



Bovine colostrum in human health promotion: determinants and moderators of purchase intention and consumption in Brazil

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Abstract

This study aimed to investigate the perception of the Brazilian population about bovine colostrum and the perspectives of consumption and purchase of its derived foods. A questionnaire was made available on the Google Forms[®] platform and disseminated through social networks. A total of 1,179 people from 19 Brazilian states responded. Spearman's test was used to identify correlations between variables, and the Kruskal–Wallis test was used to compare means. Correlation and difference of means were considered significant when $p < 0.05$. Most respondents (45.0%) reported having no knowledge about bovine colostrum and never having had contact with it (67.8%). However, they believe that consumption can benefit human health (61.6%). They also reported their intention to consume and purchase food and derived supplements in the form of dairy products, powdered supplements, and flavored liquid supplements. Sensory aspects can contribute to the non-consumption of bovine colostrum. However, a lack of knowledge about the products and their benefits, availability, and price can further influence the intention not to consume derivatives. Thus, it is likely that foods derived from bovine colostrum will be well accepted if commercialized in the Brazilian market.

Keywords: functional food; consumer market; health; supplement.

Practical application: Brazilians' perception of bovine colostrum, purchase intention, and consumption.

1 INTRODUCTION

Bovine colostrum, rich in proteins and fats and low in lactose compared to milk, is secreted 3–5 days postpartum (Conte & Scarrantino, 2013; McGrath et al., 2016). Its bioactive properties have sparked interest in developing functional foods (Dzik et al., 2017).

Research on human consumption of bovine colostrum has highlighted numerous health benefits. Rathe et al. (2014) identified its positive effects on gastrointestinal and immunological disorders, attributed to high levels of transforming growth factor- β (TGF), immunomodulatory components, and antimicrobial properties. Immunoglobulin and lactoferrin in bovine colostrum serve as adjuncts or alternative therapies for treating and preventing infectious diseases in children and adults. These components strengthen natural immunity, especially in newborns, potentially reducing neonatal mortality rates (Bagwe et al., 2015; Dzik et al., 2017).

Bovine colostrum supplements benefit athletes by preventing overtraining and improving sports performance, and they also benefit the elderly by preventing osteoporosis and reducing arthritis symptoms (Mizelman et al., 2017; Silva et al., 2019).

Bagwe-Parab et al. (2020) highlighted the therapeutic applications of bovine colostrum, emphasizing its anticancer potential and that of its components (lactoferrin, CLA, and alpha-lactalbumin), which are active in promoting health in

the treatment of acute infectious diarrhea, *Helicobacter pylori* infections, irritable bowel syndrome, and inflammatory bowel disease. The study also reports its antibacterial, antiviral, and antifungal properties and antitumor effects observed in in vitro and in vivo studies.

Recent research also explores its role in improving respiratory health and as a therapy for conditions like SARS-CoV-2 infection. It has shown efficacy against respiratory infections and allergies and in mitigating exercise-induced immunosuppression in high-performance athletes (Galdino et al., 2021).

Bovine colostrum is marketed in various forms globally, including powder, capsules, and dairy products such as yogurt, fermented milk, curd, ice cream, dairy drinks, and butter, which have demonstrated good sensory acceptance (Silva et al., 2019; Tripathi & Vashishtha, 2006).

Given the nutritional benefits of bovine colostrum, its market potential appears promising. However, more public health studies need to explore consumer acceptance and intention to use these products, particularly in Brazil, which hinders the development of a consumer culture. This study aimed to survey Brazilian awareness of bovine colostrum and interest in its derived foods, contributing to a better market understanding for manufacturing and marketing new functional products using bovine in Brazil.

