

## HEALTH EDUCATION NEEDS HIDDEN IN THE INFORMAL BEEF CONSUMER PROFILE IN NORTHEASTERN BRAZIL

### A NECESSIDADE DE EDUCAÇÃO EM SAÚDE OCULTA NO PERFIL INFORMAL DO CONSUMIDOR DE CARNE BOVINA NO NORDESTE DO BRASIL

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**ABSTRACT:** Outbreaks of diseases, epidemics and even pandemics can arise from the consumption of contaminated meat. Due to consumers' lack of knowledge about food safety and foodborne diseases, the aim of this research was to explore the consumer's informal beef profile in the Northeastern region of Brazil, contributing to improve One health and to highlight the need for health education. A descriptive study was conducted with 150 questionnaires. The profile of individuals indicated that they live in rural areas, have low education levels, prefer to buy meat at open-air local fairs, and perceive the hygiene of these markets as satisfactory, despite the actual lack of hygiene. Although participants claimed to be aware that the consumption of meat and meat products can cause diseases, the majority were unaware of the specific diseases associated with these foods and the significance of meat inspection stamps. Our study suggests a potential relationship between low education levels, lack of knowledge about hygiene and the importance of consuming inspected meat products, exposing consumers to the risk of acquiring diseases and sheds light on future research directions. Therefore, this study highlights the need for health education, transforming consumers into agents of oversight to improve One Health.

**KEYWORDS:** Health education; Meat; One health.

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**RESUMO:** Surtos de doenças, epidemias e até pandemias podem surgir do consumo de carne contaminada. Devido à falta de conhecimento dos consumidores sobre alimentos seguros e doenças veiculadas por alimentos, o objetivo desta pesquisa foi explorar o perfil dos consumidores de carne bovina informal da região Nordeste do Brasil, contribuindo para melhorar a Saúde Única e destacar a necessidade de educação em saúde. Foi realizado um estudo descritivo com 150 questionários. O perfil dos indivíduos indicou que eles vivem em áreas rurais, possuem baixo nível educacional, preferem comprar carne em feiras livres locais e percebem a higiene desses mercados como satisfatória, apesar da real falta de higiene. Embora os participantes afirmassem saber que o consumo de carne e produtos derivados da carne pode causar doenças, a maioria desconhecia as doenças específicas associadas a esses alimentos e a importância dos selos de inspeção da carne. Nosso estudo sugere uma relação potencial entre o baixo nível educacional, a falta de conhecimento sobre higiene e a importância de consumir produtos de carne inspecionados, expondo os consumidores ao risco de adquirir doenças, e ilumina futuras linhas de pesquisa. Portanto, este estudo destaca a necessidade de educação em saúde, transformando os consumidores em agentes de fiscalização para melhorar a Saúde Única.

**PALAVRAS-CHAVE:** Educação em saúde; Carne; Saúde única.

## 1. INTRODUCTION

The Brazilian beef production chain is of utmost importance to the economy of Brazil and the world, ranking first in exports and second in global meat production (Embrapa, 2023). Meeting customer demands is crucial, as consumers seek high-quality meat cuts, whether from markets or local fairs. This quality is often assessed only at the time of purchase and consumption, whereas such concern should begin at the production stage, making it essential to prioritize food safety and improve One Health (Nespolo, 2021).

In the Northeast, one of the primary methods of marketing this product is through local fairs. These markets were established to enable rural producers to offer their products directly to consumers (Silva *et al.*, 2010). However, some producers lack concern regarding the processes of obtaining and producing food or are unaware of the hygiene and sanitary precautions that must be taken to ensure food safety, particularly in the marketing of animal-derived products and their by-products (Matos *et al.*, 2017; Nespolo, 2021; Nordhagen *et al.*, 2023).

Thus, like many products sold at local fairs, beef is exposed to various situations that may lead to contamination (such as being left at high ambient temperatures) and can also originate from illegal slaughter, exposing consumers and handlers to microorganisms that can harm their health, potentially resulting in various zoonoses and even death

(Nespolo, 2021). Additionally, animal-derived foods can harbor antimicrobial-resistant pathogens and represent a potential source of infections in humans (Ribeiro *et al.*, 2024). Outbreaks of diseases, epidemics, and even pandemics can arise from the consumption of contaminated beef. It is estimated that 60% of human diseases are of animal origin and 75% of emerging diseases have a zoonotic source (Who, 2018; Attwood, Haajat, 2020).

