INTERNATIONAL JOURNAL OF CURRENT MULTIDISCIPLINARY STUDIES
Available Online at http://www.journalijcms.com
VOL. 5, ISSUE,12(A), PP.1177-1181,DECEMBER,2019
IJCMS

RESEARCH ARTICLE

CHEMICAL NUTRITIONAL COMPOSITION OF COMMERCIAL MEAT DERIVATIVES

Josileide Gonçalves Borges* and Leonardo Luiz Dantas de Souza Santana

Department of Pharmacy, Petrolina, Pernambuco, Brazil

ARTICLE INFO

Received 10th September, 2019
Received in revised form 2nd October, 2019
Accepted 26th November, 2019
Published online 28th December, 2019

Keywords:

Meat products; Chemical composition; AOAC; Legislation; Health.

ABSTRACT

Brazil is one of the largest producers of animal protein. Meat is a food of high nutritional value, meat products are widely consumed by population because of their affordable value. Some meat products are high in lipids, should be consumed in moderation by people with restricted fat intake. The aim of this work was to evaluate the nutritional chemical composition of commercial meat products derivatives. Twenty brands of meat products (sausages, ham, bologna, Lower ham and turkey breast) were analyzed. These products were analyzed for chemical composition following official methodologies of AOAC (Analysis of the Association of Official Analytical Chemists). All products presented variable values of moisture (35.68-77.46%), minerals (2.70-4.37%), proteins (7.51-19.80%), lipids (0.67-16.50%), carbohydrates (2.25-48.61%) and caloric value (78.23-309.28 kcal. $100g^{-1}$). High lipid content of some products associated with their caloric value shows importance of reducing consumption of these products in order to preserve health.

INTRODUCTION

Beef is essential for human health because it has a high concentration of nutrients and low energy per unit weight. It is an excellent source of protein, having in its 20 amino acids present, 9 essential that the body cannot synthesize and the only way to obtain is through food (Souza, 2011).

With respect to proteins, the main amino acids found are: isoleucine, lysine, leucine, tryptophan, threonine, methionine, phenylanine, valine, histidine. Main vitamins found are those of the B complex, among them niacin, thiamine, riboflavin, pantothenic acid. Among the main minerals we have iron, zinc, potassium, phosphorus and manganese. Another important component found is conjugated linoleic acid (CLA) and omega 6: omega 3 (ω6: ω3) fatty acids (Cook, Appel and Whelton, 2016; Frieden, 2016; Delgado-Pando *et al*., 2018). However, centesimal composition of meat varies according to muscle type, age, animal species, nutrition, race, and sexual condition, pre-slaughter and post-slaughter management (Forrest, 1979; Pinheiro *et al*., 2008).

Meat products are sourced from fresh meat that has been processed, including cooking, smoking, salting, or any addition of seasonings, additives and / or seasonings. These processes aim exclusively at elaboration of new products and reduction of perishability, reducing action of degradation enzymes, improving product shelf-life and transportation. Processing in sausages does not significantly modify original nutritional qualities, however, characteristics of color, taste and aroma are attributed to each type of process (Benevides, 2007).

Consumption of meat products has had a great growth with increase of population of countries (Henchion *et al*., 2014; Kumar and Karne, 2018). Although these products have affordable value, a considerable portion of population has been more careful with food choices aimed at preserving health. It is well known that foods high in fat associated with lack of physical activity can contribute too many diseases. This work aimed to evaluate nutritional chemical composition of commercial meat products derivatives.

MATERIAL AND METHODS

Study site

Physicochemical analyzes of meat products were performed at General Chemistry and Analytical Laboratories of Federal University of Valley of San Francisco, Petrolina, Pernambuco, Brazil.

