seis repetições por tratamento. Ao completar 24 h após o abate, avaliou-se conformação muscular e grau de acabamento realizada no músculo *Longissimus dorsi* na 13^a costela. Amostra representativa entre a 10^a e 12^a costelas foi coletada para avaliações dos componentes físicos das carcaças. Assim como as demais variáveis estudadas, o peso de carcaça quente, rendimento de carcaça, comprimento de carcaça e área de olho de lombo não foram influenciados pelos diferentes teores de torta nas rações. Os valores médios de porcentagem de músculo, osso e gordura da carcaça foram de 53,45; 16,14 e 29,46%, respectivamente, semelhantes entre tratamentos. Portanto, a utilização de até 600g kg⁻¹ de torta de girassol em substituição ao farelo de algodão, como principal fonte proteica, não alterou as características de carcaça e a qualidade da carne de novilhas Nelore.

Palavras-chave: área de olho de lombo, maciez, marmoreio, rendimento de carcaça.

Introduction

The use of pies in animal feeding is growing, mainly by the development of biodiesel industry. The biodiesel is produced by mediation of transesterification, in which glycerin is separated from the fat or vegetable oil. The process generates two products: esters and glycerin, besides co-products, as the pies (Abdalla, Filho, Godoi, Carmo, & Eduardo, 2008). The Zebu breeds, mainly the Nelore, although well adapted to the conditions imposed by the tropical

environment, not always receive adequate feeding, resulting in a lower performance and consequently, later slaughter, influencing in the quality of the carcass, besides reflecting negatively in the productivity of the marketable meat (Rotta et al., 2009).

The practice of confinement, associated to the use of co-products is shown to be economically interesting, providing better quality carcass, enabling the reduction of the age at slaughter. In this sense, the use of sunflower co-product, such as the sunflower pie, in replacing the protein sources

might be advantageous both ways economic and nutrition, once it allows that the soy bran is released for other purposes, as export, or to the production of monogastric animals which are more demanding in terms of quality of the dietary protein (Oliveira, Mota, Barbosa, Stein, & Borgonovi, 2007).

According to the cost of feeding beef cattle in confined regime represents in average 70% the total cost of the termination system, what justifies the search for alternative foods and with low commercial value, as the agribusiness co-products, enabling to reduce the cost with feeding.

Mesacasa et al., (2015), replacing sunflower pie in the place of soy bran (0, 24,40 e 54%) in supplement for cattle in cutting grazing during the drought season, it was concluded that the sunflower pie can replace the soy bran in supplementation 100%, without harming the nutritional parameters.

In order to contribute with the production of better quality meat using alternative foods, this study aimed to evaluate the behavior of food intake, the characteristics of carcass and the quality of Nelore beef heifers, fed with rations containing sunflower pie replacing cottonseed meal.

Material and methods

The management of animals during the experimental period was accomplished with the approval of the Ethics Committee in Animal Experiments of the State University of Londrina (CEEA/UEL), registered under the process number 27/10. The experiment was conducted in Londrina, in the state of Paraná, Brazil (23°19'32" S; 51°12'32" W) exerting thirty Nelore heifers, with about 24 months old of age and 274 ± 28 kg of starting weight, housed in 10 collective stalls, with three animals in each stall, being two for treatment,

during 76 days, 28 days for adaptation of the animals in experimental conditions.

The experimental design utilized was the entirely randomized with Five treatments and six animals per treatment. The treatments consisted in a ration "control" and four rations with different levels (150; 300; 450 e 600 g kg⁻¹ DM) replacing the cottonseed meal by sunflower pie.

The rations were formulated to attend the demands of animals with a daily average gain of 1.1 kg, (Table 1), as proposed by the NRC (1996).

The complete ration was offered to the animals twice a day once at 8:00 a.m. and at 5:00 p.m. so that there was scraps of 10% of the dry matter offered. Daily in the morning, before the feeding, the scraps of the previous day were removed and weighed to accomplish the adjustment of the quantity of food offered and subsequent calculations of consumption of the dry matter (DM) per animal in average per stall.