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2 METHODOLOGICAL PROCEDURES

2.1 Survey instrument and application

A questionnaire (Appendix 1, Supplementary File) was utilized for data collection, structured with closed questions based on the Likert scale offering five response options. Respondents were queried about their lifestyle habits, including frequency of milk and dairy product consumption, exercise routines, and any health conditions restricting dairy intake. Additionally, participants were assessed on their familiarity with bovine colostrum, perceptions of its health benefits, exposure to colostrum, and intentions regarding consumption and purchase of colostrum-derived products. Questions also explored preferences for consumption methods and the impact of sensory, market, and price factors on decisions related to colostrum consumption.

Due to the limited regulation of bovine colostrum in Brazil and its exclusive handling within dairy production units, it was assumed that most Brazilians were unaware of or had never consumed it. To address this, definitions of colostrum and its potential health benefits were provided. These additions aimed to mitigate biases from participants' lack of familiarity with the product.

2.2 Application of the questionnaire

The questionnaire was distributed digitally using the Google Forms® platform from July 16, 2020, to July 31, 2020 (15 days). Dissemination occurred through messaging apps, social media, email, and a website focused on the dairy production chain. Participants remained anonymous, with assurances that collected data would be used solely for academic purposes. Additionally, participants were informed that the survey did not promote raw consumption of bovine colostrum due to potential health risks. All respondents provided informed consent prior to participating, and the study was categorized under "public opinion survey with unidentified participants" as per Resolution No. 510, dated April 7, 2016 (Brasil, 2016), exempting it from evaluation by the Research Ethics Committee.

2.3 Sampling

A total of 1,308 individuals responded to the questionnaire. Exclusion criteria included a filter question, with 129 individuals providing an incorrect response indicating inattention, thus excluded from data analysis. Ultimately, responses from 1,179 individuals were included. For questions regarding variables influencing the non-consumption of bovine colostrum, responses marked "no opinion" were excluded to minimize biases, resulting in 843 valid responses. A statistical model calculated the sampling error at 2.85% (95% confidence level).

2.4 Statistical analysis

Categorical responses were presented as percentages. Spearman's test evaluated correlations between variables, with coefficients interpreted as weak (0–0.3), moderate (0.3–0.6), or strong (>0.6). Preferences for consumption methods were compared using the non-parametric Kruskal–Wallis test, transforming response categories into numeric values for analysis. This test also identified statistical differences in variables' impact on

colostrum consumption decisions. Statistical analyses were conducted using SAS (version 9.0), with significance at $p < 0.05$.

3 RESULTS

The socioeconomic profile of the respondents ($n = 1,179$) showed that the majority identified themselves as female (61.7%), and the age group with the highest number of participants was between 21 and 30 years (40.7%). Most had a complete postgraduate degree (35.8%) or an incomplete college degree (28.2%). The family income with the most participants was 1–3 minimum monthly salaries (28.8%) and more than 9 minimum monthly salaries (27.4%).

Participants came from 19 Brazilian states. By region, 1% were from the North, 1% were from the Centre-West, 4% were from the South, 8% were from the Southeast, and 86% were from the Northeast.

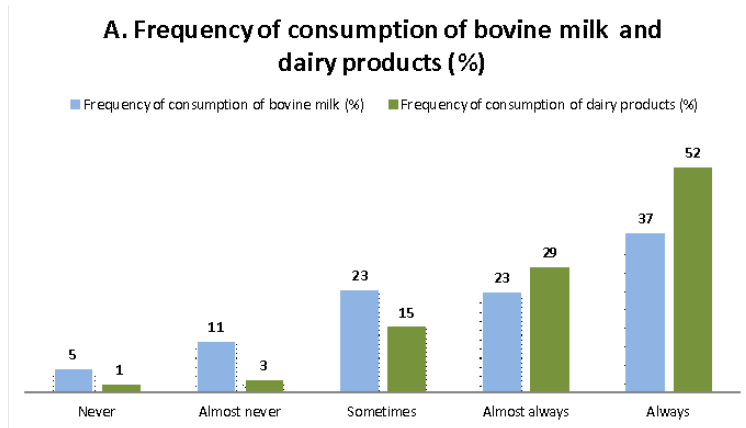
Most respondents reported always consuming milk (37%) and milk byproducts (52.3%), and 81.2% of respondents had no problems preventing consumption (Figures 1A and 1B). Regarding physical activity, 3.5% of respondents reported none, 41.0% of respondents reported practiced a little or sometimes, and 35.5% of respondents reported almost always or always (Figure 1C).