Food safety, while it is important, is also popular public health issue gaining momentum worldwide (Chen *et al.*, 2020), as the consumption of unhealthy foods poses threats to health and jeopardizes the lives of all individuals. Unsafe food creates a vicious cycle of diarrhea and malnutrition, compromising the nutritional status of the most vulnerable populations (Paho, 2022). When food is unsafe, individuals cannot thrive, hunger and poverty cannot be alleviated, and a healthy life is unattainable. The World Health Organization estimates that each year, 600 million people globally contract foodborne illnesses (FBIs), resulting in 420,000 deaths (Who, 2022). In the Americas region, it is estimated that 77 million people suffer from FBIs annually, with more than 9,000 fatalities (Paho, 2022). The Centers for Disease Control and Prevention (CDC) estimates that every year, 48 million people become ill, 128,000 are hospitalized and 3,000 die due to FBIs (Brasil, 2024).

Foodborne diseases also have a huge and detrimental impact on the economic development of countries. According to the World Bank, foodborne illnesses cost society \$7.4 million annually in productivity loss, burdening health systems and reducing development due to the loss of confidence in safe tourism, food production, and marketing systems (Ferreira, 2017; Paho, 2022). Economic losses due to foodborne illnesses in developing countries cannot be reliably estimated due to underreporting and the difficulty in establishing causal relationships between food contamination and resulting illnesses or deaths. The total productivity loss associated with these diseases in low- and middle-income countries is estimated at \$95.2 billion per year, and the annual cost of treating foodborne illnesses is \$15 billion (Who, 2022).

Most people do not concern themselves with the necessary standards for processing, packaging and marketing the food they will consume and/or offer to others. However, consumers play a crucial role in this scenario, as food safety is a shared responsibility among governments, producers and consumers, each having a role to play from farm to fork to ensure that food does not pose a health threat (Nespolo, 2021; Who, 2022).

Therefore, understanding the consumer profile is important for comprehending their decision-making behavior and purchase motivations, as well as their knowledge about food safety consumption. The main objective of our research is to explore the consumer's informal beef profile and awareness in the Northeastern region of Brazil, contributing to the improvement of One Health, regarding the potential public health risks associated with the consumption of this food. It also contributes to highlighting the need for health education to raise awareness about the importance of consuming inspected beef and the role of consumers as oversight agents.

## **2. MATERIALS AND METHODS**

A descriptive study was conducted, utilizing nominal qualitative measurement variables (Martins, 2001), conducted in a city of northwest region of Brazil with 41.202 habitants, from November to December 2019. Data were collected through random interviews with the population, conducted voluntarily in locations such as supermarkets, open-air local fairs and the city center. The research was conducted in various locations throughout the city, with the aim of exploring the consumer profile, their habits and preferences, in addition to their knowledge, concerns and interest in acquiring new information about the safe consumption of meat and its by-products. The non-probability sampling was employed, which promotes that the participants who are conveniently and voluntarily accessible are selected from the population. A total of 150 adults individuals voluntarily agreed to respond to questionnaires containing 20 questions (Figure 1).

The research was approved by the ethics committee and included a Free and Informed Consent Term from participants, under CAAE number 06067818.0.0000.5546. The data were analyzed descriptively (Martins, 2001).