Samples of the rations offered and the scraps were collected three times per week and dried in greenhouse with forced air circulation at 72°C. At the end of the experimental period the samples were analyzed to determine the dried matter, ashes, ethereal extract crude protein according to Mizubuti, Pinto, Pereira and Ramos (2009), fiber in neutral detergent and fiber in acid detergent according to Detmann et al. (2012).

The animals were weighed at 28 and then at 48 days after the adaptation period totalizing 76 days of experimenting. The weighings occurred in the morning after fasting of solids at about 16 hours. The average daily gain (ADG) was calculated between the reason total gain divided by the number of days. The food conversion of dry matter was estimated as being the reason between the ADG and the intake of DM.

Table 1. Proportion of the ingredients and chemical composition of the experimental rations.

Item	Sunflower pie (g kg ⁻¹ DM)				
	0	150	300	450	600
Proportion of ingredients (% DM)					
Sorghum silage	40.00	40.00	40.00	40.00	40.00
Cottonseed meal	15.30	14.00	12.30	9.60	7.20
Ground corn	41.50	40.30	39.30	39.20	38.70
Sunflower pie	-	2.50	5.20	7.90	10.80
Limestone	1.20	1.20	1.20	1.20	1.20
Urea	0.50	0.50	0.50	0.60	0.60
Mineral salt	1.50	1.50	1.50	1.50	1.50
Chemical composition (g kg ⁻¹ DM)					
Dry matter	421.50	452.50	436.30	423.60	463.60
Organic matter	925.00	928.70	923.20	925.20	925.60
Mineral matter	75.00	71.30	76.80	74.80	74.40
Crude protein	103.20	112.10	109.30	113.60	128.30
Neutral detergent fiber	559.20	524.00	522.80	484.50	532.30
Acid detergent fiber	253.10	230.30	252.10	245.30	252.10
Ethereal extract	24.70	33.30	35.70	40.90	56.40
Total digestible nutrients ¹	689.90	714.00	688.10	696.20	688.10

¹Calculated as: NDT = [88.9 - (0.779 x %FDA)].

Source: Author.

At the end of the experimental period the animals were slaughtered in a commercial fridge according to guidelines proposed by the Brazilian legislation according the technical regulation of stunning methods to humanitarian slaughtering of butcher animals (IN n° 3, of January 17, 2000). Immediately after slaughter, the carcass were identified, weighed and stored in cold chamber with the temperature ranging to 0°C during 24 hours.

After 24 hours of refrigeration the carcass were weighed again and conducted the subjective evaluation of resignation (score from 1 to 5) and consummation (score from 1 to 10) as proposed methodology by García-Torres et al. (2005). The pH of the carcass was measured in the muscle *Longissimus dorsi* with the aid of a portable potentiometer Texto® 205 insertion electrode.

The length of the carcass was obtained by the measurement of the distance between the cranial edge of the pubis and the medial cranial edge measured in the half of the left side of the carcass. By exposing the muscle *L. dorsi* between the 12th and the 13th ribs, it was accomplished the visual evaluation of the degree of marbling (score from 1 to 10) according to methodology proposed by Americam Meat Science Association [AMSA]. (2001). To the measurement of the rib eye area, it was traced the outline of the muscle in vegetable paper and posteriorly express as the total area (cm²) with the aid of a planimeter. The thickness of fat covering was measured using digital caliper.

A sample of the *L. dorsi* muscle between the 10th and the 12th ribs, it was removed, packed, identified, cut in (02) two steaks with approximately 2.5 cm. Posteriorly it was fulfilled an analyses of the water loss by pressure by the method proposed by Barbut (1996). The rest of the samples were frozen to -18°C. After one month of icing, the samples were thawed for evaluation of the water loss in the defrosting and cooking, softness and determination of the centesimal composition.

The softness of the meat was evaluated in an objective way, with the use of the texturometer device TX Ture Analiser TAXT21 with blade of Warner Bratzler Shear, where the necessary power was determined for the shearing of the fiber bundle

roast beef (an average of six analyses per steak, 1.25 cm of thickness and 2.5 cm of length).

To determine the physical carcass composition in muscle (M), fat (F) and bone (B) it was extracted one piece of the muscle *Longissimus dorsi*, between the 10th and 12th rib, according the methodology proposed by Hankins and Howe (1946), reported by Carballo, Monserrat and Sánchez (2005), where, muscle: 15.56 +0.81 (M), fat: 3.06+0.82(F) and bone: 4.30+0.61(B).

