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Brazilian Carbon Neutral Beef as an Innovative Product: Consumption Perspectives Based on Intentions' Framework

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ABSTRACT

Before launching a new beef brand concept based on high sustainability and environmental production principles, the Brazilian market was tested using a survey informed by Intentions' Framework scales. To identify the determinants of the willingness to consume and pay for a new brand of beef based on Carbon-Neutral production principles, 1,000 valid responses were evaluated, using Exploratory Factor Analysis. A Hierarchical Cluster Analysis identified five classes of respondents. The classes showed general skepticism regarding exaggerated ethical and/or sustainability claims which led to rejection or indifference, particularly of those from lower income families with children. Despite this, there was an overall positive attitude toward good production practices and product innovation. The resulting typology throws a light onto consumers in markets such as Brazil or similar. The dataset could be also further explored by stakeholders in beef chain, particularly in new product development, positioning and targeting segments.

Introduction

In meat supply chains, whenever the verification and control systems have failed, consumers have reacted by distrusting food products and their brands. This has been typical of, for example, the Horse Meat scandal, and the BSE cases in the UK, as well as the Meat Traceability failure in Brazil, to name but a few. These scandals have had an immediate and devastating impact on the demand for meat (Cunha, de Moura, Lopes, Santos & Silva, 2010; Quevedo-Silva et al., 2020; Sander et al., 2018; Verbeke et al., 2007). As a result of the breakdown of trust, consumers have favored those products and brands which guarantee higher ethical, food safety and environmental standards. Consequently, initiatives such as the One Health concept which guarantee the integration of human, animal and environmental concerns that mitigate issues of food safety and risk management to avoid supply chain disruption (Zinsstag et al., 2020) has gained traction. Therefore, sustainability and environmental issues have been deemed to be the new drivers influencing food consumption (Liu et al., 2015).

Brewer and Prestat (2002) proposed a model containing six attitudinal determining factors, specifically, food chemistry, consumer health, food spoiling, regulatory issues, fraud and third-party assertive actions. It became a milestone in consumer behavior research to the extent that each factor

can be explained as having an impact on the purchase decision (Bolek, 2020; Evans & Redmond, 2016; Nam et al., 2018; Wilcock & Ball, 2017). Furthermore, it has also become of interest to stakeholders, particularly in meat supply chains, because better solutions can be found during critical situations.

Yet, the consumers' attitudes regarding food safety can widely differ according to their respective attributed levels of concern regarding an issue. Therefore, purchase intentions have been deemed to be a complex construct involving psychological, sociocultural, and demographic factors which contribute to the building of consumers' attitudes. Nonetheless, other variables such as individuals' beliefs have also become part of some models aimed at explaining intention (Fishbein & Ajzen, 2011; Lucchese-Cheung et al., 2020). Individual beliefs can influence the way consumers interpret food safety and how they evaluate benefits and risks. Beliefs can also influence how trust is gained (or lost) as well as the extent to which they attach credibility to information sources. Thus, these different ways of perceiving foods end up affecting consumers' purchase intentions by influencing their willingness to pay (Liu et al., 2015; Telligman et al., 2017a; Verbeke & Vackier, 2004).

Consequently, strengthening brand and certification attributes have been critical as to how companies guarantee consumers' access to relevant information in an attempt to assure greater safety and enhance consumers' trust (Grunert et al., 2004; Verbeke & Ward, 2006). This is the reason why animal protein certification has become a choice attribute which enhances product quality perception and confidence for meat consumers (Aprile et al., 2012). Furthermore, Henchion et al. (2017) have mentioned the stakeholders' efforts in guaranteeing production systems, animal welfare, and products' origin through certification schemes. These consequently assure environmental safeguard methods, traceability, animal nutrition integrity, genetic improvement and technologies as part of the production process.

Extensive research has been conducted into consumption behavior, preferences and the willingness of beef consumers to pay more for products carrying labels that communicate traceability, as well as product differentiation based on meat quality guarantees (Chen & Huang, 2013; Cicia et al., 2010; Dickinson & Von Bailey, 2005; Hobbs et al., 2005; Lim et al., 2014; Menozzi et al., 2015; Song et al., 2017; Van Rijswijk & Frewer, 2012; Wu et al., 2011). Therefore, it is widely accepted that traceability has contributed toward increased consumers' confidence in food systems supporting quality assurance (Hobbs, 2016). For example, knowing about an animal's origin has proven to be of great relevance for European consumers (Spence et al., 2018; Telligman et al., 2017b). As a result, some countries have been recognized for having better production and traceability systems than others, which has been the case of the UK. Thus, origin has become an important quality attribute that further guarantees consumers' trust. Discerning consumers, who recognize the value of product differentiation, believe that the price paid for a product should reflect the higher cost resulting from its assured quality and safety certification processes.

Furthermore, it has been also the case that food supply chains often fail to provide sufficient guarantees to attest for food integrity, quality and safety Trienekens (2011). According to Hobbs (2020), the COVI19 pandemic has also served to increase the concerns consumers had toward food production systems, particularly regarding animal health and welfare. To guarantee a continuous meat supply that did not jeopardize consumers' health, meat processing companies were forced to adjust their slaughter and meat processing lines to minimize consumers' negative product safety risk perception. All efforts were made to avoid a detrimental effect on demand. Burnier et al. (2021) proposed the concept of Legality, which is about how consumers perceive the ability of slaughterhouses and meat processors to adhere to, for example, the expected labor force and work condition standards. This is particularly relevant in meat processing establishments which operate under a low pay policy and often offer low working conditions. Thus, a solution would be that, instead of having a risk attenuation approach, improvements should be implemented in the production processes that can allow traceability, by enhancing transparency and the sharing of credible information.