Meat Products Samples

Samples of meat derivatives were purchased in cities of Petrolina-PE and Juazeiro-BA. Petrolina is a municipality in state of Pernambuco, located in San Francisco Valley region, neighboring municipalities of Juazeiro and Sobradinho. Located at 380 meters altitude, latitude 9° 23' 39" South, longitude 40°

*✉ ***Corresponding author:*** **Josileide Gonçalves Borges**
Department of Pharmacy, Petrolina, Pernambuco, Brazil

30' 35" West. Juazeiro is a city in state of Bahia. Neighboring municipalities of Petrolina and Sobradinho, Juazeiro is 5 km south-east of Petrolina. Located at 369 meters altitude, latitude: 9° 26' 18" South, longitude: 40° 30' 19" West. Twenty types of meat products (sausages, ham, bologna, Lower ham, turkey breast) from different brands were chosen. Six samples of sausages and hams, 3 samples of ham, mortadella and 2 samples of turkey breast (smoked and light) were purchased. Preservation during this time was carried out in a refrigerated environment at 4 °C. Samples were individually ground in meat grinder at time of analysis.

Nutritional Chemical Analyzes

Moisture was determined by instrumental method using infrared moisture analyzer apparatus (BEL Engineering). Mineral residue, lipid and protein content were determined following official methodology (AOAC, 2012). Mineral residue (MR) was determined by gravimetric method with incineration of samples in muffle furnace heated to 550 ºC, followed by desiccant cooling and weighing processes until sample reached constant weight. Total proteins were extracted by kjedall by digestion, distillation and titration of each sample. Lipids were determined by Bligh-Dyer. (1959) using a mixture of methanol, chloroform, distilled water, followed by shaker stirring for 30 minutes (Shaker SK 180-Pro). Carbohydrate content was calculated by difference between 100 and sum of values obtained for moisture, protein, total lipids and ashes. All analyzes were performed in triplicate. Caloric value per 100 g of food was determined by multiplying amounts of carbohydrates, proteins and lipids found by 4, 4 and 9, respectively, at end, result of three multiplications was added (Brazil,1998). Value was expressed in kcal. 100 g^{-1} of sample.

Statistical analysis

Statistical analysis was performed by One-way ANOVA, using STATISTICA® 7.0 program, values considered significant with $p > 0.05$. were expressed as average ± standard deviation. Results were compared using Tukey test to identify significant differences between test results, with a significance level of 95% for each parameter evaluated.

RESULTS AND DISCUSSION

Meat and meat products contain essential nutrients of high biological value, B-complex vitamins, minerals such as iron, zinc, high quality proteins (Franco, 2002). Results of chemical nutritional composition of different trademark meat products are shown in Table 1. Meat products have a very varied nutritional composition depending on type of meat derivative analyzed, with variable moisture value (35.68-77.46%), minerals (2.70-4.37%), proteins (7.51-19.80%), lipids (0.67-16.50%), carbohydrates (2.25-48.61%), caloric value (78.23-309.28%).

In all meat derivatives it is noted that water is major constituent, hams have highest contents (77.21-77.54%), sausages lowest moisture content. This is because water influences palatability, decreasing hardness, maintaining juiciness of final product. Water and fat are determining components of these quality parameters. Increasing water or moisture content increases juiciness and decreases hardness of sausage (Price and Schweigert, 1994). However, this high moisture content favors reduction of product life as it is favorable environment for development of deteriorating microorganisms, so it is so important to obey values established by legislation in force for these products.

According to Normative Instruction N°. 4 of March 31, 2000 (Brazil, 2000), maximum amount of moisture allowed is 65%. Considering this Normative Instruction, it can be verified that samples of hams, lower ham and turkey breasts submitted for evaluation exceed limit established by legislation.

Commonly consumed meat is an important source of high biological value proteins, B-complex vitamins, especially red meat, of high bioavailability compared to iron in plant foods (Rocha *et al*., 1982; Salles-Filho and Zackiewic, 2001).

Table 1 Chemical nutritional composition of meat products.