The evaluation of the centesimal composition, in dry matter (%), gross protein (%), ethereal extract (%) and in mineral matter (%), of the meat it was fulfilled following the procedure described by Association of Official Analytical Chemistry [AOAC] (1995).

The statistical analyses was fulfilled by analyses of variance by GLM, using the statistical package Statistical Analysis System [SAS], (2001). The influenced characteristics by the use of sunflower pie substituting the cottonseed meal were submitted to analyses of Turkey ($p \leq 0.05$) of probability.

Results and discussion

The variables ADG ($\hat{Y} = 0.970$ kg) and CA ($\hat{Y} = 8.02$ kg), not differ ($p \geq 0.05$) among the treatments (Table 2).

The use of sunflower pie in the ration did not influence ($\hat{Y}=7.33$) the intake of dry matter (Table 3), regardless the way of expression, might be in daily quantity (kg day⁻¹) or in relation to the percentage of live weight (kg 100 kg⁻¹ LW). But analyzing the intake in reason of live weight to the intakes observed in this study were lower than the 2,45% LW recommended by NRC (1996).

The intake of FND (kg day⁻¹) in (Table 3) was not influenced by the replacement of sunflower pie by the soybean meal. Mendes, Ezequiel, Galati, and Feitosa (2005), whom working with male cattles, receiving diets with cottonseed meal as source of protein, ranging in energy sources with grain corn. 9.8% corn germ meal and 9.9% of soy hulls, observed significant effect on intake of FND (4.3; 4.5; 4.5 kg day⁻¹ of FND, respectively).

Table 2. Average in performance to the characteristics of initial weight, final weight, daily weight gain, intake of dry matter and feed conversion Nelore heifers fed with different levels of sunflower pie.

Variable ¹	Sunflower pie contents (g kg ⁻¹ DM)					Average	CV (%)
	0	150	300	450	600		
Initial weight, kg	302.0	305.1	291.2	305.1	299.1	300.1	14.42
Final weight, kg	352.8	351.3	338.1	346.3	346.0	347.0	14.28
ADG, kg	1.06	0.96	0.98	0.86	0.98	0.97	22.74
CF, kg DM kg ⁻¹	7.21	8.29	7.79	9.02	7.78	8.02	10.22

¹ADG = Average daily gain; CF = Convert food; ($p > 0.05$).

Source: Author.

Table 3. Average of daily intake of dry matter (DM), crude protein (CP), fiber in neutral detergent (FND), total digestive nutrients (TDN) and ethereal extract (EE), fed with different levels of sunflower pie.

Nutrient	Sunflower pie contents (g kg ⁻¹ DM)					Average	CV (%)
	0	150	300	450	600		
Ingestion, kg dia ⁻¹							
DM	7.32	7.57	7.46	6.90	7.41	7.33	9.59
CP	0.80	0.89	0.85	0.82	0.97	0.86	12.38
FDN	3.95	3.87	4.02	3.18	3.98	3.80	7.81
TDN	5.17	5.39	5.14	4.86	5.11	5.13	10.42
EE	0.19	0.26	0.28	0.30	0.44	0.30	11.82
Ingestion, kg 100 kg ⁻¹ LW							
DM	2.25	2.32	2.36	2.13	2.31	2.28	9.02
CP	0.25	0.27	0.27	0.25	0.31	0.27	12.62
FDN	1.22	1.21	1.29	1.00	1.25	1.19	10.10
TDN	1.60	1.66	1.65	1.51	1.61	1.61	9.07
EE	0.06	0.08	0.09	0.10	0.14	0.09	16.06

(p > 0.05).

Source: Author.

The authors alleged that the difference observed in the treatment with corn was minor ($p < 0.05$) due to the low levels of FND in the diet with corn and high values of FDA and cellulose in the diets containing soybean hulls.

