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Effect of the COVID-19 pandemic on food habits and perceptions: A study with Brazilians

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ABSTRACT

Background: Following the COVID-19 pandemic (caused by the SARS-CoV-2 coronavirus) at the beginning of 2020, containment measures have been taken by different countries around the globe. Citizens were forced to stay in quarantine, affecting their food consumption habits and food sector. These impacts have not yet been properly understood. Thus, it is important to describe the consequences of COVID-19 on food consumption habits globally, especially in the context of developing countries, such as Brazil.

Scope and approach: In this study, the Brazilian's food consumption habits and perceptions during the COVID-19 pandemic were assessed, highlighting the food consumption changes and selection of food products. Consumer perceptions about issues related to food safety and food marketing were also assessed. An online survey was performed and data were analyzed by descriptive analysis; independence and per cell chi-square test; and factor analysis.

Key findings and conclusions: Brazilians perceptions indicated that the COVID-19 pandemic context (assessed in May 2020) changed their food consumption and purchase. Respondents stated that they are eating and buying a greater amount of food, indicating a perception of a less healthy diet, mainly by women. On other hand, they are prioritizing homemade preparations and fresh food. Moreover, they reduced their shopping trips to markets and are starting to use delivery services and shopping platforms. Basic products of animal, vegetable, and bakery origin are being preferred during this period, in addition to economical packaging and products. Brazilians also indicated that they are more concerned with food safety and hygienic practices. However, at a time when global health is threatened, government agencies must create measures that ensure the food supply and consumer's awareness, in order to guarantee the country's food security during the current crisis.

1. Introduction

The novel SARS-CoV-2 coronavirus is known to cause an acute respiratory syndrome called COVID-19, which is an easily transmissible disease spreading from person to person via cough, sneeze, respiratory droplets, or exhale (ECDC, 2020; Rizou et al., 2020). It broke out in continental China and has spread out across the world. The number of confirmed cases and deaths by COVID-19 in the world has increased substantially, mainly in the European and American continents (WHO,

2020). According to data from the Ministry of Health, Brazil is one of the countries most affected by the new coronavirus in the American continent (Brasil, 2020).

Following the COVID-19 proliferation, containment measures have been taken by different countries around the globe, including Brazil. Citizens have been requested to stay at home and limit their outings to strict necessities (Bracale and Vaccaro, 2020). Given this scenario, the industrial, agribusiness and food services sectors have already suffered major impacts in the first quarter of the year. In the first two months of

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the year, the effects of the pandemic on the Brazilian economy were diluted, as they were limited to a possible reduction in international demand and concerns related to the supply of necessary inputs in some industrial sectors. However, from March, with the restriction measures adopted to contain the disease, the projection is that the COVID-19 pandemic impacts would be greater and would affect several industries (FGV, 2020).

Although food and water are not considered direct transmission routes for SARS-CoV-2, it is not possible to ignore the fact that the virus remains viable on different surfaces for several days, especially in environments with inadequate hygienic conditions (Duda-Chodak et al., 2020), as well as the presence of the virus in feces of infected individuals and the contamination of animals consumed by humans, such as pigs and rabbits (Yekta et al., 2020). Thus, further studies are needed regarding the real role of food in the virus transmission route. Norouzbeigi et al. (2021) evaluated the stability of SARS-CoV-2 against different processing in dairy products, noting that pasteurization processes were able to completely inactivate the viral load, except for full-fat milk, where there seems to be a protective effect on the content of fat. Still, freezing for 60 days maintained the infectivity of the virus in the products, indicating that foods can play the role of virus carriers.

Measures taken to reduce clusters and transmission of the new coronavirus significantly impacted the food sector (Oliveira et al., 2020), as well as the population's food consumption habits, once personal characteristics, cooking at home and shopping frequency influence consumption (Gustat et al., 2017). Thus, the COVID-19 pandemic has affected how households buy, prepare and consume food. These impacts have not yet been properly understood, especially in the context of developing countries, and few studies are comprising the Brazil scenario. Therefore, a better understanding of the first impacts of COVID-19 on Brazilian's food consumption and purchase attitudes and perceptions will guide government actions related to health promotion opportunities; and will assist companies' opportunities to leverage the food market in the context of the pandemic, establishing safe food marketing and commercialization strategies that meet the desires and needs of the population.