Questionnaire

1. Full Name: \_\_\_\_\_ ( ) Prefers not to identify
2. Age: \_\_\_\_\_
3. Gender: ( ) Male ( ) Female
4. Level of education:
  - (a) Incomplete elementary school
  - (b) Completed elementary school
  - (c) Incomplete high school
  - (d) Completed high school
  - (e) Incomplete higher education
  - (f) Completed higher education
  - (g) Incomplete postgraduate education
  - (h) Completed postgraduate education
  - (i) Illiterate
5. Where do you live? ( ) Urban / Neighborhood: \_\_\_\_\_ ( ) Rural
6. What is your profession? \_\_\_\_\_
7. Do you consume meat and meat products (hot dog sausages, pork sausage (linguiça), salami, dried meat (charque), and others)? ( ) Yes ( ) No
8. What meat products are most consumed in your home? (You may choose more than one option) (a) Fresh meat (b) Bologna (c) Sausages (d) Hamburger (e) Other: \_\_\_\_\_
9. How often do you consume fresh meat? ( ) Daily ( ) Weekly ( ) Other
10. Where do you usually buy beef and its derivatives? a) Supermarket b) Neighborhood market c) Open-air local fairs d) Greengrocer's (or local produce market) e) Directly from the farm f) Other
11. Do you prefer to buy beef and meat products directly from the producer, at street markets, or processed (sold in stores)? a) Producer b) Street markets c) Processed
12. Do you trust the product being sold at these places? ( ) Yes ( ) No Why? \_\_\_\_\_
13. Reason for choosing a particular place to shop: a) Hygiene of the location b) Hygiene of the handler c) Appearance of the product d) Price e) Good service f) Convenience g) Other: \_\_\_\_\_
14. What treatment do you apply to the fresh meat you buy? a) Consumes raw meat b) Consumes fully cooked meat c) Consumes undercooked meat d) Other: \_\_\_\_\_
15. Have you or anyone in your household ever been ill after eating beef or consuming any meat product? ( ) Yes ( ) No
16. In your opinion, can consuming meat and its derivatives cause any diseases? ( ) Yes ( ) No
17. If yes, what diseases can be transmitted by consuming meat and its derivatives? a) Cysticercosis b) Salmonellosis c) Ascariasis d) Trichinosis e) All of the above f) Other: \_\_\_\_\_ g) Unknown
18. Do you look for inspection stamps on the packaging of the products you buy? a) Yes, and I know what they mean b) Yes, but I don't know what they mean c) No, and I don't know what they mean
19. How would you like to receive information related to healthy meat consumption and its derivatives? a) Printed materials (books, pamphlets, flyers) b) Newspapers c) Radio d) Television e) Lectures f) Social media (Facebook, Instagram) g) Other: \_\_\_\_\_ h) Does not see the need to receive information
20. When you buy beef, do you consider the welfare of the slaughtered animals? ( ) Yes ( ) No

**Figure 1.** Questionnaire conducted to assess the profile of meat consumers.

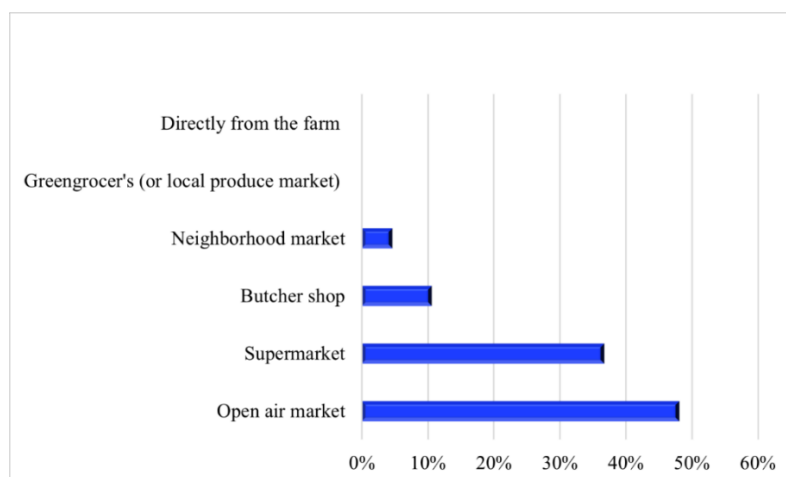
### 3. RESULTS

Over 50% of the interviewed individuals were aged between 18 and 42 years (63.96%), with 16.64% in the age group of 18 to 22 years, 15.34% between 23 and 27 years, 13.3% between 28 and 32 years, 9.34% between 33 and 37 years, and 9.34% between 38 and 42 years. Additionally, 10.6% were aged between 43 and 47 years, 12.0% between 48 and 52 years, 6.0% between 53 and 57 years, 2.0% between 58 and 62 years, 2.0% between 63 and 67 years, 1.34% between 68 and 72 years, and 2.0% between 73 and 77 years. Among the 150 respondents, 76.7% were female and 23.3% were male. Regarding education level, a large portion of the respondents (52.6%) had low or no formal education, 35.3% with incomplete elementary education, 12.0% with incomplete secondary education and 5.3% being illiterate. Only 18.7% of individuals completed secondary education, 17.3% completed elementary education, 4.7% had incomplete higher education and 6.7% completed higher education.