According to Van Soest (1994), the voluntary intake of dry matter is correlated to the level of FND by the reticle – rumen are more slow than the other constituents, presenting great effect in the rumen fill and the food residence time in the rumen, compared to the non-fibrous components of the food. In this sense, it can be assured that the sunflower pie presented similar effects to the cottonseed meal in the ruminal dynamics, for it did not altered the intake of dry matter, by the animals, among the treatments.

Domingues et al. (2010), evaluated the intake of the heifers fed with different levels of sunflower pie in replacement to the cottonseed meal, and observed significant effects ($p \leq 0.01$) of the levels of the sunflower pie (0, 25, 50, 75 and 100%) in replacement to the cottonseed meal over the intake of dry matter (IDM) where was observed cubic behavior. However, when the IDM was expressed in g kg⁻¹ LW^{0.75} and in %LW was observed a decreasing linear behavior. These authors also verified that the animals that received only cottonseed meal as protein food ingested larger quantity ($p < 0.05$) of dry matter, in kg/day, than when received rations

containing sunflower pie, due to the fact that the fat contained in this provender, rich in polyunsaturated fatty acids, as being hiohydrogenated by the bacteria and protozoan resulted in a larger energy intake and consequently the reduction in the intake of dry matter.

Oliveira et al. (2007), verified that depending on the level of EE in the diet, the intake might be affected, as well as by the levels of FDA and of FND. The authors also highlighted that the high level of FDA of the sunflower seed is in the skin and, in the case of the processing, the seeds go through a previous cleaning. However, in this study, the ration intake was not influenced by the levels of ethereal extract nor by the levels of FND (Table 3).

The slaughter weight (SW), hot carcass weight (HCW), carcass yield (CY), resignation (R) and degree of consummation (DC) did not differ among the treatments (Table 4). The WS was similar to the weight verified by Paulino et al. (2008) to female Nelore fed with 1.2 % of concentrated in relation to the body weight. Coutinho Filho, Peres, and Justo (2006), verified body weight of 384 kg for female Santa Gertrudis with an average gain of 1.2 kg at the end of 109 days of confinement, using rations with levels of GP and TDN similar to the ones used in this experiment.

The CY variable ($\hat{Y} = 51.11\%$), are close to the ones observed by Goes et al. (2012). The same authors obtained similar results to the present study about the carcass yield 52% and the fat thickness 2.4mm. The same authors concluded that the replacement of 20 and 40% improved the daily weight gain and the body condition of the animals can be replaced without changing the characteristics of the carcass and the quality of the Nelore heifers meat termination pasture during the dry season of the year.

The animals presented similar resignation, varying from 3.2 (rectilinear carcass) and 2.5 (sub rectilinear carcass) with medium musculature, typical of the zebu breeds. The bull breeds usually present better muscular development and resignation of carcass compared to zebus (Euclides Filho et al., 2003).

Table 4. Average and coefficient of variation (CV) to the characteristics of carcass, due to the levels of inclusion of the sunflower pie.

	Sunflower pie (g kg ⁻¹ DM)					Average	CV (%)
	0	150	300	450	600		
SW (Kg)	378.0	373.4	359.3	381.7	370.4	372.6	10.85
HCW (Kg)	194.7	191.3	188.5	190.3	186.7	190.3	10.70
CY (%)	51.5	51.2	52.45	49.99	50.4	51.1	2.65
R	3.16	2.50	2.66	2.83	3.17	2.87	23.49
DC	3.0	3.0	2.0	3.0	3.0	2.8	20.51

Slaughter weight (SW), hot carcass weight (HCW), carcass yield (CY), resignation (R) and degree of consummation (DC); ($p > 0.05$).

Source: Author.

The degree of consumption presented ($\hat{Y} = 2.8$), corresponding to carcass with medium coverage. The minimum demanding of fat thickness varies geographically, however, from the qualitative point of view, it is necessary the minimum of 3 mm (Kuss et al., 2008). The average observed in this study was of 5.0 mm, indicating that the carcass presented the consumption necessary.

The different levels of inclusion of sunflower pie did not influence the quantitative characteristics of the carcass and its respective measures of development ($p > 0.05$). These, are a little affected when compared to animals in the same age, genetic group and nutritional state (Table 5).