Therefore, this study aimed to provide an analysis of the first impacts on Brazilian's food consumption attitudes and perceptions due to the COVID-19 pandemic, highlighting the food consumption changes and selection of food products. Moreover, the consumer's perceptions about issues related to food safety and food marketing were assessed.

2. Survey design and approach

2.1. Pandemic situation during the study

All consumers answered the questionnaire in May 2020. According to data from the Johns Hopkins University (Johns Hopkins University,

2020) platform, this month Brazil had 514.992 cases and 29.341 deaths. Moreover, Brazil was the fourth country in the number of deaths from the disease, behind the USA, United Kingdom and Italy. Strict containment measures were being applied.

2.1.1. Subjects

The study was made using a convenience sample in which 312 Brazilians (59.9% women and 40.1% men, over 18 years old – Table 1) performed an online survey. Convenience sampling is a non-probabilistic method, usually used in qualitative research when the objective is to obtain an approximation of either specific topic, in which the elements are selected for your convenience, voluntarily or accidentally (Aaker et al., 1995; Andrade et al., 2016).

Respondents indicated their agreement and commitment to participate in the research through an informed consent form. They were classified according to their socio-demographic profile, in order to assess the influence of these factors on their responses (Grunert et al., 2012).

2.2. Survey

The online questionnaire was prepared using Google Forms and was divided into four sections, in order to collect data related to the socio-demographic profile, consumption and food buying habits and perceptions, and concerns related to food hygiene and safety. All issues were addressed in the context of the COVID-19 pandemic in Brazil. The studies of Pacheco et al. (2018), Fami et al. (2019), Eating Motivation Survey by Phan & Chambers (2016) and motivations regarding food insecurity (Puddephatt et al., 2020) guided the questions elaboration. The constructed items tried to be succinct, simple, and clear for respondents to understand.

The first section had questions about the respondents' socio-demographic profile, including gender, age group, occupation, average monthly household income, education level, number and age of people living at their houses. In the second section, the respondents' perceptions of changes in their food consumption habits during the COVID-19 pandemic were assessed. They indicated if they noted differences in their food consumption habits due to the pandemic and quarantine context and indicate the perceived changes. The third and fourth sections comprised questions about habits, attitudes and perceptions involved in the food consumption and purchase during the covid-19 pandemic and quarantine context. An evaluation using the Likert scale was introduced aiming to verify the level of consumers' concordance with the presented sentences (Nocella et al., 2014). The evaluation of attitudes and perceptions was focused on affirmations regarding purchasing practices and consumption of different food categories; consumers' preferences and perceptions for products from small/local and/or national/global producers; food safety habits and perceptions. The respondents indicated their agreement with statements

Table 1
Respondent's demographics.

Gender (%)						
Women			Men			
59.90%			40.10%			
Age group (%)						
18–25 years	26–35 years	36–45 years	46–55 years	56–65 years	Over 65 years	
48.70%	27.20%	13.80%	7.10%	2.60%	0.60%	
Occupation (%)						
Student		Employed		Unemployed		Retired
48.40%		47.80%		3.50%		0.30%
Average monthly household income (%)						
No income	Up to 1 minimum wages	From 1 to 3 minimum wages	From 3 to 5 minimum wages	From 5 to 7 minimum wages	Over 7 minimum wages	
10.30%	10.90%	26.90%	16.00%	10.60%	25.30%	
Educational attainment (%)						
Elementary school		Elementary school		Middle high school		Higher education incompleted (in progress)
Completed		Completed		9.90%		Higher education completed or more
1.00%		1.00%		41.30%		46.80%

using a five-point scale, ranging from ‘totally disagree’ to ‘totally agree’. The purchase periodization of different food products during the pandemic period was also assessed by a frequency scale varying from ‘I am not giving priority’ to ‘I am giving full priority’.

An initial pilot study was conducted with 20 respondents to identify possible problems relating to the phrasing of questions, omissions and other difficulties experienced by respondents (Mitchell et al., 2012; Rodrigues et al., 2017). Some minor modifications were made to the phrasing of questions and response options. The revised questionnaire was then administered to 25 different people to evaluate the modifications and check whether further modifications were needed.

Finally, the online questionnaire was carried out over the internet in May 2020, through disclosure on social networks. An invitation containing the objectives and the research link was widely publicized. Respondents confirmed their agreement and commitment to participate in it. The following were guaranteed: the right to secrecy and anonymity, the absence of payments resulting from your participation in this research, the right to withdraw at any time from participating in the research without causing any loss, among other aspects.

