




ORIGINAL ARTICLE

Influence of intrinsic and extrinsic factors on the sensory perception and intention to purchase buffalo meat by consumers in Southeast Brazil

Influência de fatores intrínsecos e extrínsecos na percepção sensorial e intenção de compra de carne de búfalo de consumidores do Sudeste do Brasil

Bruna Fernandes Andrade¹ , Marielle Maria de Oliveira Paula¹, João de Deus Souza Carneiro¹, Paulo Rogério Fontes², Robledo de Almeida Torres Filho³, Eduardo Mendes Ramos¹ , Alcineia de Lemos Souza Ramos^{1*} 

¹Universidade Federal de Lavras (UFLA), Departamento de Ciência dos Alimentos, Lavras/MG - Brasil

²Universidade Federal de Viçosa (UFV), Departamento de Tecnologia de Alimentos, Viçosa/MG - Brasil

³Universidade Federal de Viçosa (UFV), Instituto de Ciências Exatas e Tecnológicas, Florestal/MG – Brasil.

***Corresponding Author:** Alcineia de Lemos Souza Ramos, Universidade Federal de Lavras (UFLA), Departamento de Ciência dos Alimentos, Campus Universitário, CEP: 37200-900, Lavras/MG - Brasil, e-mail: alcineia@ufla.br

Cite as: Andrade, B. F., Paula, M. M. O., Carneiro, J. D. S., Fontes, P. R., Torres Filho, R. A., Ramos, E. M., & Ramos, A. L. S. (2022). Influence of intrinsic and extrinsic factors on the sensory perception and intention to purchase buffalo meat by consumers in Southeast Brazil. *Brazilian Journal of Food Technology*, 25, e2022002. <https://doi.org/10.1590/1981-6723.00222>

Abstract

This study aimed to evaluate the effect of extrinsic factors (meat type, price, and nutritional claims) on purchase intention and the perception of intrinsic factors (tenderness, juiciness and flavor) in buffalo loin in a region of Brazil where the marketing of buffalo meat is not common. Photos of the steaks were treated and labels were designed to simulate the retail purchase process, with the effects of extrinsic factors being evaluated through conjoint analysis. Sensory tests of difference from control, purchase intention, and overall acceptance were performed for intrinsic factors. Regarding the purchase process, a determining factor was the price, with buffalo meat having a better purchase intention when associated with a lower price. The lowest price also proved to be more important than the presence of nutritional information for most respondents, however, nutritional information was necessary for consumers characterized over 50 years old. Good acceptance was perceived after tasting buffalo meat, even with less tenderness and juiciness compared to Nellore, and only a minority respondents were willing to pay more for it. The buffalo meat presents a potential option for the consumer, when offered in association with marketing strategies that emphasize nutritional and/or sensory information, such as tenderness and juiciness.

Keywords: Conjoint analysis; Purchase intention; Acceptance; Murrah, Nellore, Angus.



This is an Open Access article distributed under the terms of the [Creative Commons Attribution License](https://creativecommons.org/licenses/by/4.0/), which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

Resumo

O objetivo deste estudo foi avaliar o efeito de fatores extrínsecos (tipo de carne, preço e alegações nutricionais) sobre a intenção de compra e a percepção de fatores intrínsecos (maciez, suculência e sabor) em lombo de búfalo, em uma região do Brasil onde a comercialização de carne de búfalo não é comum. As fotos dos bifes foram tratadas e os rótulos foram projetados para simular o processo de compra a varejo, sendo os efeitos dos fatores extrínsecos avaliados através da *conjoint analysis*. Testes sensoriais de diferença do controle, intenção de compra e aceitação global foram realizados para os fatores intrínsecos. Em relação ao processo de compra, um fator determinante foi o preço, sendo que a carne de búfalo teve melhor intenção de compra quando associada a um menor preço. O menor preço também mostrou ser mais importante do que a presença de informações nutricionais para a maioria dos entrevistados, porém as informações nutricionais foram valorizadas pelos consumidores com mais de 50 anos. Foi percebida boa aceitação após degustação para a carne de búfalo, mesmo com menor maciez e suculência em relação à nelore, sendo que apenas uma minoria dos respondentes estava disposta a pagar mais por ela. A carne bubalina apresenta potencial opção para o consumidor quando sua ofertada é associada a estratégias de *marketing*, contendo informações nutricionais e/ou sensoriais, como maciez e suculência.

Palavras-chave: Análise conjunta; Intenção de compra; Aceitação; Murrah; Nelore; Angus.

Highlights

- Buffalo meat was less accepted and associated with a lower purchase intention than beef but was not rejected by consumers.
- Consumers over 50 years old value the presence of nutritional information.
- Buffalo meat has a promising market as a new commercial meat option because it has good acceptance and purchase intent.

1 Introduction

Buffalo farming is important for the production of meat, milk and other coproducts in less industrialized countries, especially in Asia. India is the largest world producer of buffalo meat, which is considered of lower quality than beef due mainly to the lack of herd standardization and the slaughter of large numbers of advanced age animals (Kiran et al., 2016; Lambertz et al., 2014). Brazil has the largest buffalo herd in the West, totaling 1.4 million animals (Instituto Brasileiro de Geografia e Estatística, 2019); however, the consumption of buffalo meat is still limited to some regions of the country. Buffalo meat is not well identified in part of Brazil due to its similarity with beef, as there are records that buffalo meat is marketed in two different ways: as buffalo meat, labeled as a high-quality (premium) meat; and sold as beef, when classified as having inferior quality (such as discarded females after the productive period) or when devalued in the producing region (Andrade et al., 2020; Oliveira et al., 2015).

There are few studies that discuss the quality of buffalo meat, especially in relation to sensory quality and the factors that influence consumer choice. The study of meat quality is complex because consumer perceptions and preferences are affected by a set of intrinsic and extrinsic factors (Meyerding et al., 2018; Shan et al., 2017). Intrinsic characteristics are related to aspects such as color, texture, juiciness, flavor and aroma, while extrinsic factors correspond to psychological and marketing factors, information displayed on the label, package design, price, and sociodemographic and cultural characteristics of consumers (Resurreccion, 2004; Bello Acebrón & Calvo Dopico, 2000). Thus, consumers rarely make choices using only one attribute. Generally, associations are made from a set of factors that may or may not promote satisfaction. As a result, consumer preferences and purchase intention are not homogeneous; *i.e.*, decisions to buy or not a product can be made based on different quality attributes (Verbeke & Viaene, 1999).

Conjoint analysis allows assessing the influence of certain preselected extrinsic factors on the purchase intention or acceptance of consumer groups (Green & Krieger, 1993). In development methodology, the products presented must be associated with a group attribute (product characteristics), and can be also alternated according to objective study, aiming at estimating relative importance of each one in the consumer's perception (Resurreccion, 2004). For meat and meat products in general, studies have indicated that some attributes have greater effects on consumer decision-making, such as country of origin of production (Bernabéu et al., 2018), meat type (Kibar & Mikail, 2018), price (Meyerding et al., 2018; Shan et al., 2017; Font i Furnols et al., 2011), nutritional warnings (Schnettler, et al., 2019), traceability (du Plessis & du Rand, 2012), animal management system (García-Torres et al., 2016), quality labels (Bernabéu et al., 2018; Font i Furnols et al., 2011) and food safety (Kibar & Mikail, 2018).