The ribeye area, characteristic that represents the level of muscular development of animals and is related to the yield of the sections of higher commercial value (Miotto, Neiva, Voltolini, Pinheiro, & Castro, 2009) it is influenced by factors such as weight at the slaughtering and genetic group.

The pH, varying between 5.57 and 5.61 (Table 6) is considered normal for beef. Therefore, did not occur the anomaly DFD (dark, firm and dry) found in pH above 6.0.

The values of water loss by pressure ranging between 23.3 and 26.6%, remained in adequate levels. Fernandes et al. (2008), found an average of 72.5% to the CRA, to the females of the Canchin breed finished in confining, that is, 27.50% to the loss of water by pressure.

It was not observed differences in the levels of marbling, among the treatments. The marbling of the meat represents the quantity of intramuscular fat and is considered an important characteristic, for it is deeply related to the sensorial meat characteristics, possible to be noticed and appreciated by the consumer (Costa et al., 2002). The value found by the marbling ($\hat{Y} = 2.56$) corresponds to features, value inexpressive according to AMSA (2001), denoting small collection of

intramuscular fat. The low rate of marbling seems to have influenced in the strength of shearing with average values at 5.6 kg values above 5.0 kg characterize the meat as stiff, in these sense the maturation of the meat can be an alternative to obtain a softer meat (Ribeiro et al., 2002).

The water loss by defrosting and cooking of the muscle *Longissimus* did not differ ($p > 0.05$) among the treatments and represent averages of 2.6 and 28.8%, respectively.

The parameters of color were not influenced. The meat represented luminosity (L^*) varying between 36.3 and 39.4 (Table 7). According to Fernandes et al. (2008), the values of L^* are within the recommended as ideal (34 and 39), meanwhile the values of a^* might be considered under the average (18 and 39). The intensity of the red is directly connected to the quantity of the myoglobin present in the meat, varies mainly with the physical activity of the muscles and the physiological maturity of the animal. Values found in a^* between 16.8 and 17.7, might been explained by being confined animals with less muscular demand and minor physiological maturity.

The meat coloration and the CRA, are related directly with the value of pH. As larger the pH, smaller the L^* values, a^* and b^* and larger the CRA. As in this study the values of pH remained within the ideal limits, the characteristics of L^* , a^* and b^* and PWL presented values considered normal.

According to Carballo et al. (2005), the average proportions of each one of the components of the carcass vary from 48 to 82% to the meat, between 0.5 to 35% to the fat and between 11 to 35% to the bones. The average values of percentage of muscle, fat and bone of the carcass were of 53.45; 29.5; 16.14%, respectively (Table 8).

Table 5. Average and coefficient of variation (CV) to the quantitative characteristics of carcass due to the levels of inclusion of sunflower pie.

	Sunflower pie (g kg ⁻¹ DM)					Average	CV (%)
	0	150	300	450	600		
CL (cm)	125.16	125.66	124.33	125.33	122.50	124.60	4.22
RA (cm ²)	58.41	57.79	58.29	57.83	59.29	58.32	12.59
FT (mm)	5.85	5.13	3.74	4.34	6.01	5.01	52.02

CL – Carcass length; RA – Ribeye area; FT – Fat thickness; ($p > 0.05$).

Source: Author.

Table 6. Average and coefficient of variation (CV) to the quantitative characteristics of the meat due to the levels of inclusion of sunflower pie.

	Sunflower pie (g kg ⁻¹ DM)					Average	CV (%)
	0	150	300	450	600		
pH	5.61	5.57	5.57	5.61	5.61	5.59	1.37
PWL (%)	23.99	26.52	23.28	25.13	26.58	25.10	16.32
MARB	3.00	2.33	1.83	2.83	2.83	2.56	34.70
WLT (%)	1.97	3.18	2.98	1.66	3.31	2.62	76.43
WLC (%)	29.17	29.20	27.78	25.47	32.20	28.76	23.82
SF (kgf)	6.02	5.70	5.08	5.61	5.82	5.65	19.79

PWL – Pressure water loss; MARB – Marbling; WLT – Water loss on thawing; WLC – Water loss in cooking; SF – Shear force; ($p > 0.05$).

Source: Author.

Table 7. Average and coefficient of variation (CV) to parameters of meat color of the muscle *Longissimus dorsi* due to the levels of inclusion of sunflower pie.