Most participants in the study lived in rural areas (68.0%), while 32.0% lived in urban areas. The professional profile of the respondents was 74.6% farmers, 5.4% self-

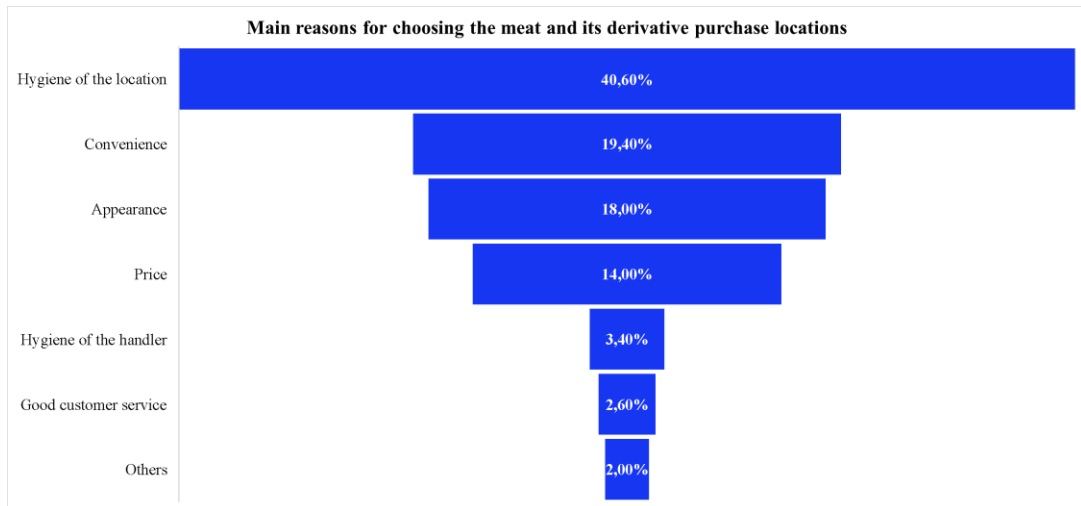
employed individuals, 6.6% students, 5.4% public sector employees, 4.6% private sector employees and 3.4% homemakers. About meat consumption, 98.66% of them reported consuming beef and its by-products, while only 1.34% did not. In terms of the most consumed meats and their derivatives, fresh beef had the highest percentage (82.1%), followed by mortadella (7.3%) and sausages (1.3%), with other options (9.3%) including poultry (8.0%) and fish (1.3%), while the respondents did not typically consume hamburgers.

Almost 50% (48.0%) of the interviewees consumed fresh meat daily, 45.4% said weekly (45.4%) and 6.6% had other consumption frequencies. The data also showed that 48.0% of consumers usually purchased beef and its derivatives at open-air local fairs, 10.66% at butcher shops, 4.67% at neighborhood markets and 36.67% at supermarkets (Figure 2).



**Figure 2.** Main purchase locations of beef and beef product consumers.

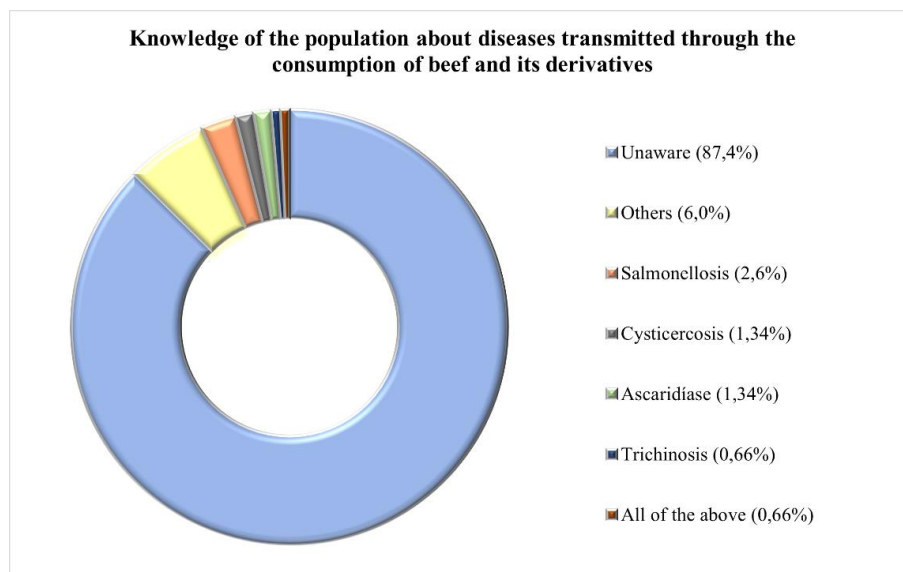
The majority (56.6%) preferred to buy directly from local open-air fairs, while a minority (43.4%) preferred industrialized products, i.e., those manufactured by industries and sold in retail stores, such as supermarkets. 50.66% of the consumers trust the products from the places where they shop, while 49.34% did not trust due to unfamiliarity with the product's origin and uncertainty about whether they are subject to inspection. The primary reason consumers choose where to buy meat and its derivatives was the hygiene of the environment (40.6%), followed by convenience (19.4%), product appearance (18.0%), price (14.0%), handler hygiene (3.4%), good service (2.6%) and other reasons (2.0%), although they were unable to justify the reasons for their choices (Figure 3).