Recently, studies employing conjoint analysis have been combined with red meat sensory tests and resulted in a better understanding of the role of consumer preference in consumer decision-making at the time of purchase and after purchase, which predicts the repetition of the choice (Schnettler et al., 2019; Meyerding et al., 2018). Due to the lack of studies evaluating the relevant factors in the purchase of buffalo meat, this study aimed to understand the influence of extrinsic factors such as meat type (Nellore, Angus and Buffalo), price (high and low) and nutritional claims on buffalo meat labels (without and with) on purchase intention and to conduct a sensory evaluation of intrinsic attributes (tenderness, juiciness and flavor), purchase intention and overall acceptance with consumers in a region of Brazil where the marketing of buffalo meat is not common.

2 Materials and methods

2.1 Obtaining the raw material

Deboned, vacuum-packed loins (*M. longissimus lumborum*) of Murrah buffaloes and Nellore and Aberdeen Angus heifers, with a production date of 24 h (maximum 48 h) and labeled premium, were obtained from two commercial plants located in the Southeast region of Brazil. The loins were transported in a cooler to the Laboratory of Meat and Derivatives Technology (Laboratório de Tecnologia de Carnes e Derivados - LabCarnes) at the Federal University of Lavras (Universidade Federal de Lavras - UFLA) and subjected to maturation in a climatic chamber at 1.5 °C for 21 days. Subsequently, the loins were frozen (-20 °C) for 30 days until the date of sensory analysis.

2.2 Instrumental characterization of meat

The meat was thawed (4 °C/24 h), and a 2.5-cm thick steak was obtained for assessing quality characteristics of the *L. lumborum* muscle of the different animals. The steaks were exposed to air at room temperature for 60 minutes for oxygenation (blooming). Next, they were photographed in a photographic studio containing four vertical lamps at each corner and a Canon PowerShot camera positioned 34 cm from the ground and programmed for autofocus and ISO 80 speed. The images were used to prepare the labels for the conjoint analysis.

Subsequently, the instrumental color of the steaks was evaluated using a Minolta CM-700 spectrophotometric colorimeter, with an 8 mm aperture, illuminant A, 10° observer angle and specular component excluded, as described by Ramos & Gomide (2017). The pH of LT muscle was evaluated with an insertion electrode at three different points of each steak, using a portable pH meter (model HI99163; Hanna Instruments, Woonsocket, RI, USA) calibrated in pH 4.0 and 7.0 buffer solution. The marbling was evaluated by image analysis as described by Giarretta et al. (2018). Marbling percentage was obtained from the relative white versus red area in total.

Finally, the shear force (SF) of the steaks was evaluated under the same cooking conditions as those used for the sensory analysis. The steaks were seasoned with 1% refined. Equal portions of salt (0,5%) were added to both sides of the steak and were lightly rubbed. The amount of salt used corresponds to the minimum defined to mimic common conditions of preparation of consumers, being representative of the taste of consumers who participated in the study. Then the steaks were grilled on a hot plate (model SCGE; Croydon; Duque de Caxias, RJ, Brazil) preheated to 200 °C for exactly 2 min and 50 s, with a thermocouple placed at its geometric center. The steaks were cooked until reaching an internal temperature of 75 °C. Then, the steaks were cooled at room temperature for 4 h, and the SF was measured according to the Warner-Bratzler square shear force (WBsSF) methodology proposed by Silva et al. (2015).

2.3 Sensory evaluation

The difference from control, purchase intention, overall acceptance and willingness to pay tests were used in the sensory analysis. A total of 100 untrained evaluators who were eligible to participate in the study were recruited based on the following criteria: willing to consume red meat and being interested and available to participate. During the recruitment of the evaluators, no information regarding the specific objective of the study was provided. The study was approved by the Ethics Committee of UFLA (CAAE: 20353519.5.0000.5148/ ethics committee approval number 3.663.281), and all evaluators agreed to the terms of the study consent form. Before undergoing the sensory tests, the evaluators answered a questionnaire with questions about demographic characteristics and their red meat consumption profile.

After thawing (4 °C/24 h), the loins were portioned into 2.5-cm thick steaks (200 g; cross-section), salted (1% sodium chloride) and grilled as described in section 2.2. The final cooking temperature (75 °C) was determined based on Brazilian red meat consumption preferences, consisting predominantly of “medium” and “well done” meat (Ramos & Gomide, 2017). An internal rectangular sample of standard size (~8.0 cm × 4.0 cm × steak thickness) was removed (excluding the edges and external fats), cut transversely (to its longest length) into 1-cm thick samples and cut again in half, obtaining samples of approximately 4-6 g (2 × 2 × 1 cm) to be served to the panelists.

Four samples were made available for the test: one sample was labeled as reference (Nellore beef) and to the right of the sample, three coded (three digits) samples were randomly distributed, corresponding to buffalo meat and Angus and Nellore beef. Nellore beef was defined as a reference because it is most common meat in Brazilian market (Ramos & Gomide, 2017). The tests were performed in a single session, with more samples being given to the judges when requested. The evaluators were asked to taste the reference sample and then the coded samples, cleansing their palate with water between each evaluation.

First, the evaluator was asked to indicate existing relationships, of intensity of difference or similarity, between each coded sample and the reference for the attributes tenderness, juiciness and flavor, using a five-point structured scale: (1) much less tender/juicy/flavorful than the reference; (2) less tender/juicy/flavorful than the reference; (3) equal to the reference; (4) more tender/juicy/flavorful than the reference; and (5) much more tender/juicy/flavorful than the reference. Then, the evaluators were instructed to disregard the reference sample and individually evaluate only the coded samples. The evaluators were asked to indicate the acceptance and purchase intention for each coded sample, using the following structured five-point hedonic scales, respectively: (1) dislike it very much, (2) dislike it, (3) indifferent, (4) like it and (5) like it very much; and (1) definitely will not buy it, (2) probably will not buy it, (3) might or might not buy it, (4) probably will buy it and (5) definitely will buy it.

2.4 Conjoint analysis of factors

The extrinsic factors present on a label that most influence the consumer choice process were evaluated by Resurreccion (2004). The full-profile data collection method (Green & Srinivasan, 1978) was conducted

in two experiments to define the treatments. The factors meat type (buffalo, Angus and Nellore loin) and price (R\$ 49,99/kg - US\$ 9,59/kg and R\$ 29,99/kg - US\$ 5,75/kg) were evaluated in the first experiment, while the factors nutritional claim (with and without claim) and price (R\$ 49,99/kg and R\$ 29,99/kg) only for buffalo meat were evaluated in the second experiment. The treatments were formed by combining one level of each factor, totaling six treatments (3 meat types \times 2 prices) in the first experiment and four treatments (2 nutritional claims \times 2 prices) in the second experiment.

The prices used for kilogram of loin were based on the prices charged in local markets in Lavras, in the state of Minas Gerais, for premium meat. The nutritional information for buffalo meat, which has lower calories (45% less) and higher protein (11%) than beef, were formulated according to information from the Brazilian Association of Buffalo Breeders (Associação Brasileira de Criadores de Búfalos - ABCB).

Virtual labels and price tags for the test were developed in CorelDRAW® 2019 according to the Brazilian food labeling standards. The design of the label and product brand were standardized, differing only in regard to the information on the meat type, the presence of nutritional claims and the image of the animal muscle. The price tag was also standardized, containing only the basic information. Pictures of each type of meat, obtained as described in item 2.2, were used in the creation of virtual trays (Figure 1) simulating the marketing conditions for retail meat (retail display).



Figure 1. Some images used to simulate the marketing conditions for retail display evaluated in conjoint analysis: beef ribeye rolls of (a) Angus, (b) Nellore, and buffalo (c) without and buffalo ribeye rolls with nutritional claim (d), both with price of R\$29,99/kg.