2.3. Statistical analysis

The statistical analysis was performed using the XLSTAT 2021.1 (Addinsoft, Paris France) and SPSS Statistics (IBM SPSS Statistics for Windows, Version 22.0 Armonk, NY: IBM Corp) software.

A descriptive analysis was performed to assess the main changes in food consumption perceived by respondents. The Independence Chi-square test was performed to verify the relationship among variables. Then, observed the existing difference, the Chi-square per cell test (Z test adjusted by Bonferroni’s method) was used (Sharpe, 2015). The level of significance adopted was ≤ 0.05 .

From attitude scales, data were extracted (means and the standard deviation) from consumer’s answers and statistically analyzed through Factor Analysis (FA). It was performed with PCA as the method of extraction. The factors with eigenvalues higher than 1 were considered relevant. Furthermore, the attributes with communalities higher than 0.3 were considered significant. The factors with communalities below 0.30 were removed and the analysis was proceeded again using Varimax rotation. Varimax rotation was chosen to favor a Thurstonian simple structure, maximizing the number of zero or near-zero factor loadings (Bosten et al., 2017).

The FA data were examined in terms of normality, collinearity, and distribution of outliers. Tests of Kaiser–Meyer–Olkin (KMO), Cronbach’s Alpha Coefficients, and Bartlett sphericity were used to determine the level of confidence. The KMO test presents normalized values (between 0 and 1) and shows the proportion of common variance of the variables (items of the instrument used). Values higher than 0.5 indicate the adequacy of the method (Pacheco et al., 2018). The Bartlett test of sphericity is based on the statistical distribution of chi-square and tests the null hypothesis (no correlation between the variables). Levels of significance lower than 0.100 indicate that the data are suitable for the treatment with FA, and, therefore, there are correlations between the variables (Maciel et al., 2013; Yong & Pearce, 2013). The Cronbach’s Alpha Coefficients are related to the level at which the measurement is error-free and, therefore, presents consistent results. Values higher than 0.6 were considered adequate (Maciel et al., 2013; Yong & Pearce, 2013).

3. Findings

3.1. Respondent’s demographics

Respondent’s demographics are described in Table 1. Most respondents were women (59.9%), aged between 18 and 35 years. 26.9% received up to three times the minimum wages (R\$3135,00), 25.3% received more than seven minimum wages (R\$7315,00), and 10.3%

attested to have no income. Regarding to the occupation, respondents were grouped in four groups: students (48.4%); employed (47.8%); unemployed (3.5%) or retired (0.3%). Most respondents had completed at least middle-high school (i.e. high school in progress), and 48.4% live with up to 4 people and 21.8% live with elderly people over 56 years old.

It is important to highlight that a considerable part of the Brazilian population has poor access to the internet, which may have influenced the respondents’ profile of this survey.

Respondent’s perceptions about food consumption habits during the pandemic and quarantine context.

Most respondents (81.01%) indicated that they noticed changes in their food consumption habits during quarantine, while only 17.95% did not notice any change. Moreover, 55.8% totally or partially agreed that the pandemic, quarantine and social isolation contexts influenced these changes. These perceptions were dependent on gender (chi-square $p < 0.01$), being the changes most noticed by women. Fig. 1 shows the food consumption changes noticed by all respondents.

Most participants (60.84%) noticed an increase in the amount of food consumed in general. Furthermore, 51.93% agreed totally or partially that their food consumption increased during the quarantine. Respondents (36.50%) indicated that they are buying a larger volume of food. Moreover, they also noticed an increase in the preparation of homemade foods compared to the period before quarantine (60.84%). Concomitant to this, 46.01% stated that there were changes regarding the food categories purchased and consumed (46.01%).

When analyzing the changes in food purchases, 33.08% of the interviewees noticed an increase in the consumption of fresh food; 30.80% of local foods and 23.19% of processed foods. Regarding how food is obtained, 56.65% of respondents say that they have reduced their trips to markets and supermarkets, while 15.21% stated that they are supplying themselves through shopping platforms, as well as obtaining meals via delivery more frequently (30.80%). However, only 17.87% indicated that they were being more careful when selecting the food suppliers they consume. In contrast, 40.39% totally or partially disagree that they trust in the food safety of packaged commercial establishments, while 28.53% neither agree nor disagree with this statement.