Nearly half of the population (45.0%) reported no knowledge of bovine colostrum. Some respondents (41.4%) believe its consumption benefits human health. Additionally, over half of the respondents (67.8%) have never seen or consumed bovine colostrum.

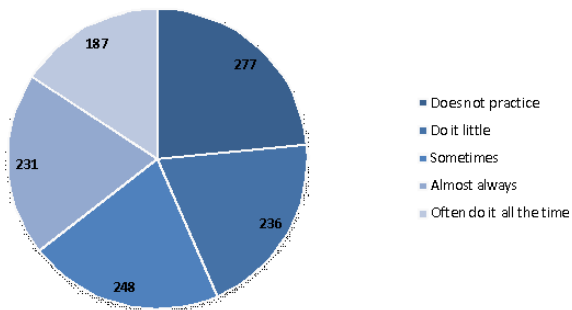
The correlation between the respondents' declared level of knowledge about colostrum and their opinion on its health benefits was significant ($p = 0.019$) but weak ($p = 0.07$) (Supplementary Table 1). Most respondents reported that they would certainly or probably consume foods derived from bovine colostrum in all forms questioned (Figure 2). Specifically, 34.9% and 33.7% would probably or certainly consume dairy products like cheese, yogurt, and dairy drinks. Additionally, 32.0% and 26.4% of respondents would probably or certainly consume bovine colostrum powder supplement, and 26.9% and 29.9% of respondents might or probably would consume the flavored liquid supplement. Among the forms of consumption, 55.2% of respondents preferred dairy products (Figure 2B). Mean acceptance was highest for dairy products (3.8 ± 1.2) and lowest for the flavored liquid supplement (3.4 ± 1.2). Most of the respondents (41.8%) would consume these products sometimes, while 29.1% and 16.1% would consume them almost always (Figures 2A–2C).

The correlation between the intention to consume the food or supplements and the frequency of intended consumption was significant ($p < 0.001$) and strong ($\rho > 0.60$). Most individuals who said they would certainly or probably consume it would do so always or almost always (Supplementary Tables 2, 3, and 4). There was a weak ($\rho < 0.3$) but significant ($p < 0.001$) correlation between consumption intention and the habits of consuming milk, dairy products, and physical activity. The higher the frequency of these habits, the higher the consumption intention.

The stated level of knowledge about bovine colostrum did not influence the intention to consume its dairy products ($p > 0.05$). However, it did influence the intention to consume the powdered and flavored liquid supplements ($p < 0.001$) with a weak correlation ($\rho < 0.3$). Individuals with much good knowledge had a higher intention to consume with certainty (Supplementary Tables 3 and 4).