The images of the products were evaluated by 403 respondents who were recruited online, untrained, eligible to participate in the study based on the following criteria: willing to consume red

meat and being interested and available to participate. No information was provided regarding the specific objective of the study, which was conducted after approval by the Ethics Committee of UFLA (CAAE: 20353519.5.0000.5148/3.663.281) and with the consent of the respondents. The respondents also answered a questionnaire on certain demographic characteristics and their red meat consumption profile.

The analysis was conducted through an online form, divided into three sections, in which the first consisted of the characterization of the respondents and their meat consumption profile, the second section corresponded to photos of the product packaging with the factors studied in the first experiment (meat type \times price), and the third section corresponded to photos of the buffalo meat packages with the factors studied in the second experiment (nutritional claim \times price). Photos of the packages were presented randomly in each section, one at a time. The respondents were instructed regarding the experimental procedure and the proposed situation to increase the validity of the results (Jaeger et al., 2017). They were asked to evaluate the products in the context of a daily choice situation at a market/butcher's display case, performed only once. Respondents were asked to measure their purchase intention for each product using a linear hedonic scale, from 1 to 5, with the following extremes: would not buy it (1) on the left and would buy it (5) on the right.

2.5 Statistical analysis

Statistical analysis were performed using the SAS® System for Windows™ (version 9.0; SAS Institute Inc., Cary, NC, USA), at a p -value of 0.05. The results of the physical-chemical characteristics were evaluated by Analysis of Variance (ANOVA), and then Tukey's means test was performed, adopting a 5% significance level.

The results obtained in tests of difference of control, purchase intention and acceptance were evaluated by ANOVA. In the control difference test, a comparison between means were performed using the Dunnett. The averages of the purchase intention and acceptance test were performed using the Tukey's test. In all tests of means were adopting a 5% significance level.

Conjoint factor analysis combined the additive model as a rule of composition (Steenkamp, 1986) and the clustering segmentation model as an analysis strategy (Moore, 1980). First, the part-worths were estimated by multiple linear regression, with dummy variables, and by least squares methods for each of the respondents. Next, respondents who did not fit the model ($P > 0.10$) were excluded, with no significant effect on any evaluated factor. The respondents who fit the model ($P < 0.10$) were clustered by the average linkage method with the Euclidean distance as a measure of part-worth dissimilarity. The groups were formed by participants who showed similar purchasing behavior (part-worths). After defining the number of groups, aggregate analysis was performed for each group, estimating the part-worths and relative importance for each group formed.

3 Results and discussion

3.1 Instrumental characterization of the loins

The pH, marbling, instrumental characteristics of shear force (WBsSF) and color indices of the buffalo (Murrah) and beef (Nellore and Angus) loin steaks are shown in Table 1. There was no difference in pH for different species of meat animals, with normal pH values for meat (5.5-5.8) (Ramos & Gomide, 2017). Buffalo meat were lower ($P < 0.05$) values for all color index (L^* , a^* , b^* , C^* and h), suggesting darker meat color. According to Dosi et al. (2006), the buffalo meat is darker in colour than bovine meat, probably due to factors as a higher myoglobin oxidation rate and lower marbling content.

Table 1. Quality characteristics of the *L. lumbrorum* muscle of Murrah buffalo and Nellore and Angus cattle.

Characteristics	Buffalo	Nellore	Angus	SEM	<i>p</i> -value ¹
pH	5.55	5.59	5.59	0.10	0.230
WBsSF (N)	18.11 ^a	17.91 ^b	17.53 ^c	0.13	<0.001
Color indexes					
Lightness, L*	37.17 ^c	33.99 ^b	39.20 ^a	0.32	<0.001
Redness, a*	16.00 ^c	21.18 ^a	23.21 ^a	0.37	<0.001
Yellowness, b*	7.32 ^c	12.32 ^a	14.81 ^a	0.25	<0.001
Chroma, C*	17.60 ^c	24.51 ^b	27.53 ^b	0.44	<0.001
Hue angle, h (°)	24.58 ^c	30.18 ^a	32.54 ^a	0.25	<0.001
Marbling percentage	3.67 ^b	6.23 ^a	5.72 ^a	1.25	<0.001

SEM = standard error of mean; WBsSF = Warner-Blatzer square Shear Force. ¹Significant probabilities ($P < 0.05$) are written in bold. ^{a-c} Means followed by different letters, between aging, differ from each other ($P < 0.05$) by Tukey's test.

Buffalo meat exhibited lower tenderness ($P < 0.05$) than beef (Nellore). Angus meat was more tender ($P < 0.05$) than beef (Nellore) as expected. According to Shackelford et al. (1995), the *Bos taurus* genotype is responsible for producing meat more tenderness than *Bos indicus*, due to induce a lower content of calpastatin and, increase intramuscular fat deposition (marbling) which contributes to the sensation of tenderness owing to stimulation of the taste buds. Nonetheless, all meats were considered “tender” by Destefanis et al. (2008) classification. According to Ramos & Gomide (2017) consumer's response meat tenderness has many variations, such as: method and degree of cooking, and the acceptability threshold of each consumer, mainly in meats with little difference in shear force. Therefore, shear force cannot always be used as a predictive model for sensory responses with consumers. Buffalo meat exhibited lower ($P < 0.05$) marbling content than bovine beef (Angus e Nellore). Therefore, it is expected a smaller contribution related to tenderness and juiciness perception sensorial buffalo meat. Although is expected greater marbling in Angus meat, no difference was found between Angus and Nellore meat. Marbling content is mainly dependent on species and management (feeding, breeding and slaughtering) animal (Ramos & Gomide, 2017).

3.2 Sensory evaluation

Of the 100 tasters, 51 were women, and 49 were men; most of them (58%) were young, aged between 18 and 29 years, with a predominant family income of 2 to 5 minimum wages. Fifty-seven percent of the consumers classified their consumption as “daily”, seeing that the majority of them (57%) had consumed Angus beef and only 16% consumed buffalo meat. The participants showed a preference for consuming well-done meat (53%).

3.2.1 Difference from control

Buffalo meat was considered ($P < 0.05$) less tender and juicy, while Angus meat was considered ($P < 0.05$) more tender and juicier than the Nellore beef reference. Conversely, the flavor of the buffalo meat and Angus beef did not differ ($P > 0.05$) from that of the reference Nellore beef. In addition, tenderness, flavor, and juiciness scores close to “(3) equal to the reference” indicated the accuracy of the sensory panel in terms of the similarity of the reference Nellore meat with its coded sample.

The tenderness, juiciness and flavor of meat are attributes of great importance for the general palatability of meat (O'Quinn et al., 2018). The buffalo meat was perceived as being less tender and juicy than the control sample (Nellore), which is an expected result because juiciness is one of the factors that contributes to the sensation of tenderness (Muchenje et al., 2009). According to the instrumental evaluation (Table 1), all three meats were below the shear force (WBsSF) of 31.5 N reported by Belew et al. (2003) for “very tender” muscles, a result that was expected for premium meats. When evaluating consumers in a restaurant and in the home, Huffman et al. (1996)

suggested that beef within the same instrumental tenderness (shear force) threshold, in general, is within the same acceptance threshold for the sensory perception of tenderness. Thus, it is likely that other factors contributed to the tenderness, especially the degree of marbling in the meats, which is highly related to the attributes juiciness and flavor (Thompson, 2004). Marbling fat refers to intramuscular fat, *i.e.*, the fat content distributed among muscle fibers, and animals of the European genotype (*Bos taurus*), such as Angus, have a greater tendency to accumulate this type of fat than do Zebu animals (*Bos indicus*), such as Nellore animals (Bressan et al., 2011). According to Iruqueta et al. (2008), the carcasses of Murrah buffaloes have a low degree of marbling, corresponding to the “small amount” classification on the American marbling scale for cattle. This is consistent with the results shown in this work, which indicated a greater sense of juiciness, tenderness and flavor for the Angus beef and lower sensations for the buffalo meat in relation to the control sample (Nellore).