The Brazilian agricultural and livestock commodity production systems have attracted a lot of negative publicity in recent years. To address this, and in the light of the United Nations Climate Change Conference COP26, public and private initiatives have attempted to tackle the extent

traditional and inefficient food production models have been detrimental to long term sustainability of the sector. In view of this, Alves et al. (2015) explained that the Brazilian Agricultural Research Corporation (EMBRAPA), via its Beef and Livestock Station (CNPGC) have set up a producers' certification scheme initially for those farmers supplying meat to Marfrig Global Foods S/A. Under the scheme, beef producers not only adhered to Carbon Neutral Beef (CNB) method of production, but also to a guaranteed quality standard. The proposal of an assured high-quality carbon neutral beef constituted an innovative concept brand in the market. It would cater for lower carbon and greenhouse gases emissions, high animal welfare, the adoption of good agricultural practices which should not be detrimental to the environment, as well as the compliance with current Brazilian socio-environmental legislation.

The cornerstone of the CNB concept brand was based on farmers adhering to an Integrated Crop-Livestock-Forest (ILPF) production system. According to Alves et al. (2015), ILPF has the capability of enabling sustainable intensification through the more efficient use of land, i.e. the diversification of production though using soil rotation aimed at conservation. It would also cater for a better use of natural resources and inputs, the reduction of land pressure (earth-saving effect on land change use), animal welfare, carbon sequestration and the mitigation of greenhouse gas emissions via its sequestration. Thus, the production of beef cattle, from systems adopting ILPF would enable Marfrig Global Foods SA to supply sustainable meat produced in the tropics to both the domestic and the world market.

Aiming at better understanding the Brazilian beef consumer behavior prior to launching such an innovative brand into the market, a study was carried out as part of a collaboration among the Federal University of Mato Grosso do Sul (UFMS), the University of Sao Paulo (ESALQ/USP) and EMBRAPA Beef and Livestock Station (CNPGC). The initiative was also co-funded by a public-private partnership scheme between CNPGC and Marfrig Global Foods S/A. The overarching study aimed at better understanding the public's perceptions, purchase intentions and consumption roles regarding such an innovative beef brand. It also aimed at proposing a typology of beef consumers based on profiles and behaviors affected by the main determinants of the willingness to consume and pay for differentiated protein. Following this a methodology, data analysis, discussion and conclusions will be presented based on partial results of a larger study.

Material and methods

For the purpose of data collection, a company specialized in market research was contracted because it had access to a nationwide panel of respondents covering all the 26 Brazilian states and the Federal District. A questionnaire survey was created and distributed to those who were primary purchasers of meat in their households. The survey was distributed via the Internet to 1,000 people during May 2020, and 100% of the responses were collected and collated. The questionnaire comprised of demographic profiling questions (gender, marital status, household) and statements based on three intention's frameworks. Firstly, to measure the constraints *Traceability and Legality*, the Burnier et al. (2021) scale was used containing four components. Secondly, the level of *Subjective Knowledge* about certification was measured using a scale adapted from Gürhan-Canli (2003), consisting of three components. Finally, the *Purchase Intention* was measured using the scale adapted by Kozup et al. (2003) with four components. The questionnaire was organized using *Likert* scale scores ranging from 1 (Strongly Disagree) to 7 (Strongly Agree).

The dataset consisted of 1,000 data entries containing 90 variables based on the aforementioned scales. Considering a higher correlation significance of the variable, 31 were selected (not exactly 1 and not close to 0). Despite assuming a normal distribution with the correlation between variables being null, that in practice did not exist (Gujarati & Porter, 2009). Consequently, the "non-null" and "different from one" correlations between variables have been deemed to be favorable conditions in multivariate analysis with Principle Components (Johnson & Wichern, 2007). Based on the Pearson correlation analysis of the values between the variables, it is thus justifiable that those with a certain degree of correlation should be selected despite them not having initially been considered.

An Exploratory Factor Analysis (EFA), which is as a multivariate data reducer and/or confirmatory technique, was used to seek for a structure in a set of variables. EFA was performed in the dataset to explore the likely structure as well as to test a hypothesis (Hair et al., 2018). According to Johnson and Wichern (2007), the factor model adopted for an observed variable X_i with a mean μ_I was:

$$X_i - \mu_i = \tau_{i1}F_1 + \tau_{i2}F_2 + \ldots + \tau_{im}F_m + \varepsilon_i \tag{1}$$

Following the EFA a Hierarchical Cluster Analysis was carried out with data based on the 31 selected variables. An adequate number of clusters were obtained (Hair et al., 2018), thus, allowing for typification and the grouping of individuals surveyed (observations). The cluster analysis was based on the calculation of Euclidean distance as a measure of dissimilarity employing the Ward's aggregation criterion and using SPAD and R Program (Team, 2018) software.

Results and discussions

The sample was characterized as being non-probabilistic (Hair et al., 2018), representing a majority of respondents who were between 25 and 35 years of age (52.8%), who had a university degree (49.9%) and 52.8% were female. As for the territorial distribution of the respondents, 38% where from the South-East; 24% from the North-East; 20% from the South; 10% from the North and 8% from the Center-West region. This proportionality was in accordance with the Brazilian *per capita* consumption of beef based on data of the last Brazilian Family Budget Survey (POF-2009) collected by the Brazilian National Statistics Institute (IBGE) (Instituto Brasileiro de Geografia e Estatística [IBGE], 2010). Therefore, the sample distribution has conferred a greater validity and representativeness of the sample.