	Sunflower pie (g kg ⁻¹ DM)					Average	CV (%)
	0	150	300	450	600		
L*	37.7	36.3	38.2	37.5	39.4	37.8	5.91
a*	16.8	16.8	16.99	17.5	17.7	17.2	7.81
b*	9.4	8.8	9.5	9.6	10.4	9.5	10.23
c*	19.3	19.8	19.5	20.0	20.5	19.6	7.71
h*	29.2	27.6	29.2	28.9	30.4	29.0	6.79

L* - Luminosity; a* - Red intensity; b* - Yellow intensity; c* - Chroma; h* - Tone; (p > 0.05).

Source: Author.

Table 8. Average and coefficient of variation (CV) to the composition of the cooled carcass and chemical composition, due to the inclusion of sunflower pie.

	Sunflower pie (g kg ⁻¹ DM)					Average	CV (%)
	0	150	300	450	600		
Bones (%)	16.39	16.28	16.81	16.24	14.98	16.14	11.07
Muscle (%)	51.69	53.73	55.68	51.50	54.66	53.45	7.85
Fat (%)	31.74	28.69	26.69	31.34	28.82	29.50	14.10
DM (%)	28.96	28.38	28.55	29.93	28.54	28.87	5.81
Moisture (%)	71.04	71.62	71.45	70.07	71.46	71.13	2.36
CP (%)	22.52	23.30	22.33	23.02	22.98	22.83	5.55
EE (%)	0.91	0.72	0.65	0.69	0.72	0.74	64.17
MM (%)	3.29	3.46	3.55	3.17	3.39	3.37	8.02

(p > 0.05).

Source: Author.

Costa et al. (2002), working with Red Angus heifers and slaughtering the animals with 340 kg, found superior value to the muscle (63.5%) and inferior to the bones (15%) and fat (21.7%). The smaller percentage of muscle and larger percentage of fat observed to the female heifers might be related to the sex, because females possess less proportion of muscles and more fat than males, when compared to the same state of development. In this study, the percentage of muscle was always superior to 51.5% and the maximum percentage of fat observed, was in 31.7%, this way, patterns compatible with the demanding of the market, demonstrating that the Nelore female heifers have potential to reach conditions of consummation with weight, relatively low.

The meat centesimal composition was not influenced by the replacing of cottonseed meal for sunflower pie diet. The values of the CP were similar to the ones reported by Heinemann, Pinto and Romanelli (2003) (21.63%) and Andrade et al. (2010) to meat of animals of different genetic groups.

In the centesimal analyses, the fat is the component that presents bigger variation (Williams et al., 1983) and, normally, the quantity deposited result in the balance between the energy and the diet and metabolic requirement (Eriksson & Pickova, 2007). According to Campion (1975), it is desired that the meat presents content intramuscular fat superior to 2%, to promote the quality characteristics. The average of fat in the muscle

Longissimus dorsi observed in this trial (0.74%) were lower to this value, befitting to the low marbling found, what might have influenced, in a negative way, in the softness.

Conclusion

The replacing of cottonseed meal in even 600g kg⁻¹ de DM by sunflower pie, as an alternative source of protein in the ration of Nelore female heifers in termination, not influencing in the intake of nutrient and in the characteristics of the carcass of the meat, being, a variable alternative of protein in the search to reduce costs in the feeding.

References

- Abdalla, A. L., Filho, J. C. S., Godoi, A. R., Carmo, C. A., & Eduardo, J. L. P. (2008). Utilização de subprodutos da indústria de biodiesel na alimentação de ruminantes. *Revista Brasileira de Zootecnia*, 37(Supl. especial), 260-268.
- Andrade, P. L., Bressan, M. C., Gama, L. T., Gonçalves, T. M., Ladeira, M. M., & Ramos, E. M. (2010). Qualidade da carne maturada de bovinos Red Norte e Nelore. *Revista Brasileira de Zootecnia*, 39(8), 1791-1800.
- American Meat Science Association [AMSA]. (2001). *Handbook meat evaluation*. Savoy, IL: AMSA.
- Association of Official Analytical Chemists [AOAC]. (1995). *Official methods of analysis*. (16th ed.). Arlington, TEX: AOAC.
- Barbut, S. (1996). Estimates and detection of the PSE problem in young turkey breast meat. *Canadian Journal of Animal Science*, 76(3), 455-457.