Meat flavor is associated with the result of a series reactions which occur with lipids, sugars, vitamins (thiamine), amino acids, peptides, sulfur compounds, and among products of these reactions, generating volatile substances (Sun et al., 2022). According to Arshad et al. (2018), factors such as genetic difference and fatty acid composition can be identified as factors responsible for the difference in meat flavor.

Despite the significant differences in juiciness and tenderness, the flavor of buffalo meat was considered similar ($P < 0.05$) to that of Nellore beef. Hassan et al. (2018) evaluated, using a trained panel, the sensory differences between frozen Brazilian beef meat and Indian buffalo meat and reported lower tenderness, juiciness and flavor for buffalo meat. In turn, Canozzi et al. (2016) reported that among consumers in the state of Rio Grande do Sul, Brazil, buffalo meat had greater tenderness than Angus and Brangus (Brahman \times Angus) meat, with no difference in the attributes juiciness or sensory acceptance. Furthermore, according to those authors, only age and income were related to the consumers’ responses.

3.2.2 Purchase intention, overall acceptance and willingness to pay

All samples were located in the acceptable purchase intention regions, but there was a difference ($P < 0.05$) in the acceptance and purchase intention among the samples (Figure 2). The acceptance of the evaluators and purchase intention for Angus beef were higher ($P < 0.05$) than those for Nellore beef, which, in turn, were higher ($P < 0.05$) than those of buffalo meat. In addition, most evaluators would pay more for Angus (79%) and Nellore (56%) beef, whereas only 21% of evaluators would pay more for buffalo meat.

Although buffalo meat received lower sensory scores for purchase intention and acceptance, rejection was not observed among the evaluators. The acceptance, purchase intention and willingness to pay more for the meats were consistent with the perception of tenderness and juiciness.

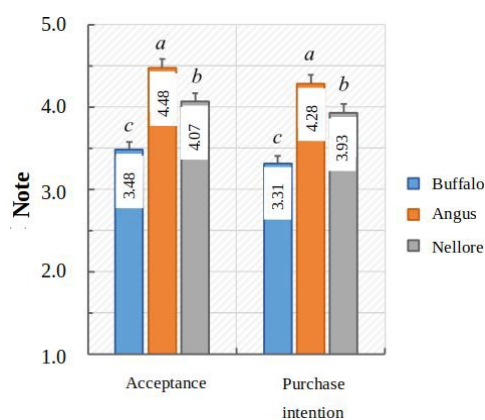


Figure 2. Average scores ($n = 100$) of acceptance and purchase intention buffalo meat and Nellore and Angus beef. Acceptance scale: (1) I will not buy it for sure; (2) I probably will not buy it; (3) I may or not buy it; (4) I will probably buy it; and (5) I will buy it for sure. Purchase intention scale: (1) dislikes it a lot; (2) little disgust; (3) indifferent; (4) likes it little; and (5) likes it a lot. ^{a-c} Means with different letters in same attribute, differ ($P < 0.05$) by the Tukey’s test.

3.3 Conjoint analysis

3.3.1 Effect of meat type and price on consumer purchase intention

In the first experiment, regarding the effect of meat type and price factors on the purchase intention of the respondents, only 35 of the 403 respondents did not fit the model and they were excluded. Cluster analysis resulted in the formation of seven groups with similar part-worths, consisting of 250, 55, 44, 15, 2, 1 and 1 respondents. The last three groups are not discussed because they were formed by few respondents. The demographic characteristics and red meat consumption profiles for each group are shown in Table 2.

Table 2. Demographic characteristics and consumption profiles of the respondents per group relative to the effects of meat type and price on the purchase intention of consumers.

% of total consumers	Group 1 (n = 250)	Group 2 (n = 55)	Group 3 (n = 45)	Group 4 (n = 15)
	67.9	14.9	12.2	4.0
DESCRIPTORS (%)				
Gender				
Female	55.2	69.4	80.0	63.6
Male	44.8	30.6	20.0	36.4
Age				
18 to 29 years	69.2	78.2	16.7	63.6
30 to 49 years	28.0	16.4	50.0	27.3
> 50 years	2.8	5.5	33.3	9.1
Income¹				
< 2 minimum wage	26.2	30.6	0.0	27.3
2 to 5 minimum wage	40.2	44.9	33.3	45.5
5 to 10 minimum wage	21.3	16.3	16.7	27.3
> 10 minimum wage	12.6	6.1	33.3	0.0
Responsible for buying meat				
Always	23.0	18.4	50.0	6.6
Often	30.5	24.5	16.6	20.0
Sometimes	23.5	26.5	16.7	26.7
Rarely/never	23.0	30.6	16.7	46.7
Frequency of meat consumption				
Rarely (<1 time a week)	7.6	12.7	0.0	18.2
1 to 2 times a week	24.0	25.5	66.7	36.4
3 to 5 times a week	52.0	49.1	16.6	36.4
Every day	16.4	12.7	16.7	9.0
Types of meat you have eaten				
Lamb	39.5	34.7	16.7	45.5
Goat	20.6	14.3	16.7	18.2
Buffalo	15.0	8.2	0.0	18.2
Horse	2.4	0.0	0.0	9.1
Have you ever eaten exotic meat?				
Yes, and I would eat it again	39.2	38.8	45.5	33.3
Yes, and I would not eat it again	10.1	4.1	18.1	16.7
No, but I would eat it	26.6	36.7	36.4	16.7
No, and I would not eat it	24.1	20.4	0.0	33.3
Have you ever eaten Angus beef?				
Yes	69.2	57.1	16.7	63.6

¹At the time of the survey, the Brazilian minimum wage was R\$ 1,045.00. Some descriptors were removed to facilitate understanding, without compromising the conclusions reached.

All the groups were formed mainly by female respondents (55.2 to 80.0%). The age profile of groups 1, 2 and 4, formed mainly by young people aged 18 to 29 years (63.6 to 78.2%), differed from group 3, formed mainly by respondents aged 30 to 49 years (50.0%). Income of 2 to 5 minimum wages was the most frequent income range in all groups (33.3 to 45.5%), with group 3 having an income above 10 minimum wages as the most frequent (33.3%), which is consistent with the older age profile for this group.

Group 3 was formed by the highest percentage (50.0%) of respondents who were “always” responsible for purchasing meat. The respondents in group 1 reported “frequently” (30.5%) and “sometimes” (23.5%) being responsible for purchasing meat, unlike those in groups 2 and 4, who were mainly “occasionally” or “never” responsible for purchasing meat (30.6 and 46.7%, respectively). Groups 1 and 2 reported higher frequencies of red meat consumption (49.1 to 52.0%, 3 to 5 times a week), whereas Group 3 had a lower frequency (66.7% with 1 to 2 times a week). Group 4 had a more diversified consumption profile.

In general, few respondents had expectations based on the previous consumption of buffalo meat. The highest percentages were found in groups 1 and 4 (15 and 18.2%, respectively), followed by group 2 (8.2%), and none of the respondents in group 3 had consumed buffalo meat. The vast majority of respondents were interested in consuming exotic meats, with group 3 having the highest percentage (81.9%) and group 4 the lowest percentage (50.0%) of respondents with this interest; groups 1 and 2 had intermediate percentages (65.8 to 75.5%) of respondents with this interest.