The Hierarchical Cluster Analysis resulted in five classes representing respondents according to the dendrogram in Figure 1. The classes were: Indifferent Attitudes, Trending Sustainable Attitudes, In Favor of Animal and Human Welfare, Very Positive Attitudes Toward CNB, Negative Attitudes Toward CNB. Tables 1–5 contain the share of the respondents within each class and the description of the respective classes. For example, Class 1 represented about 20.7% of the total 862 valid responses in this study.

Special attention should be paid to the value of each of the variables where the test value represented the extent a variable contributed to the formation of a particular class. Consequently, the higher the value, the more that variable contributed to the formation of the class. Conversely, negative values expressed the opposite idea. That meant the negative variable, for example, Appearance (−1960), in Class 1, represented a non-significant behavior of the group of individuals in that class.
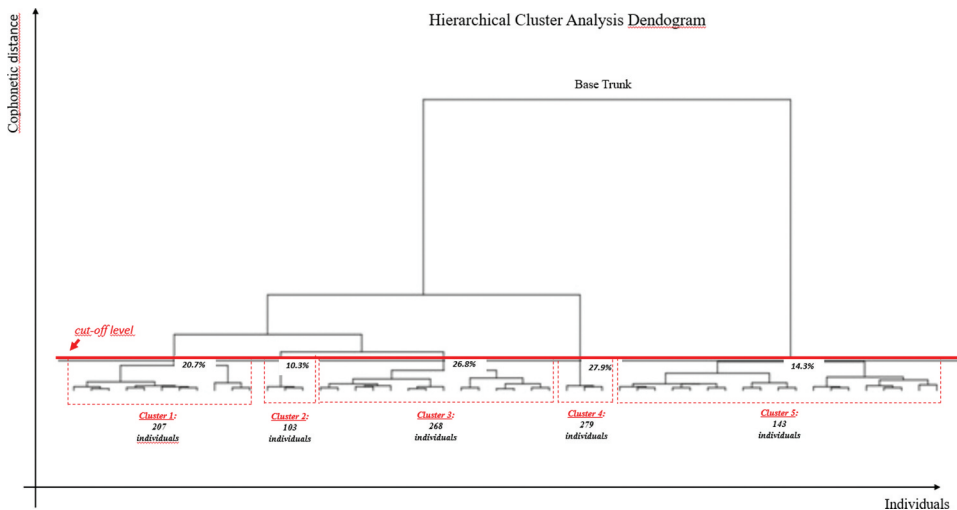

Figure 1. Dendrogram.

Table 1. Indifferent attitude toward CNB.

Variables Characteristic of Class 1 (20.7%)	Average within the class	Standard deviation within the class	Test Value
Children	4,072	2.235	2.435
Appearance	6.551	0.860	−1.960
Price	6.087	1.213	−2.124
My choice of beef is an expression of myself	3.831	1.877	−2.313
When it comes to certified beef, I consider myself to be an expert	3.454	1.890	−2.338
Fat level	5.672	1.393	−2.412
Packing	5.512	1.451	−2.482
Color	6.362	1.063	−2.516
Brand	4.947	1.558	−2.595
Friends ask me for my recommendation when buying beef	3.599	1.953	−2.657
When buying beef, I'm always sure of my choice	5.357	1.427	−2.950
My choice of beef communicates my image to others	3.802	1.887	−3.053
Texture	6.121	1.121	−3.217
I know everything about certified meats	3.386	1.724	−3.250
Certification	6.043	1.283	−3.925
I am concerned whether meat processors adhere to the legislation	5.981	1.167	−4.107
A tracked and traced food is safer	5.754	1.263	−4.369
I am concerned whether farmers adhere to the legislation	5.787	1.384	−4.496
I only choose beef when it is possible to identify its origin	5.034	1.540	−4.530
I try to choose foods that assure me of their origin	5.966	1.160	−4.556
Sustainable: I don't buy a product when I know it is detrimental to the environment	5.014	1.295	−4.573
I am concerned whether farmers and slaughterhouses adhere to labor standards	5.551	1.396	−4.930
I am concerned whether farmers and slaughterhouses refrain from employing slave labor	5.643	1.522	−4.993
I am concerned whether beef is produced from a sustainable farm	5.135	1.523	−5.063
I am concerned whether farmers have adopted sustainable practices that have reduced greenhouse gas emissions	5.058	1.522	−5.788
I am concerned whether beef is produced under water conservation and waste preventing methods	5.285	1.517	−5.923
I try to choose foods that can be traced back to their origin	5.208	1.551	−6.204
Sustainable: I don't buy products manufactured or sold by companies that harm the environment	4.633	1.431	−6.225
I am concerned whether the beef I buy is produced in farms that have not been deforested	5.101	1.552	−6.231
Future: many people tend to daydream about the future	4.754	1.573	−6.953
Sustainable: Whenever possible, I always choose products would cause less pollution	5.106	1.247	−7.220
Sustainable: When I buy goods and food, my concern for the environment interferes with my purchase decision	4.594	1.183	−7.637
Future: I spend time thinking about what my future will be like	4.845	1.388	−7.748
Sustainable: Whenever possible I always try to reduce the use of plastics	4.729	1.156	−7.753
Future: I usually think about what I will do in the future	5.232	1.313	−7.772
Future: I think a lot about what my life will be like	5.213	1.356	−8.731
BE: I am concerned whether slaughter was humanely	4.802	1.392	−8.799
BE: I care whether the animals were raised in the most natural and free manner possible	4.831	1.097	−9.507
BE: I am concerned whether the animals received a humane treatment	4.836	1.172	−9.680
BE: I am concerned whether the animals received adequate food and were treated fairly	4.952	1.227	−10.497

Regarding the attitudinal profile of Class 1, CNB was not a concept brand that would be consumed daily, thus it would not have a central role in the composition of the households' meat purchases. For that class, when choosing beef, little attention would be paid to attributes such as Appearance (−1.960), Fat Level (−2.412), Color (−2.516), Packaging (−2.482), Brand (−2.595) and Texture (−3.217). Moreover, Certification (−3.925) and Knowledge of Certification (−3.250) also attracted negative test values, thus justifying the presence of other variables that negatively contributed to the formation of this class such as: "Tracked and Traced Food is Safer" (−4.369); a low concern about Traceability; Good Production Methods; Legality (−4.107), expressed in the statement "I Worry Whether Meat Processors Adhere to

Table 2. Sustainable attitude in vogue.