**Figure 3.** Main reasons for choosing the meat and its derivative purchase locations.

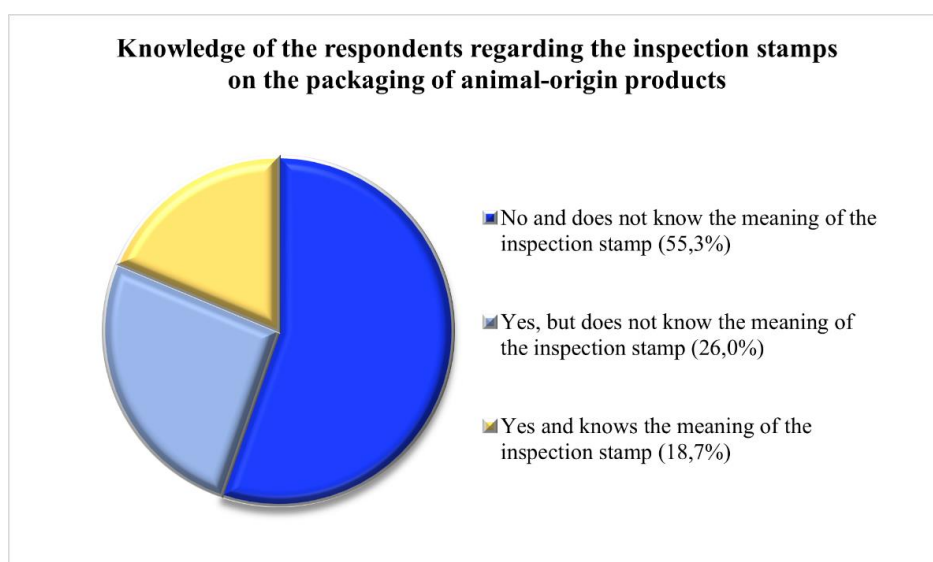
Regarding the treatment of fresh meat for consumption, 68.0% of respondents reported consuming fully cooked meat, 2.0% preferred rare meat and 30.0% prepared it in other ways, mentioning roasted (20.0%) and fried in oil (10.0%) as methods. None of the participants reported consuming raw meat. Most people (86.6%) stated that they had not fallen ill due to the consumption of beef and its derivatives; however, 13.4% reported becoming ill after consumption. Nonetheless, 73.6% indicated that consuming these products could cause some illness, while 26.7% disagreed.

Most respondents (87.4%) claimed to be unaware of the diseases associated with the consumption of meat and its derivatives, however, a smaller portion mentioned salmonellosis (2.6%), cysticercosis (1.34%), trichinosis (0.66%), and ascariasis (1.34%). Additionally, some individuals (0.66%) stated that all diseases listed in the questionnaire could be transmitted through meat consumption and a small number mentioned other diseases (6.0%), such as cholesterol issues and cancer (Figure 4).



**Figure 4.** Knowledge of the population about diseases transmitted through the consumption of beef and its derivatives.

More than half of the consumers (55.3%) reported not knowing or understanding the meaning of the inspection stamps present on the packaging of meat products. Additionally, 26.0% said to look for the stamps but didn't know their meaning, while 18.7% actively sought out the seal, claiming to understand its significance (Figure 5).



**Figure 5.** Knowledge of the respondents regarding the inspection stamps on the packaging of animal-origin products.

The research revealed that consumers are concerned about the products they purchase, as the majority (97.4%) expressed interest in receiving information related to the



healthy consumption of meat and its derivatives, while only 2.6% stated that there was no need for such information. Participants indicated television (36.0%) and lectures (30.6%) as the best means of receiving this information, while others preferred social media (14.0%), newspapers (7.2%), printed materials (5.2%), radio (3.2%) and other forms (1.2%), although they could not specify which ones. Additionally, 68.0% are concerned about the welfare of animals at the time of purchasing products, while 32.0% do not care.