C. Practice physical activity (n)



B. Health condition that prevents the consumption of milk and dairy products (n)

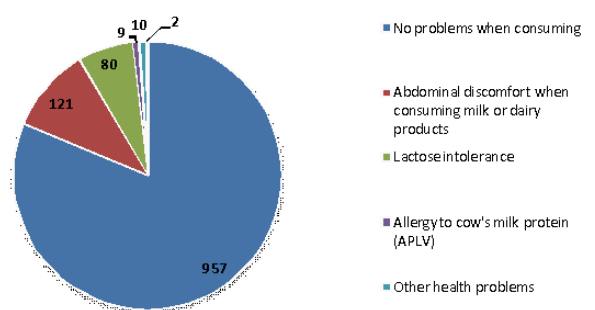
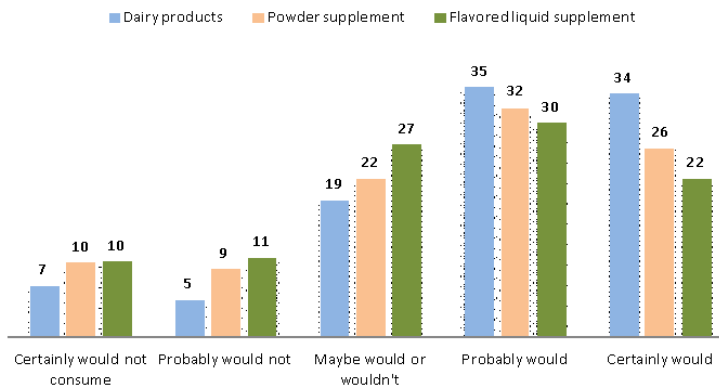
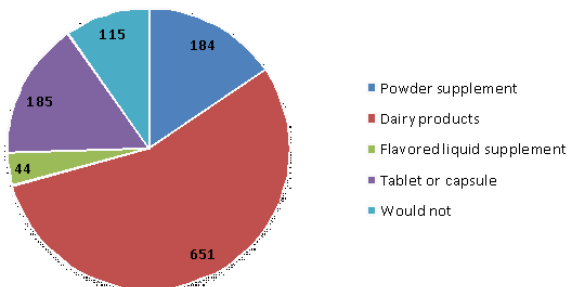


Figure 1. Lifestyle and dairy consumption habits in the study population (n = 1,179).

A. Would consume colostrum (%)



B. Preferred form of consumption (n)



C. Frequency of use (n)

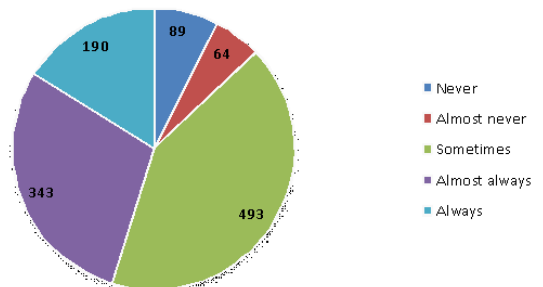


Figure 2. Intention to consume foods derived from bovine colostrum in the surveyed population (n = 1,179).

Table 1 shows that the color characteristic had the lowest mean influence on non-consumption, while taste and odor had the highest, followed by general appearance and viscosity. Price, lack of knowledge about the products, and the benefits of

consuming bovine colostrum were the variables with the highest mean influences regarding market characteristics.

Regarding the intention and frequency of purchase, most respondents reported that they would probably buy (39.9%) and sometimes

Table 1. Mean scores were assigned regarding the influence of variables for the non-consumption of bovine colostrum.