Product	Moisture (%)	Minerals (%)	Proteins (%)	Lipids (%)	Carbohydrates (%)	Caloric Value (Kcal. 100g^{-1})
Sausage A	$35.68^{r} \pm 0.03$	$3.75^{g} \pm 0.03$	$9.62^{o} \pm 0.07$	$13.50^{c} \pm 0.02$	$37.45^{c} \pm 0.01$	309.78
Sausage B	$39.76^{m} \pm 0.01$	$3.68^{h} \pm 0.01$	$9.40^{p} \pm 0.02$	$13.68^{b} \pm 0.03$	$33.48^{f} \pm 0.01$	294.64
Sausage C	$38.74^{0} \pm 0.01$	$3.29^{m} \pm 0.02$	$7.51^{r} \pm 0.03$	$9.40^{e} \pm 0.02$	$41.06^{b} \pm 0.01$	278.88
Sausage D	$38.42^{p} \pm 0.02$	$4.14^{c} \pm 0.01$	$10.24^{l} \pm 0.01$	$7.54^{f} \pm 0.01$	$39.66^{c} \pm 0.01$	267.46
Sausage E	$39.56^{n} \pm 0.01$	$3.98^{d} \pm 0.05$	$10.96^{i} \pm 0.01$	$6.47^{h} \pm 0.01$	$39.03^{d} \pm 0.02$	258.19
Sausage F	$35.89^{q} \pm 0.01$	$3.47^{j} \pm 0.01$	$8.56^{q} \pm 0.02$	$3.47^{p} \pm 0.02$	$48.61^{a} \pm 0.02$	259.91
Ham A	$77.35^{d} \pm 0.01$	$3.89^{e} \pm 0.03$	$11.16^{h} \pm 0.02$	$4.14^{m} \pm 0.03$	$3.46^{p} \pm 0.01$	95.74
Ham B	$77.54^{b} \pm 0.02$	$3.86^{ef} \pm 0.02$	$10.40^{j} \pm 0.01$	$3.87^{n} \pm 0.02$	$4.33^{n} \pm 0.01$	93.75
Ham C	$77.65^{a} \pm 0.01$	$3.46^{j} \pm 0.04$	$12.19^{e} \pm 0.01$	$3.46^{p} \pm 0.01$	$3.24^{p} \pm 0.02$	92.86
Ham D	$77.68^{a} \pm 0.01$	$3.68^{h} \pm 0.01$	$9.88^{n} \pm 0.02$	$3.68^{o} \pm 0.01$	$5.08^{l} \pm 0.01$	92.96
Ham E	$74.21^{g} \pm 0.01$	$2.70^{p} \pm 0.02$	$15.44^{c} \pm 0.01$	$3.89^{n} \pm 0.03$	$3.76^{o} \pm 0.01$	111.81
Ham F	$76.46^{f} \pm 0.01$	$4.37^{a} \pm 0.04$	$11.09^{h} \pm 0.02$	$3.22^{q} \pm 0.02$	$4.86^{m} \pm 0.02$	92.78
BolognaA	$55.56^{l} \pm 0.01$	$2.86^{o} \pm 0.03$	$13.79^{e} \pm 0.02$	$15.80^{a} \pm 0.02$	$11.99^{i} \pm 0.02$	245.32
Bologna B	$55.89^{i} \pm 0.02$	$2.86^{o} \pm 0.03$	$15.78^{a} \pm 0.03$	$6.67^{g} \pm 0.02$	$18.80^{h} \pm 0.02$	198.35
Bologna C	$55.63^{j} \pm 0.02$	$3.36^{l} \pm 0.04$	$9.97^{m} \pm 0.02$	$11.27^{d} \pm 0.01$	$19.77^{g} \pm 0.01$	220.39
Lower ham A	$73.42^{h} \pm 0.02$	$4.23^{b} \pm 0.02$	$15.60^{c} \pm 0.03$	$4.50^{j} \pm 0.01$	$2.25^{s} \pm 0.01$	111.90
Lower ham B	$74.25^{g} \pm 0.02$	$3.02^{n} \pm 0.01$	$15.16^{d} \pm 0.03$	$4.71^{i} \pm 0.02$	$2.86^{q} \pm 0.01$	114.47
Lower ham C	$73.38^{h} \pm 0.01$	$3.76^{g} \pm 0.02$	$15.80^{a} \pm 0.02$	$4.37^{l} \pm 0.03$	$2.69^{r} \pm 0.01$	113.29
Turkey breast. Light	$77.45^{c} \pm 0.01$	$3.83^{f} \pm 0.01$	$11.66^{g} \pm 0.03$	$0.67^{s} \pm 0.04$	$6.39^{j} \pm 0.01$	78.23
Turkey breast. smoked.	$76.83^{e} \pm 0.01$	$3.62^{i} \pm 0.09$	$10.27l \pm 0.01$	$2.34^{r} \pm 0.01$	$4.94^{m} \pm 0.02$	81.90

* Values expressed as average ± standard deviation followed by equal lowercase letters in same columns do not differ statistically at 5% level (Tukey test).