Variables Characteristic of Class 2 (10.3%)	Average within the class	Standard deviation within the class	Test Value
CNB allows for maintaining the current level of red meat consumption without it neither being a contributor factor of greenhouse gas intensification nor destroying the environment	1.495	0.500	6.096
Compared to traditional beef, CNB protects the environment much more	1.466	0.499	5.343
BE: I am concerned whether the animals received adequate food and were treated fairly	6.388	0.937	3.812
Sustainability can be measured and verified in food production.	1.146	0.353	3.435
BE: I am concerned whether the animals received a humane treatment	6.175	1.127	3.182
Supermarket	1.777	0.812	3.140
I am concerned whether meat processors adhere to the legislation	6.621	0.752	2.973
I try to choose foods that assure me of their origin	6.602	0.817	2.929
BE: I care whether the animals were raised in the most natural and free manner possible	6.107	1.190	2.805
I am concerned whether beef is produced under water conservation and waste preventing methods	6.206	1.059	2.450
I am concerned whether farmers and slaughterhouses adhere to labor standards	6.320	1.117	2.408
Appearance	6.854	0.427	2.380
I am concerned whether farmers adhere to the legislation	6.466	1.050	2.363
Gender	1.612	0.487	2.306
I only choose beef when it is possible to identify its origin	5.796	1.503	1.994
When it comes to certified beef, I consider myself to be an expert	3.369	1.961	−1.985
Meat boutique	2.447	0.833	−2.094
The crisis caused by the Corona virus is a health one, and presently I am afraid to consume beef	3.058	1.985	−2.149
Sustainable: When I buy goods and food, my concern for the environment interferes with my purchase decision	4.981	1.607	−2.500
Friends ask me for my recommendation when buying beef	3.417	2.022	−2.671
I feel a little lost when choosing meat	3.408	2.111	−2.925
I know everything about certified meats	3.107	1.864	−3.642
Education	4.942	1.816	−3.698
Family Income	3.359	1.314	−3.758
I never know if I'm making a good choice when purchasing beef	3.029	1.953	−4.385
I would buy CNB if it were available in the market	4.039	1.915	−11.878
There is a high probability that I will buy CNB	3.951	1.819	−12.101
I would trade the beef I eat today for CNB	3.039	1.757	−13.241
I am willing to pay a higher price for CNB	1.874	1.067	−15.108
I would be willing to pay more for CNB	1.903	1.170	−15.625
I would pay more for CNB compared to conventional meat	2.019	1.132	−15.726
I would spend my money on CNB because it is worth the additional cost	2.223	1.149	−16.098

the Legislation," and Risk Probability based on the statement I Am Sure Of My Choice (−2.950). Moreover, issues related to Good Production Methods were again not determinant of consumption behavior neither were Sustainability (−4.573), the Environment (−7.637) and Animal Welfare (−9.680).

The demographics of Class 1 were typical of those belonging to large households particularly with many children. For that Class, Price (−2.124) did not attract a high negative test value, thus indicating that to some extent price was not a major issue. However, the respondents would still not be willing to pay a higher price for beef certification. Consequently, the likely innovative product CNB would not be relevant for those in that Class.

Class 2, Trending Sustainability Attitude, made up 10.3% of the sample and represented those who declared themselves to be aware of sustainability and animal welfare issues. However, their views did not necessarily mirror their purchasing behavior. This could be interpreted as if the issues were considered as being part of current common knowledge, hence "fashionable." In that Class, the notion of food quality and safety in beef were expressed as concerns about Animal Welfare (3.182), Legality (2.973) and Origin (2.929).

Table 3. Attitude in favor of animal and human welfare.