Table 2 presents the mean scores, standard deviation, and factor loadings of the attitudes and perceptions about food consumption during the pandemic and quarantine periods. In this study, Cronbach’s alpha was used to determine the reliability of the scale and the value of 0.727 stated that the scale used in the present study can be considered of good consistency, although values higher than 0.6 are considered good (Maciel et al., 2013). The KMO was calculated and the amount of 0.767 was obtained, which indicated that the variables’ correlation was good, as the minimum of 0.5 is usually used as the acceptable limit (Maciel et al., 2013). Finally, Bartlett’s Test of Sphericity ($p < 0.0001$) confirms that there are patterned relationships among the variables. A statistically significant Bartlett test ($p < 0.05$) indicates that sufficient correlations exist between the variables to continue with the analysis (Sobhanifard, 2018).

In the communalities analysis, if the value is more than 0.3, it would suggest a strong relationship between the variables (Rahnama, Fadaei, & Baghersalimi, 2017). From the 18 items of the Likert scale assessed, 6 were important to evaluate the effect of Covid-19 pandemic and quarantine context on the respondent’s food consumption (Factors 1: items 1, 2,3,6, 9,10, communalities 0.744, 0.784, 0.611, 0.490, 0.788,0.464, respectively). They suggested that there was a change in the way of choosing foods of diet, with an increased amount of food ingested with less healthiness, in particular sweets what it can related to more time at home without external activities and their emotional state. These perceptions were influenced by Gender ($p < 0.01$), being them more noticed by women. (Table 3). Moreover, the influence of emotional statements on food consumption habits was dependent on gender, age group and average monthly household income (Table 4).

Regarding to shopping habits, it was noted the buying food in small size food enterprises was prioritized (factor 2 - item 15; 0.752) due to the

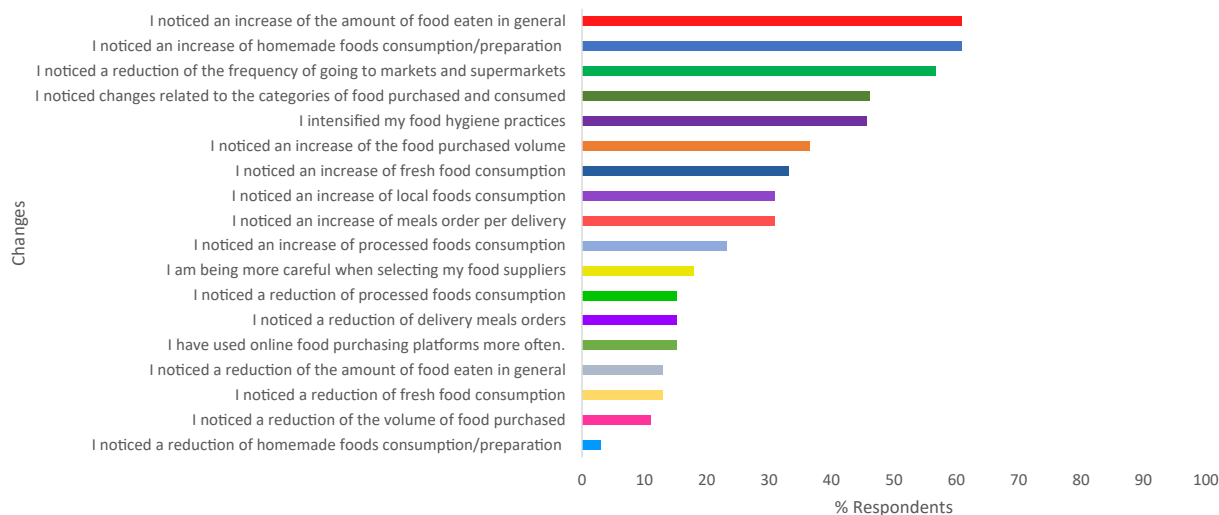


Fig. 1. Food consumption changes noticed by Brazilians during the COVID-19 pandemic and quarantine context.

trust placed in them, being this an important aspect for consumers (factor 2, 0.343) (Table 2). Moreover, 80.77% of consumers believe that local companies will be more affected than large industries. Due to this perception, local products should be also prioritized during their purchases.