Meat derivatives are wholly or partially prepared with meat, meat or fat, edible by-products from slaughter animals or other

species, may be added ingredients of plant, animal origin, also seasonings, and spices, authorized additives (Ordóñes, 2005).

Meat products were found to be a significant protein input (7.5-19.9%), two brands of ham (B and C) had highest protein content and brand C sausage lowest protein content totals. According to Hammad *et al*. (2020) in their experiments crude protein content of beef, chicken were 20.64% and 22.73%. These data show that depending on meat product, method of preparation there may be a loss of protein, although it is noted that among products analyzed presented are ones that most preserve protein content when compared to their original raw material. Normative Instruction N°. 4 of March 31, 2000 (Brazil, 2000) states that protein content should be at least 12%, so only 9 samples from this study were found to be in accordance with this Normative Instruction.

Lima *et al*. (2017) analyzing proteins in raw hams found a content of 33.31%. Barretto;Barretto and Telis-Romero. (2016) found for pork ham cooked pork contents between 15.36-15.96%. Behling *et al*. (2014) in making fiber mortadella found protein content between 15.91 and 17.25%

Santin (2011) confirmed importance of protein for athletes, for those who wish to gain muscle mass. What sustains them is high quality protein, which is exactly one found in lean beef. Protein is designed to synthesize,maintain body tissues (muscle and organs), provide energy, support immune system, and help carry nutrients, vitamins and minerals.

Meat derivatives showed variable value of minerals (2.70-4.37%) among analyzed products and among raw material used. Ash is inorganic residue (white or gray) that remains after incineration of organic matter, serves as measure of total amount of minerals present in food. It can be observed that sausages have highest value of minerals compared to other products. Sausage is product made up of wide variety of meat and non-meat ingredients (Ayo *et al*., 2008). According to Pitombo *et al*. (2013) ash content found in confined superprecoses cattle was 1.04 -11.06%. Hammad *et al*. (2020) found total contents of beef, chicken ashes of 1.53% and 0.96%, respectively.

According to Cecchi. (2003) total ash content for meat and meat products is 0.5 to 6.7%. These values appear to increase during preparation of meat products due to addition of formulation ingredients and depending on product produced. Lima *et al*. (2017) when analyzing raw hams found ash content of 6.23%. Barretto; Barretto and Telis-Romero. (2016) found for cooked pork ham contents between 2.47 and 2.81%. Behling *et al*. (2014) when elaborating mortadella with fibers found mineral contents of 4.55 to 5.56%.

In addition to protein and minerals, meat derivatives have a high lipid content ranging from 0.97% for light turkey breast to 16.5% present in one of lower hams (Table 1). Although these values vary by product type and brand, all samples analyzed are within limits established by Normative Instruction N°. 4 of March 31, 2000 (Brazil, 2000), which establishes maximum permitted quantity of 30 % samples of fat.
Lima *et al*. (2017) found for raw hams a lipid content of 16.35%. Barretto; Barretto and Telis-Romero. (2016) found for cooked pork ham contents from 3.61 to 3.68%. Behling *et al*. (2014) when elaborating fiber mortadella found lipid contents ranging between 14.10 to 15.59%.

Term lipid is used to indicate wide variety of organic products that have common characteristic of not being soluble in water but in no polar solvents (hexane, ether, chloroform). Lipids are formed by several chemical compounds, quite different from each other, with fatty acids being substance present in greater quantity (Oliveira *et al*., 2012). Lipids play an important role in acceptance of meat products, since their concentration, composition strongly influence sensory properties of texture, taste, color and flavor (Pino, 2005). Meat products can provide significant amounts of saturated fats, especially palmitic acid, to a lesser extent, stearic acid, due to the type of animal, type of animal husbandry, location of meat (beef) (Rocha *et al*., 1982; Salles-Filho and Zackiewics, 2001).