Variables Characteristic of Class 3 (26.8%)	Average within the class	Standard deviation within the class	Test Value
BE: I care whether the animals were raised in the most natural and free manner possible	6.284	0.869	7.262
BE: I am concerned whether the animals received adequate feed and health treatment	6.410	0.730	7.103
BE: I am concerned whether the animals have received a humane and ethical treatment throughout their life	6.265	0.919	6.837
Future: I think a lot about how my life will be like	6.463	0.812	6.658
BE: I worry if the slaughter was carried out humanly	6.224	1.030	6.532
Sustainable: When I buy goods and food, my concern for the environment interferes with my purchase decision	5.869	0.993	6.076
Future: I usually think about the things I will do in the future	6.358	0.872	6.061
Sustainable: Whenever possible, I always choose products that would cause less pollution	6.231	0.876	5.988
Sustainable: I always make an effort to reduce the use of products that use scarce natural resources.	5.959	1.038	5.879
Future: I spend time thinking about how my future will be like	6.022	1.065	5.232
I only choose beef when it is possible to identify its origin	6.597	0.703	5.148
I try to choose foods that assure me of their origin	6.205	1.061	5.132
I am concerned about farmers adhering to the legislation	6.526	0.891	5.066
A tracked and traced food is a safer one	6.437	0.851	4.714
Sustainable: I don't buy a product if I know about the likely damage it could cause to the environment	5.843	1.142	4.592
I am concerned whether farmers and slaughterhouses refrain from employing slave labor	6.448	1.034	4.587
I am concerned about meat processors adhering to the legislation	6.556	0.811	4.271
I would buy CNB if it were available in the market	6.056	0.935	4.269
I am concerned whether beef comes from processors that conserve water and prevent its waste	6.172	1.133	4.212
Future: many people tend to daydream about the future	5.843	1.260	4.204
Certification	6.593	0.807	4.149
I am concerned whether farmers and slaughterhouses adhere to labor standards	6.302	1.090	4.060
I am concerned about beef being produced from farms that have not been deforested	5.989	1.291	4.005
I am concerned the farmer has adopted practices that reduce greenhouse gas emissions	5.951	1.276	3.760
Sustainable: I don't buy products manufactured or sold by companies that harm the environment	5.612	1.416	3.713
There is a high probability that I will buy CNB	5.974	0.979	3.659
Texture	6.534	0.852	3.498
I worry whether beef comes from a sustainable farm	5.993	1.270	3.356
Fat level	6.112	1.182	3.149
Color	6.660	0.629	2.763
Packing	5.963	1.307	2.675
Is fresh	6.713	0.655	2.311
I only choose beef when it is possible to identify its origin	5.683	1.390	2.234
Brazil produces beef with greater sustainability and well-being standards than other countries	1.396	0.489	2.116
Appearance	6.754	0.628	2.072
I would trade the beef I eat today for CNB	5.396	1.299	2.044
Brand	5.403	1.459	2.022
CNB meat makes it possible to maintain the current levels of red meat consumption without neither intensifying greenhouse gas effect nor destroying the environment	1.201	0.401	−2.101
Compared to traditional beef, CNB protects the environment much more	1.201	0.401	−2.142

Despite having an attitude of mistrust toward innovation in beef, the variables that best represented the perception of the respondents in Class 2 related to concerns about sustainability. As for product's attributes, Appearance (2.380) contributed the most to this class's formation. Those in Class 2 were typically male who had a higher education degree, and a family's monthly income between US$733 and US$1,368,[1] thus belonging to the B2 stratum according to the Brazilian Family Budget Survey (POF-2009; IBGE, 2010).

Table 4. Very positive attitudes toward CNB.

Variables Characteristic of Class 4 (27.9%)	Average within the class	Standard deviation within the class	Test Value
I am willing to pay a higher price for CNB	6.444	0.814	19.247
I would pay more for CNB compared to conventional meat	6.505	0.761	18.750
I would spend my money on CNB because it is worth the additional cost	6.538	0.727	18.385
I would be willing to pay more for CNB	6.416	0.892	17.928
Sustainable: When I buy products and food, my concern for the environment interferes with my purchase decision	6.670	0.713	16.009
I would trade the beef I eat today for CNB	6.559	0.921	15.140
Sustainable: I always make an effort to reduce the use of products that use scarce natural resources.	6.634	0.818	14.550
There is a high probability that I will buy CNB	6.799	0.467	14.364
BE: I worry whether the animals have received a humane treatment	6.785	0.490	13.875
Sustainable: Whenever possible, I always choose products that cause less pollution	6.810	0.467	13.844
Sustainable: I don't buy a product when I know the likely damage it can cause to the environment	6.573	0.826	13.785
BE: I am concerned whether the slaughter was carried out humanly	6.796	0.513	13.725
I would buy CNB if it were available in the market	6.774	0.607	13.715
BE: I care whether the animals were raised in the most natural and free manner possible	6.756	0.626	13.661
Sustainable: I don't buy products manufactured or sold by companies that harm the environment	6.427	1.058	13.299
BE: I am concerned whether the animals received adequate feed and health treatment	6.835	0.433	13.149
Future: I spend time thinking about what my future will be like	6.627	0.819	12.990
Future: I usually think about the things I will do in the future	6.796	0.540	12.327
I am concerned whether beef comes from a sustainable farm	6.660	0.745	11.710
I am concerned whether the farmer has adopted practices that reduce greenhouse gas emissions	6.591	0.854	11.680
Future: I think a lot about how my life will be like	6.796	0.591	11.500
Future: many people tend to daydream about the future	6.416	1.194	11.040
I am concerned about where beef that comes from farms that have not been deforested	6.556	0.910	10.944
I am concerned whether beef is produced under water conservation and waste preventing methods	6.656	0.796	10.635
I try to choose foods that can be traced back to their origin	6.620	0.833	10.612
I only choose beef when it is possible to identify its origin	6.373	1.125	10.602
I am concerned whether farmers and slaughterhouses adhere to labor standards	6.746	0.695	10.177
A tracked and traced food is a safer one	6.778	0.575	9.925
I know everything about certified meats	4.753	2.043	9.373
I am concerned whether meat processors adhere to the legislation	6.857	0.487	9.299
I try to choose foods that assure me of their origin	6.814	0.509	9.014
I am concerned whether farmers adhere to the legislation	6.789	0.594	9.003
Friends ask me for my recommendation when buying beef	4.914	2.149	8.850
I am concerned whether farmers and slaughterhouses refrain from employing slave labor	6.688	0.943	7.939
When it comes to certified beef, I consider myself a connoisseur	4.602	2.136	7.906
My choice of beef is an expression of myself	4.957	2.126	7.786
You can tell a lot about the person based on their choices	4.928	2.119	7.608
Certification	6.796	0.665	7.595
My choice of beef communicates my image to others	4.961	2.048	7.353
When buying beef, I'm sure of my choice	6.158	1.316	6.878
Brand	5.814	1.649	6.795
Packing	6.237	1.210	6.257
Texture	6.645	0.803	5.627
I like a meal which contains beef more than one that does not	5.864	1.719	5.576
Fat level	6.233	1.203	4.935
Beef is important to me	5.878	1.549	4.914
Color	6.756	0.742	4.738
Appearance	6.867	0.599	4.658
During the Corona virus pandemic, I started to consume more beef	4.480	2.227	4.515
Is fresh	6.781	0.780	3.823

(Continued)

Table 4. (Continued).