Fig. 2 shows the frequency of purchase prioritization of different food categories during the quarantine context. Respondents indicated that they are prioritizing fresh animal (meat, eggs, milk and dairy products) and vegetal (fruits and vegetables in general) products during their purchases. Bakery products, grains, and cereals are also among the most frequently purchased products. From the beverages, coffee also stood out. The processed food purchase was less expressive among respondents, especially the ready-made or frozen foods. These results are in line with the increase in homemade preparations and prioritization of fresh and local foods (49.68% of the interviewees expressed giving total or partial priority to buy fresh products, in contrast to 68.27% and 67.95% of consumers that revealed to give little or no priority to buy frozen and processed products respectively). Finally, the purchase of gourmet products with high added value was the least significant among respondents. 75% said they give little or no priority to these products. However, its consumption was more frequently reported by respondents with higher income (>7 minimum wages; chi-square $p < 0.01$).

Regarding to the packaging characteristics, 57.07% indicated that are giving preference to buy products with economical packaging, being 27.56% indifferent regarding this aspect; and 40.71% noticed that they are opting to buy package products, while 34.94% are indifferent.

3.2. Food hygiene practices and perceptions

Table 5 presents the mean scores, standard deviation, and factor loadings of evaluated attributes regarding food hygienic practices and perceptions during the pandemic and quarantine period. In this study, Cronbach's alpha of 0.777 stated that the scale used had a good consistency and the KMO of 0.862 indicated that the variables' correlation was good (Maciel et al., 2013). Bartlett test ($p < 0.05$) indicates that sufficient correlations exist between the variables to continue with the analysis (Sobhanifard, 2018).

From the 14 items of the Likert scale, 10 were important to demonstrate the respondent's food hygienic practices and perceptions during the quarantine period (Factors 1: items 1, 2, 3, 4, 5, 6 and 7, communalities 0.738, 0.575, 0.838, 0.904, 0.920, respectively). All of them indicated that the food hygienic practices were intensified - 90.07% of the participants totally or partially agreed that they are taking more care of this aspect, because they believe that food can be a source

of covid-19 contamination (item 2) - 74.03% respondents totally or partially agreed that food is a possible route of virus contamination. Moreover, 71.80% totally or partially agreed that they are seeking to learn more and more about the correct way to sanitize their food; 71.47% are cleaning more frequently the food packaging obtained in commercial establishments, especially the processed food (67.31%). Moreover, 72.44% and 64.11% totally or partially agreed that they are taking more care of the hygienic conditions of the surfaces they handle and the places where they store their food. This concern is not fixed in obtaining food for home, but also non-household consumption.

Respondents indicated that they were confident in the safety of fresh and packaged food purchased (Factor 2 - items 9, 10 and 11: 0.781; 0.909; 0.894 respectively). However, more than half (63.36%) of the interviewees totally or partially agreed that they will be more careful about the food establishments they will attend from now on; and 71.16% indicated that they would maintain these food-sanitizing practices even after the COVID-19 pandemic. Linked to that, 47.43% of respondents totally or partially disagreed with the statement 'the food prepared outside the home is safe'. This corroborates the perceived increase in homemade preparations during quarantine.

4. Implications

4.1. Food consumption habits and perceptions during the pandemic and quarantine context

Alarming reports emerged from major US food producers about broken food chains and consequently wasting of good foods during the COVID-19 pandemic scenario (The Guardian, 2020). Worldwide, food demand increased during the pandemic period, associated with consumer insecurity related to possible food shortages and the unstable economic situation, as a consequence of restrictive measures of social isolation (Han et al., 2021). Therefore, it is important to assess the perceived changes in food consumption by consumers around the world. This study indicated that containment measures that were implemented by the Brazilian government, as well as the quarantine and social isolation due to the COVID-19 pandemic, influenced Brazilians' food consumption and purchase. These changes were influenced by gender, being more noticed by women. Moreover, respondents indicated that their emotional state influenced these changes.

Women are usually responsible for purchasing and managing the household food supply (Bava et al., 2008; Soorani & Ahmadvand, 2019). Despite the high presence of women in the labor market, she is still responsible for most of the household tasks. This possibly justifies the

Table 2
Mean scores and standard deviation (SD) of evaluated attitudes and perceptions about food consumption during the pandemic and quarantine.