#### 4. DISCUSSION

This study identifies a profile of young consumers (63.96% of them between 18 and 42 years old) and predominantly female (76.7%). Supporting findings from other studies (Matos *et al.*, 2017; Moreira *et al.*, 2017; Cipriano *et al.*, 2021; Realini *et al.*, 2023; Werkneh *et al.*, 2023), the results suggest a greater willingness among younger individuals and females to participate in research. A study investigated the profile of beef consumers at local fairs in a municipality in Northeastern Brazil and found that 44.53% of respondents had an average age of 50 years (Matos *et al.*, 2017), indicating that there may be variation in the age range of interviewed consumers. The high female participation suggests that domestic responsibilities are primarily borne by women (Moreira *et al.*, 2017).

More than half of the respondents (52.6%) had low or no formal education, 68.0% lived in rural areas and 74.6% were farmers. We found 5.3% to be illiterate. The low or nonexistent education levels among the respondents may be associated with the fact that most reside in rural areas and face difficulties accessing schools and education. A profile of meat consumers research of Midwest region of Brazil (Nascimento *et al.*, 2018), reported that 28% had incomplete primary education. In 2023, the illiteracy rate in Brazil was 5.4%, with 54.7% of illiterate individuals living in the Northeast region according to the National Household Sample Survey (Ibge, 2023).

Almost all respondents (98.66%) reported consuming beef and its derivatives, as found in other studies (Almeida *et al.*, 2011; Kirinus *et al.*, 2013). This reflects the Brazilian preference for beef consumption and reinforces the information that 71.48% of the beef produced in the country is directed to the domestic market, with Brazil ranking third among the largest beef consumers in the world, highlighting its significance for the economy (Abiec, 2023; Embrapa, 2023). A limitation of this study was the lack of inquiry about monthly income, as there are reports suggesting that this may influence purchasing

decisions and knowledge about safe foods (Werkneh *et al.*, 2023). However, other studies indicate no impact (Oliveira *et al.*, 2017).

The most consumed product in households was fresh beef (82.1%), with few individuals consuming meat derivatives, and no one consuming hamburgers. A large portion of respondents reported consuming fresh meat daily (48.0%) or weekly (45.4%), and they typically purchase beef and its derivatives at open-air local fairs (48.0%) and supermarkets (36.67%). However, the majority (56.6%) preferred to buy fresh meat at open-air local fairs, while a smaller portion (43.4%) preferred purchasing processed products, referred to in this study as those manufactured by industries and sold in stores, such as markets and supermarkets. These results indicate that consumers tend to shop at various locations, but their preference for purchasing is at open-air local fairs.

Another study also found that the majority (80.5%) of consumers prefer to buy fresh beef at open-air local fairs in a city of Northeast region of Brazil (Almeida *et al.*, 2011). Different results were reported in the profile of beef consumers study made in a city of São Paulo, in the Southeast region of Brazil, where 82.0% of consumers stated a preference for supermarkets as their shopping location (Raimundo, Batalha, 2013). This difference in shopping preferences between states may be attributed to the socioeconomic conditions of each state and, primarily, to cultural habits, as the type of food consumption in the population is determined by economic, social, nutritional and cultural factors (Oliveira, Thébaud-Mony, 1996). Therefore, it is important to gain a better understanding of consumers' perceptions of food safety, as this can influence, along with other socioeconomic aspects and demographic variables, the choice of food to be consumed (Nespolo, 2021).

Open-air local fairs in Brazil are known for selling food exposed to various conditions that facilitate contamination (Matos *et al.*, 2017; Rodrigues *et al.*, 2019; Morais *et al.*, 2023), where meat is left exposed to ambient heat on countertops without any protection and is handled by unwashed hands. These locations also often have the presence of insects, rodents and other animals, such as dogs roaming the area. Frequently, there is a lack of sinks and potable water, equipment is not properly sanitized, waste is not disposed of correctly and handlers are not trained in good hygiene practices, creating an environment that is entirely unfavorable to One health. Therefore, the preference for buying meat at open-air markets may be justified by the fact that many individuals have a low level of education, lacking knowledge about the importance of keeping meat

refrigerated; the hygienic conditions of sales locations and handlers; the hygienic and technological quality of meat and its derivatives; zoonoses; and the environmental impact of waste from this type of commerce (Nespolo, 2021).

People who buy meat at open-air fairs in the city reported believing that the product is fresh because the meat is warm, exposed to ambient heat and can be touched with unwashed hands at the time of purchase to check for tenderness. However, individuals do not realize that this way of thinking and acting leads to food contamination and the proliferation of microorganisms in meat, nor does it guarantee that the meat is tender or fresh. Corroborating this study, research about the profile of beef consumers in a city of Northeast region of Brazil, identified 43.02% of individuals who typically purchase beef and its derivatives at street markets reported that this tradition is based on the belief that products sold at these locations are fresh (Matos *et al.*, 2017).