Most respondents also had expectations based on the previous consumption of Angus beef: 69.2% for group 1; 57.1% for group 2; and 63.6% for group 4. Group 3 had the highest percentage of respondents who had not consumed Angus beef or did not know how to answer (66.7%).

Table 3 describes the Relative Importance (RI) and the part-worths for the four main groups formed.

Table 3. Relative importance and part-worths for the groups formed from the conjoint analysis of meat type and price.

% of total consumers	Group 1	Group 2	Group 3	Group 4
	(n = 250)	(n = 55)	(n = 45)	(n = 15)
	67.9	14.9	12.2	4.0
Attributes and relative importance	Part-worths			
MEAT				
Angus	1.27	-0.39	-0.27	-0.73
Buffalo	-1.91	0.08	0.23	-0.37
Nellore	0.64	0.31	0.04	1.10
Relative importance (%)	93.40	21.38	14.90	54.46
PRICE¹				
Low (R\$ 29,99/kg)	0.11	1.30	1.43	0.77
High (R\$ 49,99/kg)	-0.11	-1.30	-1.43	-0.77
Relative importance (%)	6.60	78.62	85.10	45.54

¹ in Brazilian currency (real, R\$).

In group 1 (n = 250), which contained the majority (67.9%) of respondents, meat type had a higher RI (93.4%) than price (6.60%), indicating that the type of meat was the factor that most influenced the purchase intention of these respondents. They attributed a lower purchase intent to buffalo meat (-1.91), indicating that they were less willing to purchase this type of meat but greater purchase intentions for Angus beef (1.27), followed by Nellore beef (0.64).

Groups 2 (n = 55) and 3 (n = 45), which represented 27.1% of the respondents, attributed a higher RI to price (78.62 and 85.10%) and greater purchase intention for meats with a lower price (R\$ 29,99/kg), indicating that they were not willing to pay more for meat. Angus beef negatively affected the purchase

intention of these groups (-0.39 and -0.27, respectively). However, Group 3 had a higher purchase intention for buffalo meat, while Group 2 had a higher purchase intention for Nellore beef (0.23).

Conversely, group 4 ($n = 15$), which represented only 4.0% of the respondents, did not show a more prominent RI for only one factor, with a greater balance in RI between meat type (54.46%) and price (45.54%), indicating that both factors affected the purchase intention of this group. They had a greater intention to purchase Nellore beef at a lower price (R\$ 29,99/kg). It is also noteworthy that both Angus beef and buffalo meat contributed negatively to the purchase intention of this group (-0.73 and -0.37).

The vast majority of respondents had greater purchase intention for the lowest price meat, although not all of them attributed the same RI to this factor. Thus, it was possible to classify the respondents as those who selected the product by meat type, regardless of price (group 1, Table 3); those who opted for the lower price product (groups 2 and 3); and those who based their choice on two factors: meat type and lower price (group 4).

During the decision to purchase or not to purchase a product, consumers associate information related to factors extrinsic to the product, such as price, country of origin, traceability, animal management, brand and color (Meyerding et al., 2018), with previous experience of consumption, when preexisting, because consumers whose expectations formed in a previous tasting are confirmed or exceeded tend to repeat their choice (Deliza & MacFie, 1996). According to Meyerding et al. (2018), quality perception and meat preference are complex and may vary according to the sociocultural, technological, political and economic changes in consumers.

The highest purchase intention for meat type varied among the different groups of respondents. Angus beef is usually sold at a higher price than Nellore beef, and there is usually no regular supply of buffalo meat. This market characteristic is consistent with the higher percentage of participants who selected the product by meat type, regardless of price (67.9%) and showed a preference for Angus beef compared to Nellore beef, while the other respondents did not prefer Angus beef. Although a study reported that the relationship between meat price and quality is not always clear (Schnettler et al., 2019), the result found is in accordance with those from a study by Meyerding et al. (2018), in which consumers associated genotype with meat quality and, in general, considered Angus beef to be of better quality. Thus, it is expected that they associated high price with protection against low-quality products (Merlino et al., 2018).

Buffalo meat was one of the meats with the highest purchase intention, along with Nellore beef, for the 27.1% (groups 2 and 3) of respondents who opted for the lower price product. These consumers were more interested in consuming exotic meats (75.5 to 81.9%), albeit with a lower percentage of respondents who had already consumed buffalo meat (8.2 and 0.0%) and a higher percentage of respondents who were “always” responsible for purchasing red meat (Table 2).

In addition, group 3 (12.2% of the participants) was composed mainly of respondents who expressed a preference for buffalo meat (0.23) compared to Nellore beef (0.04). Group 3 was composed mainly of respondents aged between 40 and 49 years (33.3%) and > 50 years (33.3%), with an average family income above 10 minimum wages (33.3%). As buffalo meat is not regularly offered in Brazil, the simulation of an everyday purchase from a supermarket or butcher's display case may have contributed to the higher price per kilogram being considered a barrier to product choice rather than being associated with quality.

Kibar & Mikail (2018) evaluated the effect of meat type (beef, lamb, goat), purchasing sources and price on consumer choice. Those authors found that regular consumers decide whether to purchase meat based mainly on price. Conversely, nonregular consumers were more selective in choosing the type of meat. Du Plessis & du Rand (2012) also reported that price was the main factor to be considered in consumer decision-making when purchasing lamb meat.

Therefore, the results suggested that when buffalo meat was sold at low prices, it could be noted that consumers who had a higher frequency of responsibility for purchasing meat, aged between 30 and 39 years, with an average family income above 10 minimum wages and with a higher willingness to consume exotic meats might be the target audience for the buffalo meat market, even though they did not have previous experience of consuming this product. Other factors may also have contributed to the differences in the purchase intention of the products, such as the appearance of the steaks (Figure 1), which differed in size and shape, color and fat content.

3.3.2 Effect of price and nutritional claims on intention to purchase buffalo meat

In the second experiment regarding the effect of price and nutritional claims on the label of buffalo meat on the respondents' purchase intention, 146 responses from the 403 respondents were eliminated because they did not fit the model. Cluster analysis resulted in the formation of seven groups with similar part-worths within each group, consisting of 172, 63, 6, 12, 2, 1 and 1 respondents. Because the last three groups were formed by few respondents, their data are not discussed. Table 4 shows the demographic characteristics and red meat consumption profile for each group.

Table 4. Demographic characteristics and consumption profiles of the respondents per group relative to the effects of price and nutritional claims on intention to purchase buffalo meat.