Item	statements on consumer attitudes and perception scale	Factor loading			
		Mean scores	SD	D1	D2
1	I noticed a change in my food consumption habits	3.545	1.292	0.744	−0.025
2	I am consuming a greater quantity of food in general	3.369	1.424	0.784	0.018
3	My diet is less healthy	2.811	1.457	0.611	0.032
4	I am consuming more processed products	2.535	1.356	0.467	−0.005
5	I am consuming fresher products	3.218	1.249	0.055	0.061
6	My candy consumption has increased considerably	2.990	1.415	0.490	0.024
7	My alcoholic beverage consumption increased	2.093	1.380	0.058	0.008
8	My coffee consumption increased	2.510	1.526	0.200	−0.192
9	I believe that my emotional state has influenced my eating habits during the pandemic and quarantine context	3.574	1.428	0.788	0.064
10	I have opted for the purchase of non-perishable products	2.696	1.200	0.464	−0.155
11	I have opted to buy products from companies engaged in social causes	2.218	1.212	−0.072	0.073
12	I have opted to buy products from companies engaged in fighting Covid-19	2.308	1.263	−0.037	0.060
13	I believe that large companies will be affected by pandemic context	2.965	1.392	−0.070	−0.063
14	I believe that small businesses will be affected by pandemic context	4.253	1.059	−0.078	0.522
15	Buying products from producers/local traders should be prioritized	4.208	0.971	0.031	0.752
16	The food quality of large companies is bigger than small producers/local traders	2.410	1.131	0.035	−0.649
17	Products from small producers/local traders are safer than from large companies	2.901	1.036	0.216	0.343
18	I will be more judicious in selecting purchasing establishments even when the covid-19 pandemic ends	3.407	1.247	0.328	0.104

^aFactor loadings in bolding are significant in the axis after promax rotation. Values were obtained considering the considering the Likert scale: 1—strongly disagree; 2—disagree; 3—neither agree nor disagree; 4—agree; 5—strongly agree.

greater perception regarding changes in consumption habits during the COVID-19 pandemic. Moreover, emotional factors may have been more prominent given the accumulation of tasks arising from home office work and home activities (Bentley & Yoong, 2000; Benzel, 2020; Montemurro, 2020). In China, Li et al. (2021) found that the risk situation experienced as a result of the COVID-19 pandemic negatively affected food purchase and consumption habits in the country, from the point of view of sustainability. Concepts such as risk perception and knowledge about COVID-19, as well as gender and age, influence this issue.

According to the study conducted by Mintel (an international market intelligence agency) from April 13 to 30, 2020 in Brazil, the most overloaded profiles during quarantine, such as women, parents of children under 18 at home and those who work and study are the ones that most declared to resort to indulgent food and drinks to deal with anxiety (Mintel, 2020). According to Bandelow and Michaelis (2015), anxiety disorders affect a large part of the population of the 21st century, especially young adults inserted in the labor market. This may have intensified during the quarantine context and, consequently, reflected the emotional influence on food consumption habits. This can be linked to the greater consumption of candy noted mainly by women, which

Table 3
Changes in food consumption habits noticed by different genders.

		Women (%)	Men (%)
I noticed a change in my food consumption habits during the pandemic and quarantine context.			
Chi-square = 0.005; p < 0.01	Agree	60.40	48.80*
	Disagree	15.00	28.00*
	I do not agree nor disagree	24.60	23.20
I am consuming a greater quantity of food in general			
Chi-square = 0.005; p < 0.01	Agree	58.30	42.40*
	Disagree	20.90	36.80*
	I do not agree nor disagree	20.90	20.80
My candy consumption has increased considerably			
Chi-square = 0.031; p < 0.05	Agree	44.40	29.60*
	Disagree	33.70	42.40
	I do not agree nor disagree	21.90	28.00
I believe that my emotional state has influenced my eating habits during the pandemic and quarantine context			
Chi-square = 0.000; p < 0.001	Agree	69.00	42.40*
	Disagree	17.10	34.40*
	I do not agree nor disagree	13.90	23.20*

Table 4
Emotional state and its influence on food consumption habits during the pandemic and quarantine context.