The lack of knowledge among consumers of animal products regarding the technological process of slaughter and the importance of hygienic and sanitary controls during production can lead them to make bad choices when purchasing these foods, consequently exposing them to the risk of acquiring various diseases, such as zoonoses (Nespolo, 2021). Additionally, improper personal hygiene habits, such as handling meat with unwashed hands, contribute to product contamination and the occurrence of diseases. The choice of shopping in supermarkets was attributed to the availability of other products in the location, making the purchase of meat and its derivatives more convenient. Despite the data indicating that people care about the hygienic conditions of the places where they buy meat, preference for purchasing in markets – places that provide refrigeration for meat and greater hygienic care – is primarily due to convenience. This again highlights the consumer's lack of knowledge regarding the hygiene and sanitary quality of the meat.

When comparing the ages of respondents with the places where they acquire products, it was observed that all age groups frequent the same locations, indicating no preference for a particular age group regarding the place of purchase. More than half of the consumers (50.66%) stated that they trust the products from the places where they shop, again highlighting the population's lack of knowledge about good manufacturing practices, foodborne illnesses, and the hygienic and sanitary conditions of beef, since 56.6% of people prefer to buy at open-air markets. Another portion (49.34%) of consumers reported not trusting the products they are purchasing due to unfamiliarity with their origins and uncertainty about their sanitary inspection. Therefore, there remains a prevalence among

consumers who visit the purchase locations and acquire meat and its derivatives without questioning, but there are also those who, despite continuing to shop at open-air markets, express some concern about the origin and inspection of the products.

The results revealed a lack of awareness among people regarding hygiene, as 40.60% of consumers expressed concern about the hygiene of the purchasing location; however, only 3.4% were concerned about the hygiene of the handlers. The majority (56.6%) preferred to buy at open-air markets, which are places where products are easily exposed to physical, chemical, and microbiological contaminants. Most individuals (68.0%) preferred to consume fully cooked or roasted meat (20.0%), while only a small portion (2.0%) liked rare meat, and none consumed raw meat. There is a reduced risk of ingesting meat that could harm the consumer's health; however, this does not eliminate the possibility of microorganism transmission and subsequent illness.

Consuming rare meat poses health risks, and the results suggest that women are more aware of this, as women tend to have less confidence in food safety compared to men (Werkneh *et al.*, 2023), and educational level is related to concerns about food safety (Kornelis *et al.*, 2007; Nespolo, 2021). The data found, such as the fact that the majority of people (86.6%) have not fallen ill due to the consumption of beef and its derivatives, the majority (73.6%) reporting that the consumption of these products can cause some illness, and most (87.4%) being unaware of the diseases associated with their consumption, demonstrate that despite the low level of education of most respondents and their lack of knowledge about hygiene, a significant portion of people understands the risk of contracting a disease from consuming meat and its derivatives. However, they are unaware of which diseases may be transmitted by these products and their severity. A study about consumer profiles in a municipality in northeastern Brazil and their perceptions of the hygienic aspects of meat sales in open-air markets, reported that only 10% of respondents mentioned any diseases (Diniz *et al.*, 2012).

The lack of public awareness about the dangers these foods pose to human health, animal welfare, and the environment, coupled with the influence of social contexts that hinder the transformation of longstanding habits due to personal beliefs, exposes individuals to the risk of contracting diseases (Veflen *et al.*, 2020; Wyatt, 2024). One-third of foodborne illnesses are zoonotic, and this situation will worsen if the consumption of animal products increases without sufficient attention to risk mitigation (Leahy *et al.*, 2022). Zoonoses negatively impact the economies of countries due to absenteeism from

work, decreased productivity and tourism, and high costs associated with hospitalizations and health treatments. Moreover, the greater the public's knowledge, the more likely behavioral changes will occur, leading to fewer hospitalizations and deaths, thereby promoting both One Health and the country's economy (Yan *et al.*, 2018; Nespolo, 2021; Souza *et al.*, 2021).

The change in individual behavior can affect collective behavior change and, therefore, influence the accumulated number of hospital notifications. Individual behavior change significantly contributes to the prevention and control of emerging diseases (Yan *et al.*, 2018). Moreover, one of the factors of unethical behavior in consumption may be institutional dependence, which refers to the belief that institutions, such as the government, have the responsibility to ethically regulate which products may be sold (Eckhardt *et al.*, 2010). However, food safety is a responsibility that must be shared by governments, producers, and consumers (Nespolo, 2021; Who, 2022). Consumer behavior is a multifaceted research area (Lim *et al.*, 2023), and further studies should be conducted.