Variables Characteristic of Class 4 (27.9%)	Average within the class	Standard deviation within the class	Test Value
Beef is absolutely necessary for me	5.470	1.809	3.578
Price	6.462	1.015	3.519
The crisis caused by the Corona virus is a health one and, presently I am afraid of consuming beef	3.806	2.355	3.021
Family Income	4.108	1.605	2.864
Marital Status	1.595	0.559	1.989
Gender	1.448	0.497	−2.201
Children	3.405	2.197	−2.882
Sustainability is something that can be measured and verified in food production	1.029	0.167	−2.956
Brazil produces beef with greater sustainability and well-being than other countries	1.262	0.440	−3.369
Responsible for purchasing beef	1.315	0.543	−3.516
CNB meat makes it possible to maintain the current level of red meat consumption without neither being a source of greenhouse gas intensification effect nor destroying the environment	1.151	0.358	−4.477
Compared to traditional beef, CNB protects the environment much more	1.151	0.358	−4.516

Interestingly, both the statements "I would buy CNB if it were available in the market" and "There is a high probability that I will buy CNB" attracted negative test values of −11.878 and −12.101 respectively. The respondents in this class rejected the new concept brand CNB. Similarly to Class 1, the respondents also tended to be price sensitive, however, the test value price sensitiveness was higher (−15.108). Yet, they declared "I care whether the animals were raised in the most natural and free manner possible" (2.805) and agreed that sustainability could be measured in food production (3.435). On the other hand, they indicated neither to be very familiar with the topic of Animal Certification (−3.642), nor to be Concerned about the Health issues when Consuming Beef during the Covid19 pandemic. Furthermore, they declared it would be safer to choose beef according to product Origin (1.994). They also mentioned that Concern About The Environment (−2.500) would not be relevant in their purchase decision.

Yet, the respondents grouped in that Class tended to contradict their original perceptions regarding CNB. Thus, the typification of this class is valuable for further studies of purchase behavior in meat. This is because despite them expressing positive attitudes toward sustainability, often a declared intention is not necessarily reflected as a behavior. The respondents in that class, typically of lower income households, tended to be price sensitive as they would not purchase better quality certified beef. In turn, their attitude would negatively impact on their willingness to change their usual consumption behavior. In the case of Class 2, the respondents were aware of the concept of sustainability, but, by not being able to fully understand the issues around it, they could not see the advantages of a meat certification label. Therefore, sustainability awareness was acted as following a trend which is a trend in the media instead of embedding that knowledge in their purchase routines.

Class 3 approximately represented 27% of the respondents and it was characteristically made up of positive test values which favored attitudes toward beef consumption supporting Animal Welfare Issues, Good Production Systems, Health and Welfare Conditions and Slaughter. These respondents also tended to be Concerned about the Future (6.061). The most relevant attributes of choice for this Class were those related to Sustainability, Origin and Traceability. Both intrinsic meat attributes such as Texture, Color, Fat Level, Being Fresh, and extrinsic such as Packaging positively contributed to the formation of this class, despite them being less preponderant. Therefore, Class 3 was named "Attitudes in Favor of Animal and Human Welfare," which was also supported by other attributes such as Concerns with the Days to Come, Legality of Production Systems and Slaughterhouses that Favor High Labor Standards, Reject Exploitation and the Use of Slave Labor. Consequently, these

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[1]In 2020, the average Brazilian Real currency exchange rate to the American dollar was R$5.156 to US$1.00.

Table 5. Attitudes against CNB.

Variables Characteristic of Class 5 (14.3%)	Average within the class	Standard deviation within the class	Test Value
CNB meat makes it possible to maintain the current level of red meat consumption neither being a source of greenhouse gas intensification effect nor without destroying the environment	1.364	0.481	3.423
Children	4.238	2.193	2.898
Sustainability is something that can be measured and verified in food production	1.119	0.324	2.750
Compared to traditional beef, CNB protects the environment much more	1.336	0.472	2.554
Butcher	1.965	0.560	2.508
Family Income	3.594	1.492	−2.515
The crisis caused by the Corona virus is a health one and presently I am afraid of consuming beef	2.986	1.881	−3.032
During the Corona virus pandemic, I started to consume more beef	3.476	1.812	−3.424
I would rather prefer a meal containing beef than one that does not	4.797	1.945	−3.738
Beef is absolutely necessary for me	4.524	1.996	−4.308
You can tell a lot about the person based on their choice	3.385	1.813	−4.750
Beef is important to me	4.825	1.926	−4.860
Price	5.783	1.587	−4.942
My choice of beef is an expression of myself	3.392	1.892	−5.016
When it comes to certified beef, I consider myself an expert	2.888	1.836	−5.350
My choice of beef communicates my image to others	3.203	1.842	−5.732
Fat level	5.245	1.690	−5.857
I am always consulted when a friend needs a recommendation	2.979	1.822	−5.866
Color	6.042	1.414	−6.178
I know everything about certified meats	2.825	1.661	−6.195
Is fresh	6.070	1.471	−7.337
When buying beef, I'm sure of my choice	4.727	1.673	−7.772
Brand	4.161	1.887	−8.003
Texture	5.664	1.482	−8.027
Appearance	6.084	1.531	−8.387
Packing	4.748	1.920	−8.408
Certification	5.301	1.710	−11.162
I am concerned whether farmers and slaughterhouses refrain from employing slave labor	4.797	1.872	−11.434
I would trade the beef I eat today for CNB	3.629	1.633	−11.616
I am willing to pay a higher price for CNB	2.839	1.403	−11.696
Future Many people tend to daydream about the future	3.944	1.709	−11.797
I would be willing to pay more for CNB	2.923	1.449	−11.916
I would pay more for CNB compared to conventional meat	2.986	1.458	−12.219
I would spend my money on CNB because it is worth the additional cost	3.175	1.445	−12.463
I only choose beef when it is possible to identify its origin	3.860	1.700	−12.899
I would buy CNB if it were available in the market	4.196	1.534	−12.980
I worry if the beef comes from a sustainable farm	4.084	1.879	−13.257
Future: I spend time thinking about how my future will be like	3.951	1.699	−13.585
I am concerned whether the farmer has adopted practices that reduce the emission of greenhouse gas emissions	3.937	1.859	−13.617
I am concerned whether beef is produced under water conservation and waste preventing methods	3.916	1.894	−13.691
There is a high probability that I will buy carbon meat	4.042	1.577	−13.824
Future I think a lot about what my life will be like	4.427	1.593	−14.195
I am concerned whether the beef comes from processors that conserve water and prevent its waste	4.175	1.833	−14.226
I try to choose foods that assure me of their origin	4.084	1.687	−14.451
I am concerned whether producers and slaughterhouses adhere to labor legislation	4.357	1.879	−14.560
Sustainable: I don't buy products manufactured or sold by companies that harm the environment	3.350	1.435	−14.785
I am concerned whether farmers adhere to the legislation	4.608	1.866	−14.792
Future: I usually think about the things I will do in the future	4.294	1.638	−14.798
I am concerned whether meat processors adhere to the legislation	4.874	1.758	−15.146
A traced food is a safer one	4.559	1.788	−15.166
I try to choose foods that assure me of their origin	4.930	1.585	−15.332