% of total consumers	Group 1 (n = 172)	Group 2 (n = 63)	Group 3 (n = 6)	Group 4 (n = 12)
	66.9	24.5	2.3	4.7
Descriptors				
Gender				
Female	49.4	65.1	33.3	83.3
Male	50.6	34.9	66.7	16.7
Age				
18 to 29 years	73.5	85.7	83.3	83.3
30 to 49 years	24.1	11.1	0.0	16.7
> 50 years	2.4	3.2	16.7	0.0
Income¹				
< 2 minimum wage	27.1	31.7	50.0	25.0
2 to 5 minimum wage	44.1	44.4	50.0	33.3
5 to 10 minimum wage	18.8	12.7	0.0	33.3
>10 minimum wage	10.0	11.2	0.0	8.4
Responsible for buying meat				
Always	18.2	19.1	16.7	33.3
Often	32.4	30.2	33.3	8.3
Sometimes	25.3	20.6	33.3	41.7
Rarely/never	24.1	30.1	16.7	16.7
Frequency of meat consumption				
Rarely (<1 time a week)	8.8	9.5	0.0	16.7
1 to 2 times a week	28.8	27.0	16.7	16.7
3 to 5 times a week	45.3	44.5	66.6	58.3
Every day	16.5	19.0	16.7	8.3
Types of meat you have eaten				
Lamb	44.1	41.3	33.3	50.0
Goat	20.0	23.8	0.0	25.0
Buffalo	12.9	19.0	33.3	8.3
Horse	3.5	1.6	0.0	0.0
Have you ever eaten exotic meat?				
Yes, and I would eat it again	38.2	39.7	66.6	58.4
Yes, and I would not eat it again	9.4	6.3	0.0	0.0
No, but I would eat it	33.0	36.5	16.7	33.3
No, and I would not eat it	19.4	17.5	16.7	8.3
Do you read labels?				
Always/often	40.0	28.6	50.0	33.3
Sometimes	22.9	27.0	16.7	16.7
Occasionally/never	37.1	44.4	33.3	50.0

Table 4. Continued...

% of total consumers	Group 1	Group 2	Group 3	Group 4
	(n = 172)	(n = 63)	(n = 6)	(n = 12)
	66.9	24.5	2.3	4.7
Descriptors				
Important information on frozen or vacuum-packed meat packages				
Shelf life	93.5	96.8	83.3	83.3
Nutritional information	22.4	14.3	16.7	0.0
Animal welfare information	12.4	7.9	0.0	0.0
Brand	52.9	46.0	50.0	41.7
Chemical additives	25.9	20.6	33.3	25.0

¹At the time of the survey, the Brazilian minimum wage was R\$ 1,045.00. Some descriptors were removed to facilitate understanding, without compromising the conclusions reached.

Groups 1 and 3 comprised mostly of men (50.6 to 66.7%), and groups 2 and 4 comprised mostly of women (65.1 to 83.3%). All groups were formed mostly by young people aged 18 to 29 years (73.5 to 85.7%), with an average family income of 2 to 5 minimum wages being the most frequent income range in all groups (33.3 to 50.0%) and a frequency of red meat consumption of 3 to 5 times per week (44.5 to 66.6%).

A low percentage of respondents had expectations based on the previous consumption of buffalo meat (8.3 to 33.3%), and a high percentage of respondents showed interest in consuming exotic meats (71.2 to 91.7%). In general, the respondents had a low frequency of reading product labels, with groups 2 and 4 composed mainly of those who “occasionally/never” read product labels (44.4 and 50.0%, respectively) and groups 1 and 3 composed of respondents who had a higher frequency (always/frequently) of reading product labels (40.0 and 50.0%, respectively).

Among the information considered important on frozen or vacuum-packed meat packages, in general, expiration date was said to be of great importance (83.3 to 93.5%), followed by brand (41.7 to 52.9%), the presence of additives (20.6 to 33.3%), nutritional information (0.0 to 22.4%) and animal welfare (0.0 to 7.9%). Only in Group 4 all participants did not consider the nutritional information on meat packages.

Table 5 shows the relative importance and the part-worths for the four main groups formed.

Table 5. Relative importance and part-worths for the groups formed from the conjoint analysis of price and nutritional information for Buffalo meat.

% of total consumers	Group 1	Group 2	Group 3	Group 4
	(n = 172)	(n = 63)	(n = 6)	(n = 12)
	66.9	24.5	2.3	4.7
Attributes and relative importance		Part-worths		
PRICE¹				
Low (R\$ 29,99/kg)	0.17	1.03	-0.67	1.71
High (R\$ 49,99/kg)	-0.17	-1.03	0.67	-1.71
Relative importance (%)	98.33	84.09	40.00	91.11
NUTRITIONAL INFORMATION				
Without	-0.003	-0.19	-1.00	0.17
With	0.003	0.19	1.00	-0.17
Relative importance (%)	1.67	15.91	60.00	8.89

¹ in Brazilian currency (real, R\$).

In group 1 (n = 172), which represented the majority (66.9%) of the respondents, the price for buffalo meat had a higher RI (98.33%) than the nutritional claims (1.67%), thus indicating that price was the factor that most influenced the purchase intention of these respondents. They attributed a lower purchase intention to the higher price (-0.17), indicating that they were not willing to pay more for the presence of positive nutritional claims (0.003). Group 2 (n = 63), which represented 24.5% of the respondents, had a profile

similar to that of group 1, in which the lower price (1.03) had the highest RI (84.09%) on the purchase intention of respondents, *i.e.*, they were not willing to pay more for the presence (0.19) of positive nutritional claims, but with higher part-worth values.

Only in group 3 ($n = 6$), which represents only 2.3% of the respondents, it could be observed that nutritional claims had a higher RI (60%) than price (40.0%), with the presence of nutritional claims (1.00) and a higher price (0.67) contributing positively. This suggests that these respondents were willing to pay more for buffalo meat due to its nutritional benefits.

For group 4 ($n = 12$), which represented only 4.7% of the respondents, the price also had a higher RI (91.11%) than nutritional claims (8.89%), and the lower price led to greater purchase intention (1.71). However, nutritional claims contributed negatively (-0.17) to the purchase intention of only the respondents in Group 4. Thus, these respondents preferred lower price buffalo meat without nutritional information.

Two profiles of respondents were formed for buffalo meat: those who wanted to pay less, regardless of nutritional claims on the label (groups 1, 2 and 4; Table 4); and those who would pay more for meat with nutritional claims on the label (group 3), with the latter being very small.

Even though most consumers cared much more about the price than the nutritional claims, the vast majority of respondents positively evaluated the presence of nutritional claims on the label of buffalo meat. Only a small percentage of respondents were willing to overpay for buffalo meat with the presence of nutritional claims on the label, *i.e.*, were more concerned with health (Group 3); this group was mainly characterized by men, with a lower average family income (< 2 minimum wages, 50%; 2 to 5 minimum wages, 50%) and, in relation to the other groups, had a higher percentage (16.7%) of participants older than 50 years (Table 4).

This result suggests that age may be a factor involved in the decision to purchase buffalo meat. According to Troy & Kerry (2010), the presence of information associated with human health, such as fat and cholesterol content, on the label of beef influences consumer choice.

Merlino et al. (2018) showed that the importance attributed to nutritional information depends on the meat type and meat product evaluated. However, Schnettler et al. (2019) also reported that consumers attributed positive importance to sausages that had reduced amounts of salt and saturated fat but were not willing to overpay for the product. In addition, Shan et al. (2017) reported that although consumers value reformulated sausage with a positive impact on health, purchase intention was still more strongly influenced by price. These results are important because, although those studies were conducted with other respondents, in general, the reformulation of meat products, which sometimes have more variations in health-related aspects compared to aged meat from different species, were not considered to have a greater impact on consumer decisions.

The nutritional claim for buffalo meat did not positively influence the purchase intention of the majority of respondents. Thus, it is suggested that other factors be addressed, associated with sensory quality such as tenderness and juiciness, to favor the purchase of buffalo meat these consumers.

4 Conclusions

Although buffalo and Nellore meat showed differences in terms of tenderness, juiciness, and flavor, buffalo meat did not show sensory rejection, suggesting sensory acceptance by consumers after the tasting experience.