We observed that more than half (55.3%) of consumers do not know the meaning of the sanitary inspection stamps present on packaging, which is a concerning fact, as it demonstrates that a large portion of people are unaware and unconcerned about whether the meat they are buying and consuming is inspected or from illegal slaughter. This indicates that most people do not pay attention to the sanitary conditions of animals and good hygiene practices during the meat production process. Consumers are more concerned with the color, tenderness, and price of the food, and in some regions, this can be explained by the low level of education among the population, including individuals who are illiterate (Nespolo, 2021). The data indicated that the lower the educational level, the less knowledge there is about the inspection service stamps. In Brazil, 29.6% of the slaughter of 42.31 million cattle is not monitored (Abiec, 2023), and if the production of animal-derived products is not carried out correctly or is clandestine, the chances of Brazilian consumers contracting a disease from contaminated food are high, potentially leading to outbreaks, epidemics, and even pandemics.

It increases the burden on the healthcare system and contributes to environmental degradation, cattle theft and neglect of animal welfare and health, undermining One Health. Consumers demonstrated that, despite their lack of knowledge about the inspection service and the diseases that can be transmitted through meat and its derivatives, they are interested in receiving information related to healthy consumption via television and

lectures, indicating a potential avenue for people's health education. Different types of information sources are preferred by distinct groups within the population and consumers concerned about food safety issues may be more inclined to seek out information and sources that alleviate their concerns (Kornelis *et al.*, 2007). To mitigate emerging infectious diseases, both media advertising focused on guiding behavior change and the positive responses of individuals are crucial for controlling these emerging diseases (Yan *et al.*, 2018).

Knowing that consumer preference for open-air markets stems from the belief that the foods sold are always fresh and of higher quality (Matos *et al.*, 2017) and that for some people, adherence to cultural tradition is important (Realini *et al.*, 2023), could this influence the sale of unrefrigerated meat in markets? If consumers were aware, based on scientific knowledge, that the animal products they are considering purchasing could jeopardize their health, they would likely choose not to make that purchase and would naturally report the sales location to the relevant authorities, thereby facilitating enforcement efforts and eliminating the need for hiring more inspectors or increasing oversight of production and sales (Nespolo, 2021). This could lead to a reduction in the supply of illicit animal products.

For this, it is essential to implement knowledge through health education, modifying deeply ingrained cultural habits, which are extremely difficult to change once established. Concern for animal welfare is a requirement of sanitary inspection at the time of slaughter (Brasil, 2017) and has been increasing among meat consumers (Realini *et al.*, 2023; Ammann *et al.*, 2024). However, they need more information on the subject (Lama *et al.*, 2017; Nespolo, 2021). The fact that 68.9% of respondents expressed concern for the welfare of slaughtered animals is contradictory, given that the majority choose to buy unrefrigerated meat, unaware of the product's origin and how the animal was slaughtered. Therefore, despite claiming to be concerned about animal welfare, there is a notable lack of understanding regarding what animal welfare truly entails. Animal welfare should be addressed in education within schools (Lama *et al.*, 2017; Nespolo, 2021).

## 5. CONCLUSION

Our study suggests a potential relationship between low education levels, lack of knowledge about hygiene and the importance of consuming inspected meat products, exposing consumers to the risk of acquiring diseases and sheds light on future lines of

research. Therefore, this study highlights the need for health education, transforming consumers into agents of oversight. Health education should raise awareness and inform meat and derivative consumers about the importance of these products being inspected, as well as basic concepts of hygiene, animal welfare and foodborne diseases. When purchasing products for consumption, individuals will be aware of their origin and can choose locations with better hygienic and sanitary conditions, thereby reducing the risk of acquiring diseases associated with these foods. Once consumers are better informed, they will be able to demand higher quality and become active monitors of their own health and One Health. In this way, consumers can be agents of public health promotion and act as regulators, changing the way products are marketed by demanding safe, healthy, and high-quality items. Additionally, foodborne diseases require better reporting and prevention efforts, consequently contributing to a reduction in medical visits and public spending. Finally, sanitary surveillance should be more proactive in preventing the sale of meats and derivatives in locations lacking hygienic and sanitary conditions, such as open-air markets.

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