- Campion, D. R. (1975). Predictive value of USDA beef quality grade factors for cooked meat palatability. *Journal of Animal Science*, 40(6), 1225-1228.
- Carballo, J. A., Monserrat, L., & Sánchez, L. (2005). Composición regional y tisular de la canal bovina. In V. Cañeque, & C. Sañudo (Eds.), *Metodología para el estudio de la calidad de la canal y de la carne en rumiantes* (3a ed., p. 120-140). Madrid: Instituto Nacional de Investigación y Tecnología Agraria y Alimentaria.
- Costa, E. C. D., Restle, J., Brondani, I. L., Perottoni, J., Faturi, C., & Menezes, L. F. G. D. (2002). Composição física da carcaça, qualidade da carne e conteúdo de colesterol no músculo *Longissimus dorsi* de novilhos Red Angus superprecoces, terminados em confinamento e abatidos com diferentes pesos. *Revista Brasileira de Zootecnia*, 31(1), 417-428.
- Coutinho Filho, J. L. V., Peres, R. M., & Justo, C. L. (2006). Produção de carne de bovinos contemporâneos, machos e fêmeas, terminados em confinamento. *Revista Brasileira de Zootecnia*, 35(5), 2043-2049.
- Detmann, E., Souza, M., Valadares Filho, S., Queiroz, A., Berchielli, T., Saliba, E., ... Azevedo, J. (2012). *Métodos para análise de alimentos*. Visconde do Rio Branco, MG: Suprema.
- Domingues, A. R., Silva, L. D. F., Azambuja Ribeiro, E. L., Souza Castro, V., Freitas Barbosa, M. A. A., Mori, R. M., ... Silva, J. A. O. (2010). Consumo, parâmetros ruminais e concentração de uréia plasmática em novilhos alimentados com diferentes níveis de torta de girassol em substituição ao farelo de algodão. *Semina: Ciências Agrárias*, 31(4), 1059-1070.
- Eriksson, S. F., & Pickova, J. (2007). Fatty acids and tocopherol levels in *M. Longissimus dorsi* of beef cattle in Sweden. A comparison between seasonal diets. *Meat Science*, 76(4), 746-754.
- Euclides Filho, K., Figueiredo, G. R., Euclides, V. P. B., Silva, L. O. C., Rocco, V., Barbosa, R. A., & Junqueira, C. E. (2003). Desempenho de diferentes grupos genéticos de bovinos de corte em confinamento. *Revista Brasileira de Zootecnia*, 32(5), 1114-1122.
- Fernandes, A. R. M., Sampaio, A. A. M., Henrique, W., Oliveira, E. A., Tullio, R. R., & Perecin, D. (2008). Características da carcaça e da carne de bovinos sob diferentes dietas, em confinamento. *Arquivo Brasileiro de Medicina Veterinária e Zootecnia*, 60(1), 139-147.
- García-Torres, S., Espejo, M., López Parra, M. M., Izquierdo, M., Mendizábal, J. A., & Purroy, A. (2005). Conformación, engrasamiento y sistemas de clasificación de la canal bovina. In V. Cañeque & C. Sañudo (Eds.), *Metodología para el estudio de la calidad de la canal y de la carne en rumiantes* (3a ed., p. 105-119). Madrid: Instituto Nacional de Investigación y Tecnología Agraria y Alimentaria.
- Goes, R. H. T. B., Cerilo, S. L. N., Lima, H. L., Fernandes, A. R. M., Oliveira, E. R., Souza, K. A., ... Gressler, M. G. M. (2012). Torta de girassol em substituição ao farelo de soja nos suplementos de novilhas: desempenho e características de carcaça. *Revista Brasileira de Saúde e Produção Animal*, 13(2) 396-409.
- Hankins, O. G., & Howe, P. E. (1946). Estimation of the composition of beef carcasses and cuts. *Tech Bull. U.S.D.A.*, 926(1), 1-20.
- Heinemann, R. J. B., Pinto, M. F., & Romanelli, P. F. (2003). Fatores que influenciam a textura da carne de novilhos Nelore e cruzados Limousin-Nelore. *Pesquisa Agropecuária Brasileira*, 38(8), 963-971.