These results can be used to guide the launch product market in the southeastern region of the country according to the industry objective. Possibly due to the habit of consuming beef in the region, offering buffalo meat at higher prices (like gourmet meats) would not be an interesting strategy. According to the results shown in this work, the nutritional information must be presented on the packaging to attend to the demand of a specific group of consumers who, under these conditions, prefer buffalo meat. It should also promote marketing strategies to enhance the sensory characteristics (flavor, juiciness, and texture) and thus expand the target audience.

Acknowledgements

The authors would like to thank the Minas Gerais State Research Support Foundation (FAPEMIG; CVZ APQ-03315-17) and the National Council for Scientific and Technological Development (*Conselho Nacional de Desenvolvimento Científico e Tecnológico* (CNPq); MCT 430206/2016-0) for their financial support and the FAPEMIG for the Master's degree scholarship offered to the first author. They also like to thank Mr. Renato Sebastiani and the Frigorífico Cowpig for the research support.

References

- Andrade, B. F., Castro, M. M., Rodrigues, L. M., Torres Filho, R. A., Fontes, P. R., Ramos, E. M., & Ramos, A. L. (2020). Effects of delayed chilling on rigor development and meat quality of Murrah buffalo from different production systems. *Research, Social Development*, 10(6), 2021.
- Arshad, M. S., Sohaib, M., Ahmad, R. S., Nadeem, M. T., Imran, A., Arshad, M. U., Kwon, J. H., & Amjad, Z. (2018). Ruminant meat flavor influenced by different factors with special reference to fatty acids. *Lipids in Health and Disease*, 17, 223. PMID:30249252. <http://dx.doi.org/10.1186/s12944-018-0860-z>
- Belew, J. B., Brooks, J. C., McKenna, D. R., & Savell, J. W. (2003). Warner–Bratzler shear evaluations of 40 bovine muscles. *Meat Science*, 64(4), 507-512. PMID:22063134. [http://dx.doi.org/10.1016/S0309-1740\(02\)00242-5](http://dx.doi.org/10.1016/S0309-1740(02)00242-5)
- Bello Acebrón, L., & Calvo Dopico, D. (2000). The importance of intrinsic and extrinsic cues to expected and experienced quality: an empirical application for beef. *Food Quality and Preference*, 11(3), 229-238. [http://dx.doi.org/10.1016/S0950-3293\(99\)00059-2](http://dx.doi.org/10.1016/S0950-3293(99)00059-2)
- Bernabéu, R., Rabadán, A., El Orche, N. E., & Díaz, M. (2018). Influence of quality labels on the formation of preferences of lamb meat consumers. A Spanish case study. *Meat Science*, 135, 129-133. PMID:28968556. <http://dx.doi.org/10.1016/j.meatsci.2017.09.008>
- Bressan, M. C., Rodrigues, E. C., Rossato, L. V., Ramos, E. M., & Gama, L. T. (2011). Physicochemical properties of meat from *Bos taurus* and *Bos indicus*. *Revista Brasileira de Zootecnia*, 40(6), 1250-1259. <http://dx.doi.org/10.1590/S1516-35982011000600013>
- Canozzi, M. E. A., Sphor, L. Á., Pimentel, C. M. M., Barcellos, J. O., Poli, C. H. E. C., Bergmann, G. P., & Kindlein, L. (2016). Sensory evaluation of beef and buffalo extensively reared and its relationship to sociodemographic characteristics of consumers. *Semina: Ciências Agrárias*, 37(3), 1617. <http://dx.doi.org/10.5433/1679-0359.2016v37n3p1617>
- Deliza, R., & MacFie, H. J. H. (1996). The generation of sensory expectation by external cues and its effect on sensory perception and hedonic ratings: a review. *Journal of Sensory Studies*, 11(2), 103-128. <http://dx.doi.org/10.1111/j.1745-459X.1996.tb00036.x>
- Destefanis, G., Brugiapaglia, A., Barge, M. T., & Dal Molin, E. (2008). Relationship between beef consumer tenderness perception and Warner–Bratzler shear force. *Meat Science*, 78(3), 153-156. PMID:22062265. <http://dx.doi.org/10.1016/j.meatsci.2007.05.031>
- Dosi, R., Di Maro, A., Chambery, A., Colonna, G., Costantini, S., Geraci, G., & Parente, A. (2006). Characterization and kinetics studies of water buffalo (*Bubalus bubalis*) myoglobin. *Comparative Biochemistry and Physiology. Part B, Biochemistry & Molecular Biology*, 145(2), 230-238. PMID: 16959515. <http://dx.doi.org/10.1016/j.cbpb.2006.07.006>
- du Plessis, H. J., & du Rand, G. E. (2012). The significance of traceability in consumer decision making towards Karoo lamb. *Food Research International*, 47(2), 210-217. <http://dx.doi.org/10.1016/j.foodres.2011.05.029>
- Font i Furnols, M., Realini, C., Montossi, F., Sañudo, C., Campo, M. M., Oliver, M. A., Nute, G. R., & Guerrero, L. (2011). Consumer's purchasing intention for lamb meat affected by country of origin, feeding system and meat price: A conjoint study in Spain, France and United Kingdom. *Food Quality and Preference*, 22(5), 443-451. <http://dx.doi.org/10.1016/j.foodqual.2011.02.007>
- García-Torres, S., López-Gajardo, A., & Mesías, F. J. (2016). Intensive vs. free-range organic beef. A preference study through consumer liking and conjoint analysis. *Meat Science*, 114, 114-120. PMID:26771143. <http://dx.doi.org/10.1016/j.meatsci.2015.12.019>
- Giaretta, E., Mordenti, A. L., Canestrari, G., Brogna, N., Palmonari, A., & Formigoni, A. (2018). Assessment of muscle Longissimus thoracis et lumborum marbling by image analysis and relationships between meat quality parameters. *PLoS One*, 13(8), e0202535. PMID:30133495. <http://dx.doi.org/10.1371/journal.pone.0202535>
- Green, P. E., & Krieger, A. M. (1993). Chapter 10 Conjoint analysis with product-positioning applications. *Handbooks in Operations Research and Management Science*, 5, 467-515. [http://dx.doi.org/10.1016/S0927-0507\(05\)80033-7](http://dx.doi.org/10.1016/S0927-0507(05)80033-7)
- Green, P. E., & Srinivasan, V. (1978). Conjoint analysis in consumer research: issues and outlook. *The Journal of Consumer Research*, 5(2), 103-123. <http://dx.doi.org/10.1086/208721>
- Hassan, M. A., Abdel-Naeem, H. H. S., Mohamed, H. M. H., & Yassien, N. A. (2018). Comparing the physico-chemical characteristics and sensory attributes of imported Brazilian beef meat and imported Indian buffalo meat. *Journal of Microbiology, Biotechnology and Food Sciences*, 8(1), 672-677. <http://dx.doi.org/10.15414/jmbfs.2018.8.1.672-677>