	Intention to buy n (%)					ρ	p-value
	Certainly not	Probably not	Maybe	Probably yes	Certainly yes		
<i>Age group (years old)</i>							
≤ 20	6 (5.0)	5 (4.1)	43 (35.5)	50 (41.3)	17 (14.0)	0.15	< 0.001
21 to 30	46 (9.6)	30 (6.2)	146 (30.4)	174 (36.2)	84 (17.5)		
31 to 40	16 (6.7)	12 (5.0)	55 (23.0)	99 (41.4)	57 (23.8)		
41 to 50	8 (5.6)	6 (4.2)	24 (16.9)	65 (45.8)	39 (27.5)		
51 to 60	6 (4.3)	8 (5.7)	26 (18.4)	62 (44.0)	39 (27.7)		
> 60	3 (5.4)	2 (3.6)	14 (25.0)	20 (35.7)	17 (30.4)		
<i>Reported level of colostrum knowledge</i>							
None	37 (7.0)	23 (4.3)	181 (34.2)	196 (37.0)	93 (17.5)	0.11	< 0.001
Not much	18 (6.5)	21 (7.6)	57 (20.6)	124 (44.8)	57 (20.6)		
Fair	16 (9.8)	4 (2.5)	31 (19.0)	71 (43.6)	41 (25.2)		
Good	10 (6.4)	12 (7.7)	30 (19.2)	58 (37.2)	46 (29.5)		
Very	4 (7.5)	3 (5.7)	9 (17.0)	21 (39.6)	16 (30.2)		
<i>Opinions about the benefits of consuming bovine colostrum</i>							
Certainly not beneficial	21 (51.2)	4 (9.8)	11 (26.8)	2 (4.9)	3 (7.3)	0.39	< 0.001
Probably not beneficial	14 (17.7)	10 (12.7)	20 (25.3)	25 (31.6)	10 (12.7)		
It may or may not be beneficial	28 (8.3)	33 (9.7)	129 (38.1)	109 (32.2)	40 (11.8)		
Probably beneficial	12 (2.5)	12 (2.5)	115 (23.6)	264 (54.1)	85 (17.4)		
Certainly beneficial	10 (4.3)	4 (1.7)	33 (14.2)	70 (30.2)	115 (49.6)		
<i>Would consume dairy products</i>							
Certainly not	66 (83.5)	5 (6.3)	4 (5.1)	1 (1.3)	3 (3.8)	0.74	< 0.001
Probably not	11 (17.5)	34 (54.0)	14 (22.2)	2 (3.2)	2 (3.2)		
Perhaps	5 (2.2)	16 (7.0)	160 (69.9)	45 (19.7)	3 (1.3)		
Probably yes	0 (0.0)	7 (1.7)	103 (25.1)	279 (67.9)	22 (5.4)		
I would certainly do so	3 (0.8)	1 (0.3)	27 (6.8)	143 (36.0)	223 (56.2)		
<i>Would you consume powdered supplementation</i>							
Certainly not	71 (59.2)	11 (9.2)	24 (20.0)	9 (7.5)	5 (4.2)	0.7	< 0.001
Probably not	10 (9.1)	33 (30.0)	41 (37.3)	21 (19.1)	5 (4.5)		
Maybe	3 (1.1)	10 (3.8)	152 (58.2)	84 (32.2)	12 (4.6)		
Probably yes	0 (0.0)	9 (2.4)	74 (19.6)	262 (69.5)	32 (8.5)		
Certainly yes	1 (0.3)	0 (0.0)	17 (5.5)	94 (30.2)	199 (64.0)		
<i>Would you consume liquid supplements</i>							
Certainly not	71 (57.7)	11 (8.9)	29 (23.6)	8 (6.5)	4 (3.3)	0.7	< 0.001
Probably not	7 (5.5)	39 (30.5)	52 (40.6)	27 (21.1)	3 (2.3)		
Perhaps	5 (1.6)	5 (1.6)	163 (51.4)	124 (39.1)	20 (6.3)		
Probably do	1 (0.3)	8 (2.3)	53 (15.1)	242 (68.8)	48 (13.6)		
Certainly Yes	1 (0.4)	0 (0.0)	11 (4.2)	69 (26.6)	178 (68.7)		
<i>How often would you buy</i>							
Never	75 (90.4)	6 (7.2)	2 (2.4)	0 (0.0)	0 (0.0)	0.74	< 0.001
Rarely	4 (4.7)	42 (49.4)	34 (40.0)	5 (5.9)	0 (0.0)		
Sometimes	3 (0.6)	13 (2.4)	243 (45.1)	253 (46.9)	27 (5.0)		
Almost always	3 (0.9)	2 (0.6)	26 (7.6)	196 (57.0)	117 (34.0)		
Always	0 (0.0)	0 (0.0)	3 (2.3)	16 (12.5)	109 (85.2)		
<i>Would pay more</i>							
Certainly not	77 (61.1)	16 (12.7)	24 (19.0)	5 (4.0)	4 (3.2)	0.59	< 0.001
Probably not	4 (2.5)	32 (19.9)	72 (44.7)	47 (29.2)	6 (3.7)		
Maybe	1 (0.2)	10 (2.1)	167 (34.8)	234 (48.8)	68 (14.2)		
Probably yes	2 (0.6)	2 (0.6)	44 (12.7)	172 (49.6)	127 (36.6)		
Certainly yes	1 (1.5)	3 (4.6)	1 (1.5)	12 (18.5)	48 (73.8)		