(Continued)

Table 5. (Continued).

Variables Characteristic of Class 5 (14.3%)	Average within the class	Standard deviation within the class	Test Value
Sustainable: I don't buy a product when I know the possible damage it can cause to the environment	3.441	1.485	−16.486
BE: I am concerned whether the slaughter was carried out humanly	3.573	1.619	−16.924
BE: I am concerned whether the animals received adequate feed and health treatment	4.000	1.677	−16.996
Sustainable: When I buy products and food, concern for the environment interferes with my purchase decision	3,210	1,433	−17,188
Sustainable: I always make an effort to reduce the use of products that use scarce natural resources.	3,336	1,438	−17,725
BE: I am concerned whether the animals were treated humanly	3,650	1,520	−17,986
BE: I care whether the animals were raised in the most natural and free manner possible	3,608	1,547	−18,123
Sustainable: When possible, I always choose products that cause less pollution	3,643	1,484	−18,536

respondents tended to be receptive toward meat certification. Furthermore, Class 3 was typically representative of those consumers who trusted the Brazilian beef cattle production system and felt that beef packers adhered to a high level of animal welfare and sustainability standards compared to other countries. Therefore, Class 3 demonstrated as having an overall positive attitude toward CNB and showed a higher propensity to buy CNB, as well as to replace conventional meat for CNB. Despite CNB being positively related to Good Production Practices, two negative test values indicated the respondents were still doubtful about the extent such an innovative product could be available in the market and its methods of production would not destroy the environment. Consequently, there were concerns about the messages being communicated about the true capacity to produce CNB that would fully meet market demand. Hence, there was a lingering concern whether CNB's production system and the extent it could really protect the environment compared to the conventional one.

Class 4, representing 28% of the sample was characterized by those respondents showing the most positive intention toward the willingness to buy, pay more, and replace conventional beef for the new concept brand CNB. The respondents favored the new beef brand concept based on the values which were embedded by high Environmental and Ethical issues. Typically, they would want to Reduce the Consumption of products that Use Scarce Natural resources, cause Damage and Pollution to the Environment. Other important determinant factors were those concerning Animal Welfare, the Future, Safety, Product Quality based on assured Traceability Systems which guaranteed Origin Certification while accounting for Rules and Regulations throughout the stages of beef production and processing. In that Class, Information Search on beef quality standards that enhanced Product Knowledge are sought-after attributes, particularly regarding Meat Certification. The choice of beef purchased was understood as a Representation of the Self to Others, thus an expression of a Subjective Expertise on the (sustainability) matter. In addition, the concept brand CNB was a representation of a product-related hedonic type of consumption. Consequently, the symbolic value of CNB to those in that Class was supported by statements such as "My Choice of Meat is an Expression of Myself" (7.786) and "You Can Tell a Lot About the Person Based on their Choice of Meat" (7.608) as representatives of this class formation. In addition, attributes such as Brand, Packaging, Texture, Fat Level and Price, among others, have also contributed to the formation of that class. Class 4 was typically represented by single males, with a family monthly income varying between US$1,368 and US$5,156 who, according to the Brazilian Family Budget Survey (POF-2009), belonged to the social-economic strata A2 and B1 (IBGE, 2010). Despite being single, they declared that they were not the primary purchaser of meat (−3.516)! It could be inferred here that purchasing high-quality beef would be part of perhaps a special occasion or as part of a weekend cooking role which is likely to involve BBQ preparation for family members and friends. Despite believing themselves to be well-informed regarding matters related to animal

production and certification, these respondents were still concerned about the ability of beef produced under a CNB system to be able to sustain current, not to mention future, consumption levels of such a product without harming the environment.

Class 5 represented approximately 15% of the sample and indicated the most indecisive attitudes toward the statements about the consumption of beef. The bulk of the answers concentrated around the average values typically represented by "Did not Know" or "Have no Opinion" on the importance of tangible attributes regarding animal protein as well as for all other questions about Traceability, Environmental Responsibility, Legality, Pleasure and Symbolic Values, Risk Probability, Expertise on the Subject of Beef, Sustainable Consumption Attitude, Concern for Animal Welfare and Intention to Purchase CNB.