- Huffman, K. L., Miller, M. F., Hoover, L. C., Wu, C. K., Brittin, H. C., & Ramsey, C. B. (1996). Effect of beef tenderness on consumer satisfaction with steaks consumed in the home and restaurant. *Journal of Animal Science*, 74(1), 91-97. PMID:8778116. <http://dx.doi.org/10.2527/1996.74191x>
- Instituto Brasileiro de Geografia e Estatística – IBGE. (2019). *Municipal Livestock Production (PPM) 2018*. Rio de Janeiro: IBGE. (in portuguese).
- Irurueta, M., Cadoppi, A., Langman, L., Grigioni, G., & Carduza, F. (2008). Effect of aging on the characteristics of meat from water buffalo grown in the Delta del Paraná region of Argentina. *Meat Science*, 79(3), 529-533. PMID:22062913. <http://dx.doi.org/10.1016/j.meatsci.2007.12.010>
- Jaeger, S. R., Hort, J., Porcherot, C., Ares, G., Pecore, S., & MacFie, H. J. H. (2017). Future directions in sensory and consumer science: four perspectives and audience voting. *Food Quality and Preference*, 56, 301-309. <http://dx.doi.org/10.1016/j.foodqual.2016.03.006>
- Kibar, M., & Mikail, N. (2018). Application of conjoint analysis to determine consumers' red meat preferences in Siirt province. *Scientific Papers-Series D-Animal Science*, 61, 303-306.
- Kiran, M., Naveena, B. M., Reddy, K. S., Shahikumar, M., Reddy, V. R., Kulkarni, V. V., Rapole, S., & More, T. H. (2016). Understanding tenderness variability and ageing changes in buffalo meat: biochemical, ultrastructural and proteome characterization. *Animal*, 10(6), 1007-1015. PMID:27076348. <http://dx.doi.org/10.1017/S1751731115002931>
- Lambertz, C., Panprasert, P., Holtz, W., Moors, E., Jaturasitha, S., Wicke, M., & Gauly, M. (2014). Carcass characteristics and meat quality of swamp buffaloes (*Bubalus bubalis*) fattened at different feeding intensities. *Asian-Australasian Journal of Animal Sciences*, 27(4), 551-560. PMID:25049987. <http://dx.doi.org/10.5713/ajas.2013.13555>
- Merlino, V. M., Borra, D., Girgenti, V., Dal Vecchio, A., & Massaglia, S. (2018). Beef meat preferences of consumers from Northwest Italy: analysis of choice attributes. *Meat Science*, 143, 119-128. PMID:29738962. <http://dx.doi.org/10.1016/j.meatsci.2018.04.023>
- Meyerding, S. G. H., Gentz, M., Altmann, B., & Meier-Dinkel, L. (2018). Beef quality labels: A combination of sensory acceptance test, stated willingness to pay, and choice-based conjoint analysis. *Appetite*, 127, 324-333. PMID:29792892. <http://dx.doi.org/10.1016/j.appet.2018.05.008>
- Moore, W. L. (1980). Levels of aggregation in conjoint analysis: an empirical comparison. *Journal of Marketing Research*, 17(4), 516-523. <http://dx.doi.org/10.1177/002224378001700410>
- Muchenje, V., Dzama, K., Chimonyo, M., Strydom, P. E., Hugo, A., & Raats, J. G. (2009). Some biochemical aspects pertaining to beef eating quality and consumer health: A review. *Food Chemistry*, 112(2), 279-289. <http://dx.doi.org/10.1016/j.foodchem.2008.05.103>
- O'Quinn, T. G., Legako, J. F., Brooks, J. C., & Miller, M. F. (2018). Evaluation of the contribution of tenderness, juiciness, and flavor to the overall consumer beef eating experience1. *Translational Animal Science*, 2(1), 26-36. PMID:32704687. <http://dx.doi.org/10.1093/tas/txx008>
- Oliveira, A. C. S., Ferreira, B. C. A., Cardoso, G. V. F., Silva, C. L., Silva, A. S., Silva, F., Melo, R. M., Cardilli, D. J., Leite, F. P. L., Roos, T. B., & Moraes, C. M. (2015). Evaluation of a multiplex PCR for detection of a fraud in the minced beef meat by adding buffalo meat (in portuguese). *Revista do Instituto Adolfo Lutz*, 74, 371-379.
- Ramos, E. M., & Gomide, L. A. M. (2017). *Meat quality assessment: fundamentals and methodologies* (2a ed.). Viçosa: Editora UFV. (in portuguese).
- Resurreccion, A. V. A. (2004). Sensory aspects of consumer choices for meat and meat products. *Meat Science*, 66(1), 11-20. PMID:22063927. [http://dx.doi.org/10.1016/S0309-1740\(03\)00021-4](http://dx.doi.org/10.1016/S0309-1740(03)00021-4)
- Schnettler, B., Ares, G., Sepúlveda, N., Bravo, S., Villalobos, B., Hueche, C., & Lobos, G. (2019). Are consumers willing to pay more for reformulated processed meat products in the context of the implementation of nutritional warnings? Case study with frankfurters in Chile. *Meat Science*, 152, 104-108. PMID:30844619. <http://dx.doi.org/10.1016/j.meatsci.2019.02.007>
- Shackelford, S. D., Wheeler, T. L., & Koohmaraie, M. (1995). Relationship between shear force and trained sensory panel tenderness ratings of 10 major muscles from *Bos indicus* and *Bos taurus* cattle. *Journal of Animal Science*, 73(11), 3333-3340. PMID:8586592. <http://dx.doi.org/10.2527/1995.73113333x>
- Shan, L. C., De Brún, A., Henchion, M., Li, C., Murrin, C., Wall, P. G., & Monahan, F. J. (2017). Consumer evaluations of processed meat products reformulated to be healthier - A conjoint analysis study. *Meat Science*, 131, 82-89. PMID:28494317. <http://dx.doi.org/10.1016/j.meatsci.2017.04.239>
- Silva, D. R. G., Torres Filho, R. A., Cazedey, H. P., Fontes, P. R., Ramos, A. L. S., & Ramos, E. M. (2015). Comparison of Warner-Bratzler shear force values between round and square cross-section cores from cooked beef and pork Longissimus muscle. *Meat Science*, 103, 1-6. PMID:25569815. <http://dx.doi.org/10.1016/j.meatsci.2014.12.009>
- Steenkamp, J.-B. E. M. (1986). Perceived quality of food products and its relationship to consumer preferences: theory and measurement. *Journal of Food Quality*, 9(6), 373-373. <http://dx.doi.org/10.1111/j.1745-4557.1986.tb00807.x>
- Sun, A., Wu, W., Soladoye, O. P., Aluko, R. E., Bak, K. H., Fu, Y., & Zhang, Y. (2022). Maillard reaction of food-derived peptides as a potential route to generate meat flavor compounds: A review. *Food Research International*, 151, 110823. PMID:34980374. <http://dx.doi.org/10.1016/j.foodres.2021.110823>
- Thompson, J. (2004). The effects of marbling on flavour and juiciness scores of cooked beef, after adjusting to a constant tenderness. *Animal Production Science*, 44(7), 645-652. <http://dx.doi.org/10.1071/EA02171>

Influence of intrinsic and extrinsic factors on the sensory perception and intention to purchase buffalo meat by consumers in Southeast Brazil

Andrade, B. F. et al.

Troy, D. J., & Kerry, J. P. (2010). Consumer perception and the role of science in the meat industry. *Meat Science*, 86(1), 214-226. PMID:20579814. <http://dx.doi.org/10.1016/j.meatsci.2010.05.009>

Verbeke, W., & Viaene, J. (1999). Beliefs, attitude and behaviour towards fresh meat consumption in Belgium: empirical evidence from a consumer survey. *Food Quality and Preference*, 10(6), 437-445. [http://dx.doi.org/10.1016/S0950-3293\(99\)00031-2](http://dx.doi.org/10.1016/S0950-3293(99)00031-2)

Funding: Ministério da Ciência, Tecnologia e Inovação/Conselho Nacional de Desenvolvimento Científico e Tecnológico (MCT 430206/2016-0) and Fundação de Amparo à Pesquisa do Estado de Minas Gerais (CVZ APQ-03315-17).

Received: Jan. 10, 2022; **Accepted:** Sept. 13, 2022

Associate Editor: Carmen Josefina Contreras Castillo.