Highest lipid content was found in ham brand and two sausage brands since their values did not differ significantly by Tukey test. Animal products generally contain large percentage of saturated fat (Novelo *et al*., 2007). While meat products are an important source of nutrients, accessible to most of low-income population, dangers associated with frequent consumption of these products should be taken into account. According to World Health Organization (WHO, 2017), Cardiovascular Disease (CVD) is leading cause of death worldwide, rate virtually identical to that found in Brazil. It is estimated that 17.7 million people died from cardiovascular disease in 2015, representing 31% of all deaths worldwide. Of these deaths, it is estimated that 7.4 million occur due to cardiovascular disease and 6.7 million due to stroke. More than three-quarters of deaths from cardiovascular disease occur in low- middle-income countries. Of 17 million premature deaths (people under 70) from no communicable diseases, 82% occur in low- middle-income countries and 37% are from cardiovascular disease. Most cardiovascular diseases can be prevented by addressing behavioral risk factors - such as tobacco use, unhealthy diets, obesity, lack of physical activity, harmful use of alcohol - using strategies for general population.

According to Santos *et al*. (2013) In general, pathophysiological basis for cardiovascular events is atherosclerosis, process that develops over decades in an insidious manner, and first signs may be fatal or highly limiting. Although not having same degree of evidence, lowering triglyceride levels and raising HDL cholesterol are also considered potentially beneficial for inhibiting atherothrombotic process (Chapman *et al*., 2011).

Consumption of Trans and saturated fat is related to elevated plasma LDL cholesterol, increased cardiovascular risk. Replacement of saturated dietary fat with mono and polyunsaturated is considered a strategy for better control of hypercholesterolemia and consequent reduction of chance of clinical events. Repercussions of fat intake, however, are not restricted to lipid metabolism; type of fat ingested may also influence other risk factors, such as insulin resistance and blood pressure (Santos *et al*., 2013).

For fats, upper limit of 30% of total calories is exceeded from monthly income class of more than six minimum wages. Influence of ingested fatty acids on cardiovascular disease risk factors, on plasma lipid, lipoprotein concentrations has been widely demonstrated in several experimental population studies

(Keys *et al*., 1958; Connor *et al*., 1986; Keys and Seven, 2008). Overall, studies analyzing impact of dietary plans with controlled red meat consumption have indicated reduced blood pressure, lower risk of mortality from cardiovascular disease (De Biase *et al*., 2007). Soon these products should be reduced to avoid obesity problems, heart risks, inflammatory processes in body that can lead to development of other diseases.

Average carbohydrate levels found in this study are quite variable depending on meat product, but it is noted that in all sausage, mortadella samples are values much higher than the maximum amount (7%) allowed by Normative Instruction N°. 4 of 31 March 2000, this may be due to formulations with high percentage of cassava starch, starch or other binder.

Meats are foods with high water content and therefore easily susceptible to development of spoilage microorganisms that decrease their durability. Use of methods such as smoking, salting, curing, drying, fermentation increases shelf life, increases diversity of meat derivatives for consumption. Increase in number of heart attacks, obesity, other diet-related diseases increases need for meat industry to develop products that are sensually satisfying and healthier (Nascimento *et al*., 2007).

Acknowledgment

Authors' acknowledgment UNIVASF for making laboratories available for the experiments.

References

AOAC. 2012. AOAC International. Official methods of analysis. 19th ed. Gaithersburg, MD: Association of Official Analytical Chemists, 300p.

Ayo, J. A., Haruna, U. S., Yelmi bitrus., Ayo,V. A and Ajayi, G. 2008. Effect of informers on the quality of Acha bread. Nigerian Food Journal., 26(1):56-63.

Barretto, T. L., Barretto, A. C. S., Telis-Romero, J. 2016. Influence of ultrasound intensity on low-sodium cooked ham. XXV Brazilian Congress of Food Science and Technology. Lawns / RS. October 24-27.