Kruskal-Wallis test ($p < 0.001$) ($n = 843$). Scale: 1 - does not influence at all; 5 - influences a lot. This means that those who do not share the same letters are significantly different.

buy (45.7%) colostrum-derived products. Regarding the possibility of paying extra, 40.7% of respondents reported that they might pay or not.

A correlation was observed between the decision to purchase the products and the socioeconomic variables “age group” ($\rho = 0.15, p < 0.001$) and “family income” ($\rho = 0.07, p = 0.02$). Regarding family income, 68.7% of respondents with more than 9 minimum salaries indicated they would certainly or probably buy. The individuals who indicated they had no monthly income showed a 66.7% interest in probably buying (Table 2).

All of the physical activity practices indicated that they would buy the products. The belief that colostrum consumption is certainly or probably beneficial to human health resulted in a higher intention to certainly or probably buy, with a medium correlation ($\rho = 0.39, p < 0.001$) (Table 2). The variables “purchase frequency” and “intention to pay extra” also showed a strong correlation with the variable “purchase intention.” Of those who said they would always buy, 85.2% of respondents also reported that they would certainly buy them ($\rho = 0.74, p < 0.001$), while of those who said they would certainly pay extra for the products, 73.8% of respondents also said they would certainly buy them ($\rho = 0.59, p < 0.001$).

The socioeconomic variables influencing the purchase decision were age and family income. Older age groups (51–60 years and > 60 years) showed a higher intention to pay extra. Those with family incomes of 6–9 minimum salaries (34.0%) and more than 9 minimum salaries (36.8%) had the highest intention to pay more. Respondents with much knowledge about colostrum had a higher intention to pay extra (11.3%), and those with good knowledge probably paid more (37.8%). Believers in colostrum’s health benefits indicated a greater intention to pay more (15.9% certainly, 37.1% probably).

Of the respondents, 39.9% would buy colostrum-derived products, with 26.1% unsure. The majority of the respondents (45.7%) would purchase sometimes. Over 85% of respondents might buy these products, suggesting good market acceptance. Physical activity showed a weak but significant correlation to consuming derivatives and powdered supplements ($p < 0.05$) but not liquid supplements ($p > 0.05$). The greater the consumption intention, the higher the purchase frequency ($\rho = 0.41$ to $0.55, p < 0.001$).

Table 2. Influence of socioeconomic variables and correlation of consumption intention with the purchase decision of foods with bovine colostrum in the surveyed population ($n = 1,179$).

Variable	Mean \pm SD
Smell	3.8 ^b \pm 1.3
Taste	4.0 ^{ab} \pm 1.2
Color	2.9 ^d \pm 1.4
Viscosity	3.4 ^c \pm 1.3
General Appearance	3.5 ^c \pm 1.3
Lack of availability of products on the market	3.9 ^b \pm 1.2
Price of the products	4.1 ^a \pm 1.1
Lack of knowledge about the products and consumption benefits	4.1 ^a \pm 1.2

The percentage corresponds to the line ρ : Spearman’s correlation.

Those who consume the products might pay more, while those who consume them would pay more. The socioeconomic profile of likely consumers showed that the majority were women aged 21–30 years, with a postgraduate degree and family incomes of 1–3 and more than 9 minimum wages.