I believe that my emotional state has influenced my eating habits during the pandemic and quarantine context	Totally disagree	Partially disagree	I do not agree nor disagree	Partially agree	Totally agree
Gender ^a					
Women	9.09	8.02	12.80	20.86	48.13
Men	21.60 ^d	13.90	23.20 ^d	21.60	20.80 ^d
Age group ^b					
18-25 years	40.91	38.71	45.45	36.36	62.93
26-35 years	15.91	16.13	29.09	43.94	24.14
36-45 years	20.45	32.26	14.55	9.09	8.62
46-55 years	13.64	6.45	7.27	9.09	3.45
56-65 years	6.82	3.23	3.64	1.52	0.86
Over 65 years	2.27	3.23	0	0	0
Average monthly household income ^c					
No income	6.82	12.90	3.64	3.03	18.10
Up to 1 minimum wages	6.82	3.23	9.09	13.64	13.79
From 1 to 3 minimum wages	27.27	19.35	21.82	25.76	31.90
From 3 to 5 minimum wages	9.09	12.90	23.64	22.73	12.07
From 5 to 7 minimum wages	15.91	6.45	9.09	10.61	10.34
Over 7 minimum wages	34.09	45.16	32.73	24.24	13.79

^a Chi-square p < 0.01.

^b p < 0.01.

^c p < 0.01.

^d Significantly differ between male and female.

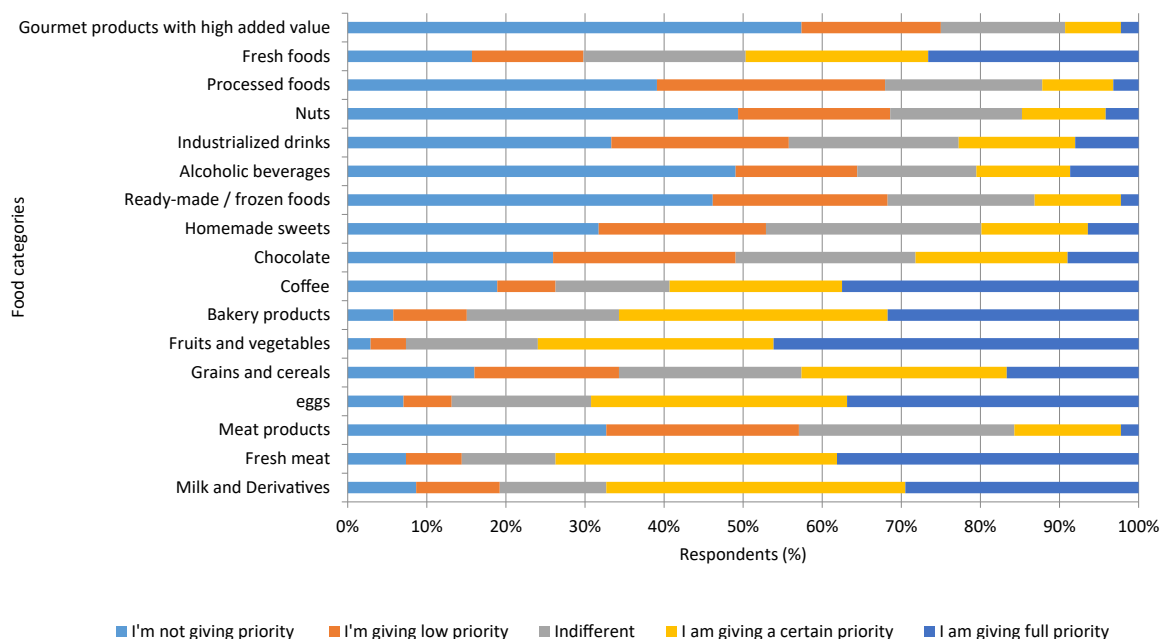


Fig. 2. Purchase prioritization of different food categories during the quarantine context.

helps with wellness sensation. In Chile, a study indicated anxiety relationships associated with increased consumption of foods that lead to weight gain during the pandemic period, such as sweets, fried foods, soft drinks, and fast food (Landaeta-Díaz et al., 2021). Tribst et al. (2021) also noted that factors such as time, skills, habits, feelings and beliefs are associated with diet changes during the COVID-19 pandemic period in Brazilian adults. Gómez-Corona et al. (2021) studied the fear developed by the population, associated with the relationship of COVID-19 with food. Based on three countries in three different conditions of social isolation severity (Mexico, Peru and Spain), the population's perceptions of fear could be classified into groups related to different concepts such as food supply, immunity, food delivery, overeating and basic needs.