That Class was representative of large households with many children, which characteristically belonged to a lower income stratum and which favored the local butcher as their choice of retail outlet when sourcing meat. The variables that most contributed to the formation of the Class 5 were indicative of negative consumption attitudes. The respondents of large households did not believe it to be possible that a beef production system such as CNB would be able to supply the actual beef volume consumed in Brazil. They did not believe CNB could be keep a high sustainability and environmental claim all the time. Therefore, being skeptical, those respondents believed that to produce beef to such a high ethical standard would inevitably require further beef systems' production intensification which, consequently, increased greenhouse gas emissions, with further detrimental impact on the environment. They were also doubtful about the extent the claims made regarding the fact that the CNB production system would effectively protect the environment more than the conventional meat production ones. In addition, Class 5 strongly rejected the notion that sustainability could be measured and conferred in food production.

Figure 2 correspond to the factorial quadrants resulting from the analysis. It can be seen that the respondents in Class 2 contrast to those in Class 4, as well as those in Class 3 contrast to those in Class 1 and in Class 5. As a result the opposing attitudes are better characterized as demonstrated in the study. Consequently, this information could be used for the purpose of informing a future Marketing Action Plan.
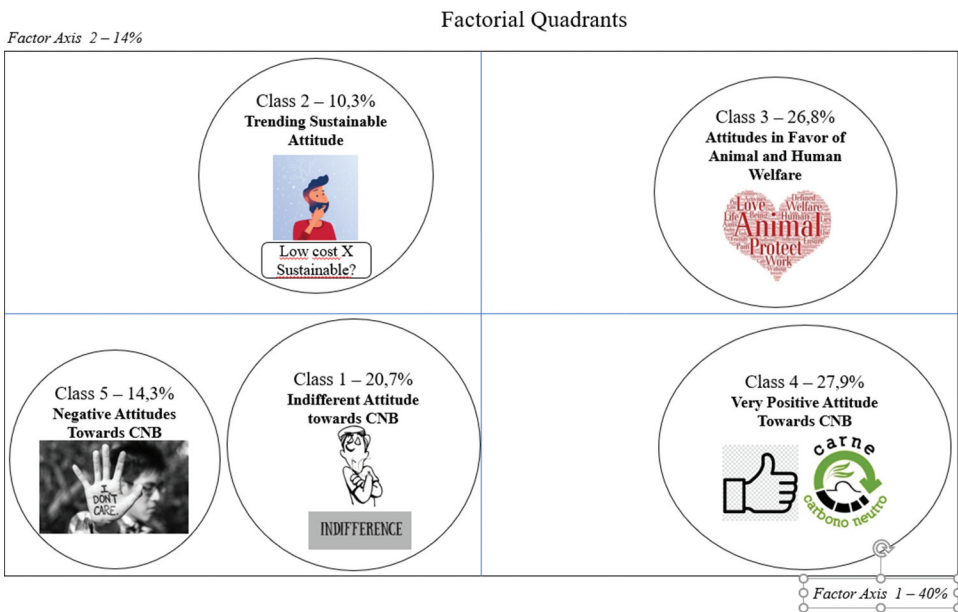

Figure 2. Factorial quadrants.

Conclusions

This study has provided an excellent insight into the perceptions of Brazilian beef consumers' and the key attributes driving their purchasing behavior. The nationwide results were thus representative of that country, and, therefore, valid and reliable. The data set is also of value for those in the meat sector for the purpose of elaborating targeting campaigns as part of marketing strategies, for academics interested in studying the topic as well as for those involved in policy making.

Generally, the Brazilian respondents tended to be attentive to Good Production Practices and had positive attitudes toward initiatives that brought innovative products to the market. This is of value particularly should these initiatives attempt to address consumers' concerns about animal welfare, production processes, norms and regulations, and adhering to sustainability issues.

Since the brand concept CNB was still to be launched onto the Brazilian market, as a product innovation, there were concerns about the extent to which the sustainability claims could be verified. On the one hand, Class 4 represented 28% of the sample whose respondents demonstrated as having the most positive attitudes toward the innovative brand concept CNB. On the other hand, about a quarter of the sample also expressed either indifference to sustainable production issues or rejection or disbelief toward the brand concept CNB. Notably, the variables that best contributed to explain this type of rejection were related to the lack of information or knowledge which also contributed to the respondents' disregard for risk.

Furthermore, innovation was perceived with distrust by the respondents who were wary about misleading information. As a result, bad, misleading information or false claims would be detrimental to a new concept brand product such as CNB. The lack of trustworthy information can contribute to the perpetuation of the negative perception associated with new products such as CNB. It could also be understood as a barrier to the marketing of conventional beef. Meat companies should exercise caution regarding overstating claims and ought to target marketing actions that address this. It is clear that the Brazilian public shows a need and desire to be better informed with reliable and trustworthy information that could better assist them during their beef purchasing decisions. Thus, the proposed typology has brought clarity to an overarching beef consumers' market segmentation which identifies values based on production systems that cater for socio-environmental, legal and sustainable aspects of beef. However, these initiatives would only make sense to a larger consumer base should attention be paid to communication campaigns that address the existing "anxieties." Hence, being assertive in the messages would hopefully bring around consumers who would be willing to pay for a differentiated product.

The results of this study represent an invaluable set of data that would be of interest to many stakeholders in the beef production and processing chain. The technique of categorizing consumers into groups according to preference scores is strategic from a managerial point of view, especially to assist in new product development, market segmentation, product positioning and launch.

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