4 DISCUSSION

Bovine milk is a minimally processed, nutrient-rich, and affordable food ideal for those without dietary restrictions (Brasil, 2014; FAO, 2013). In 2019, Brazil produced 34,112 thousand tons of milk, with an average consumption of 168.9 L/inhabitant/year; cheese was the most consumed dairy product (ABLV, 2020; FAO, 2020). This study found that 60% of respondents regularly consume milk, with 52.3% always consuming dairy products. Most of the respondents (81.2%) reported no symptoms preventing milk consumption, except for a few vegans (0.2%), making milk and its derivatives prominent in the diet.

Bovine colostrum has bioactive properties that treat gastrointestinal diseases like infectious diarrhea, *Helicobacter pylori* infections, irritable bowel syndrome, and inflammatory bowel diseases (Bagwe-Parab et al., 2020; Rawal et al., 2008). Evidence suggests it may treat certain cancers by inducing cancer cell apoptosis and suppressing tumor growth (Bagwe-Parab et al., 2020; Sharma et al., 2019). Colostrum supplements effectively treat diarrhea in HIV patients, boosting body weight, BMI, and immunity and reducing fatigue (Kaducu et al., 2011; Odong et al., 2015). Introducing colostrum-derived foods could benefit health and serve as non-invasive adjuvant therapy for diseases like cancer and HIV.

Despite documented benefits, many study participants need to learn about colostrum, with most having never seen natural colostrum. However, 60% of respondents believe its consumption is beneficial. A weak correlation ($\rho = 0.07, p = 0.019$) was found between knowledge level and perceived benefits of colostrum, with higher-educated respondents more likely to view it positively. This suggests that cultural factors, rather than health concerns, contribute to the lack of colostrum consumption and are influenced by generational habits (Savage et al., 2007).

The study showed strong interest in colostrum-derived dairy foods, with respondents willing to consume products like cheese, yogurt, ice cream, and supplements. There was a strong correlation between consumption frequency and intention to consume ($\rho > 0.6, p < 0.001$), indicating that those willing to consume colostrum products intend to do so regularly. Colostrum-derived foods were preferred by 55.2% of respondents, suggesting market potential beyond current forms of powder, tablets, or capsules (Bagwe et al., 2015; Boland, 2010), aligning with Brazilians’ habits of consuming dairy foods, especially cheese (Siqueira, 2019). Consumption intent correlated with dairy product consumption frequency.

Lifestyle habits affect consumption decisions. Physically active individuals show interest in colostrum foods and supplements, with a weak correlation. Familiarity with colostrum does not deter consumption; those familiar are more likely to consume it in all forms, suggesting no food neophobia regarding bovine colostrum, though specific tests are needed (Alley & Potter et al., 2011). Among physical traits, smell and taste influence non-consumption, viscosity, and appearance, while color has little impact. However, many respondents have not seen colostrum, which may have biased the results.

Market factors significantly influence colostrum consumption. Price, knowledge, and availability are major deterrents. Effective advertising and education are crucial for introducing colostrum products. Conferences inform medical and nutritional communities about health benefits. Higher family income correlates with greater intention to purchase colostrum. Over 50% of respondents intend to buy colostrum foods, indicating market potential. Price sensitivity remains crucial for competitive pricing.

Improper disposal harms the environment, as dairy effluents are rich in organic matter (Castillo; Rodriguez-Meza; Martelo, 2018). Proper treatment minimizes impact. Industrial processing requires unique techniques (Das & Seth, 2017). Regulatory measures for use, processing, and marketing are essential. The study's limitation is that the high education and income levels are not representative of the broader Brazilian population (IBGE, 2020). Future research should aim for diverse socioeconomic samples to reflect the national profile better and gather regional data.

5 CONCLUSION

Most interviewees declared having little knowledge about bovine colostrum, with many having never encountered it. However, they believe its consumption can be beneficial and intend to purchase and consume colostrum-derived foods or supplements. Thus, if marketed, these foods will gain market acceptance in Brazil.

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