Benevides, S. D., Nassu, R, T. 2007. Tree of Cut Sheep Knowledge. Meat Products.

AGEITEC – Embrapa Technology Information Agency. Available in: < http://www.agencia.cnptia.embrapa.br/gestor/ovinos_de_corte/arvore/CONT000g3izohks02wx5ok0tf2hbweqanedo.html> Accessed in: 08/10/2019.

Behling, M., Marquardt, L.,Rohlfe, A. L. B., Baccar, N. M., Oliveira, M. S. O. 2014. Use of wheat and soybean fibers in the preparation of mortadella. Young Researchers Magazine., 4 (1): 57-65.

BrasiL. 2000. Ministry of Agriculture and Supply. Normative Instruction No. 4 of March 31, 2000. Technical regulation for identification of identity and quality of mechanically separated meat (cms) of poultry, cattle and pigs. Available in: <http://extranet.agricultura.gov.br/sislegis/action/detalhaAto.do?method=consultarLegislacaoFederal>, accessed in: 11/15/2019.

Brasil. 1998. Ministry of Health. National Health Surveillance Agency (ANVISA). Ordinance No. 27 of 13 January 1998. Approves Regulation on Supplementary Nutrition Information (statements related to nutrient content). Available in: < http://portal.anvisa.gov.br/documents/3391 >. Accessed in: 07/24/2019.

Bligh, E. G., Dyer, W. J. 1959. A rapid method of total lipid extraction and purification. Canadian J. Biochem. Phys., 27(8): 911-917.

Chapman *et al*. 2011. European Atherosclerosis Society Consensus Panel. Triglyceride-rich lipoproteins and high-density lipoprotein cholesterol in patients at high risk of cardiovascular disease: evidence and guidance for management. Eur. J. Heart., 32 (11): 1345-1361.

Cecchi, H. M. 2003. Theoretical and Practical Foundations in Food Analysis**.** 2nd edition. Rev.Publishing company Unicamp. Campinas, SP, 208p.

Cook, N. R., Appel, L. J., Whelton, P. K. 2016. Sodium intake and all-cause mortality over 20 years in the trials of hypertension prevention. J. Am. Col. Card., 68 (15):1609–1617.

Connor, S.L., Gustafson, J. R., Artaud-Wild, S.M., Flavell, D.P., Classick-Kohn, C. J., Hatcher, L. F, *et al*. 1986. The cholesterol/saturated-fat index: an indication of the hypercholesterolaemic and atherogenic potential of food. Lancet,1(8492):1229-1232.

De Biase, S. G., Fernandes, S. F., Gianini, R. J., Duarte, J. L. 2007. Vegetarian diet and cholesterol and triglycerides levels. Braz. Arch. Card., 88 (1): 35-39.

Delgado-Pando, G., Fischer, E., Allen, Kerry, J. P., O 'Sullivan, M. G.; Hamill, R. M. 2018. Salt content and minimum acceptable levels in whole muscle cured meat products. Meat Sci, 139: 179–186.

Franco, G. 2002. Chemical composition table of foods. 4 nd. Atheneu, São Paulo.

Frieden, T. R. 2016. Sodium reduction–saving lives by putting choice into consumers' hands. J. Am. Med. Assoc., 316(6): 579–580.

Forrest, J. C. *et al*. 1979. Fundamentos de ciencia de la carne. 1 ed. Zaragoza: Acribia. 365p.

Hammad, H. H. M., Guofeng, J., Meihu, M., Ibrahim, K., Rizwan, S., Abdeen, E. E., Qi, Z., Abeer, E. N. 2020. Comparative characterization of proximate nutritional compositions, microbial quality and safety of camel meat in relation to mutton, beef, and chicken. LWT - Food Sci. Techn., 118: 108714.

Henchion, M., McCarthy, M.,Resconi, V. C., Troy, D. 2014. Meat consumption: Trends and quality matters. Meat Sci., 98:561-568.