- Kuss, F., Barcellos, J. O. J., López, J., Restle, J., Moletta, J. L., & Paula, M. C. (2008). Componentes não-integrantes da carcaça de novilhos não-castrados ou castrados terminados em confinamento e abatidos aos 16 ou 26 meses de idade. *Revista Brasileira de Zootecnia*, 37(10), 1829-1836.
- Mendes, A. R., Ezequiel, J. M. B., Galati, R. L., & Feitosa, J. V. (2005). Desempenho, parâmetros plasmáticos e características de carcaça de novilhos alimentados com farelo de girassol e diferentes fontes energéticas em confinamento. *Revista Brasileira de Zootecnia*, 34(2), 692-702.
- Mesacasa, A. C., Zervoudakis, J. T., Zervoudakis, L. K. H., Cabral, L. S., Abreu, J. G., Marques, R. P. S., ... Soares, J. Q. (2015). Torta de girassol em suplementos múltiplos para bovinos em pastejo no período seco do ano: parâmetros nutricionais. *Revista Semina: Ciências Agrárias*, 36(3), 1559-1570.
- Miotto, F. R. C., Neiva, J. N. M., Voltolini, T. V., Pinheiro, M. C. R., & Castro, K. J. (2009). Desempenho produtivo de tourinhos Nelore x Limousin alimentados com dietas contendo gérmen de milho integral. *Revista Ciência Agronômica*, 40(4), 624-632.
- Mizubuti, I. Y., Pinto, A. P., Pereira, E. S., & Ramos, B. M. O. (2009). *Métodos laboratoriais de avaliação de alimentos para animais*. Londrina: Eduel.
- National Research Council [NRC]. (1996). *Nutrient requirements of beef cattle* (7th ed.). Washington, D.C.: National Academic Press.
- Oliveira, M. D. S., Mota, D. A., Barbosa, J. C., Stein, M., & Borgonovi, F. (2007). Composição Bromatológica e Digestibilidade ruminal *in vitro* de concentrados contendo diferentes níveis de torta de girassol. *Ciência Animal Brasileira*, 8(4), 629-638.
- Paulino, P. V. R., Valadares Filho, S. C., Detmann, E., Valadares, R. F. D., Fonseca, M. A., Vêras, R. M. L., & Oliveira, D. M. (2008). Desempenho produtivo de bovinos Nelore de diferentes classes sexuais alimentados com dietas contendo dois níveis de oferta de concentrado. *Revista Brasileira de Zootecnia*, 37(6), 1079-1087.
- Ribeiro, F. G., Leme, P. R., Bulle, M. L. M., Lima, C. G., Silva, S. L., Pereira, A. S. C., & Lanna, D. P. D. (2002). Características da carcaça e qualidade da carne de tourinhos alimentados com dietas de alta energia. *Revista Brasileira de Zootecnia*, 31(2), 749-756.
- Rotta, P. P., Prado, R. M., Prado, I. N., Valero, M. V., Visentainer, J. V., & Silva, R. R. (2009). The effects of genetic groups, nutrition, finishing systems and gender of

- Brazilian cattle on carcass characteristics and beef composition and appearance: a review. *Asian-Australasian Journal of Animal Sciences*, 22(12), 1718-1734.
- Statistical Analysis System. [SAS]. (2001). *Statistical analysis system user's guide: statistics. Version 8.2*. Cary, NC: SAS Institute Inc..
- Van Soest, P. J. (1994). *Nutritional ecology of the ruminant*. Ithaca, NY: Cornell University Press.
- Williams, J. E., Wagner, D. G., Walters, L. E., Chifre, G. W., Walle, G. R., Sims, P. L., & Guenther, J. J. (1983). Effect of production systems on performance, body composition and lipid and mineral profiles of soft tissue in cattle. *Journal of Animal Science*, 57(4), 1020-1027.
- Received on December 17, 2015.*
Accepted on February 2, 2016.
- License information: This is an open-access article distributed under the terms of the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.