Lima, I. A., Gomes, H. B., Ramos, A. L. S., Piccoli, R. H., Ramos, E. M. 2017. Physical, chemical and microbiological characterization of deboned dry-cured ham with added lactulose. Braz. J.Food Technol., 20: 2016028.

Keys, A., Kimura, N., Kusukawa, A., Bonte-Stewart, B., Larsen, N., Keys, M.H. 1958. Lessons from serum cholesterol studies in Japan, Hawaii and Los Angeles. Annais Int.Med., 48 (1): 83-94.

Keys, A. 2008. Seven Countries: a multivariate analysis of atherosclerosis and coronary heart disease. Cambridge, MA: Harvard University Press; 1980.15. Lands B. A

critique of paradoxes in current advice on dietary lipids. Prog Lipid Res., 47 (2): 77-106.

Kumar, Y., Sanjivan, K. 2017. Spectral analysis: A rapid tool for species detection in meat products. Trends in Food Sci. Technol., 62:59-67.

Nascimento, R., Campagnol, P. C. B., Monteiro, E. S., Pollonio, M. A. R. 2007. Replacement of sodium chloride by potassium chloride: influence on the physicochemical and sensory characteristics of sausages. Food. Nut. Ara., 18(3): 297-302.

Novelo, D *et al*. 2007. Zootechnical evaluation and carcass quality of broilers fed diets containing fish meal or white oat. Rural Sci., 37(5):1430- 1435.

World Health Organization . 2017. Cardiovacular Disease. Available in: https://www.paho.org/bra/index.php?option=com_content&view=article&id=5253:doencas-cardiovasculares&Itemid=1096. Acessaed in: 11/18/2019.

Ordóñez, J. A. 2005. Food Technology. São Paulo, 2. Editora S. A. 294 p.

Oliveira, R. R., Lage, M. E., Neto, O. J. S., Sales, M. C. 2012. Natural Antioxidants In Meat Products. PUBVET., 6(10):197.

Price, J. F., Schweigert, B. S. 1994. Ciencia de la carne e de los productos carnicos. 2º ed. Ed. Zaragoza, p. 412-413.

Pino, L. M. 2005. Oxidative stability of broilers fed different lipid sources stored under freezing. Dissertation, Faculty of Food Science and Technology. 60 pp.

Pitombo, R. S., Souza, D. D. N., Ramalho, R. O. S., Figueiredo, A. B. A., Rodrigues, V. C., Freitas, Ferreira, J. C. S. 2013. Meat quality of superprocessive cattle finished in confinement. Braz. Arch.Vet. Med. Zoot., 65(4):1203-1207.

Pinheiro, R. S. B., Mendes Jorge, A., Francisco, C. L., Andrade, E. N. 2008. Chemical composition and yield of *in natura* and roast sheep meat. Food Sci.Technol., 28: 154-157.

Rocha, Y. R., Aguiar, J. P. L., Marinho, H. A., Shrimpton, R. 1982. Nutritional Aspects of Some Amazonian Fish. Acta Amaz., 12(4):787-794.

Salles-Filho, S., Zackiewics, M. 2001. Research priority for pigs and poultry. Meat Technol. Mag.,3(1):1-6.

Santin, J. 2011. Beef provides energy for athletes. Available in:

http://www.beefpoint.com.br/cadeia-produtiva/carne-saude/carne-bovina-fornece energia-para-atletas-76995n.aspx?agradeceComentario=1. Acessed in: 11/18/2019.

Santos, R. D., Gagliardi, A. C. M., Xavier, H. T., Magnoni, C. D., Cassani, R ., Lottenberg, A. M. P. 2013. I Guideline on fat consumption and cardiovascular health. Braz. Arch. Card.,100 (1), 48 pp.

Souza, A. A. 2011. Relationship between animal nutrition, meat quality and human health. Available in:

<http://www.beefpoint.com.br/radares-tecnicos/nutricao/relacoesentre-

nutrição animal-qualidade-de-carne-e-saude-humana-parte-1-76553n.aspx> Accessed in: 27/05/2013.

Terra, A. B., Fries, L. L. M., Terra, N. N. 2004. Salami manufacturing particularities. São Paulo: Book storeVarela. 152 p.

****