According to Gustat et al. (2017), the food environment in which individuals are inserted influences their food pattern, affecting their food supply. Couto (2018) suggested that the generalization that healthy foods are more expensive also influences decision-making in the choice of purchased foods, mainly in crisis contexts. Therefore, further studies focusing on the implications of changing consumption habits on a healthy diet are needed. According to Zachary et al. (2020), other habits change, such as inadequate sleep; reduction in physical activity; lack of dietary restrictions; eating through stress and eating snacks after meals can, in the long run, result in weight gain and impaired healthy living. So, it is important to assess how it develops during the pandemic.

Kantar's Consumer Insights Report confirms that social isolation for more than two months has altered the consumption habits of Brazilians: there was a 27% increase in occasions for consumption of food and beverages within the home (25% growth at breakfast; 30% for lunch and dinner; 21% for quick snacks) (Kantar, 2020). In a survey conducted by Mintel, a market intelligence institute, 18% Brazilian consumers said they are eating more indulgent foods and drinks, such as ice cream, chocolate and pizza, to help them deal with anxiety (Rodas, 2020a). In contrast, consumers are much more interested in foods and beverages that help them maintain good physical and mental health, as well as emotional well-being. Studies indicate a greater demand for healthy products to improve the immune system, in addition to items with other features and benefits (Rodas, 2020b). A European study carried out in 16 countries identified that, in general, there was the adoption of a healthier diet, especially in countries like Greece, Portugal and Spain. Furthermore, the consumption of food classes considered healthier (such

as fish, vegetables and fruits) was higher in countries where there were more restrictive social isolation measures, a fact associated with greater dedication to home cooking (Molina-Montes et al., 2021). Therefore, Brazilian consumer habits must be better investigated and awareness campaigns are interesting focusing on a balanced diet during and post-pandemic context.

Brazilian consumers have prioritized basic animal and vegetal-based foods, as well as fresh foods during the pandemic. This can be linked to the higher consumption of home-cooked meals indicated by them. TheNielsen Company (2020) observed different results. It noted that sales of products like shelf-stable milk and milk substitutes are up by more than 300% in US dollar growth during the current pandemic. Other items of processed food (like dried or canned beans, canned tuna, pasta and fruit snacks that have a long shelf life) also increased their sales. These results can be used as a strategy for the development of products that meet this demand from Brazilian consumers and contributes to the maintenance of a balanced diet. In addition, there was a great opportunity for the bakery market, since bakery products are among the prioritized and most consumed products by respondents. According to Bakalis et al. (2020), home baking became common and a family activity resulting in a lack of flour and yeast in the supermarkets in European countries, Australia, New Zealand and UK. Moreover, the same authors suggested that flour does exist in the food system not necessarily in the form that consumers want it, demonstrating the potential of improvement in the format, e.g., packaging products are offered.

The application of economical and individual packaging also seems to be an interesting strategy to be adopted. With the intensification of food orders via delivery, there was an increase in the use of packaging, which is mostly not biodegradable or renewable. Furthermore, these packages were immediately discarded, due to the fear of contamination by SARS-CoV-2 through the surface of the materials. Technological solutions such as the development of biodegradable packaging and incorporation of antiviral active compounds (such as silver nano-clusters) in packaging have been studied (Oliveira et al., 2021).

Marketing strategies to boost the consumption of high value-added products in times of crisis are also interesting, once consumers reported a low consumption of these. Linked to the greater preparation of homemade foods, brands must be attentive to this movement and take the opportunity to help Brazilians feel confident in preparing meals with basic items, through various actions of virtual interaction. However,

Table 5
Mean scores and standard deviation (SD) of evaluated attitudes and perceptions regarding to food hygienic practices during the pandemic and quarantine context.

Item	Statements on consumer attitudes and perception scale	Mean scores	SD	Factor loading ^a	
				D1	D2
1	My personal hygiene practices were intensified in the face of the Covid-19 pandemic.	4.503	0.841	0.738	-0.002
2	Food can be a source of Coronavirus (COVID-19) contamination	4.106	1.161	0.575	-0.260
3	I have become better acquainted with the correct ways to sanitize my food in the face of the Covid-19 pandemic.	4.064	1.138	0.836	0.016
4	My food hygiene practices were intensified in the face of the Covid-19 pandemic.	4.151	1.154	0.904	0.010
5	I have more frequently sanitized food purchased in commercial establishments.	4.109	1.129	0.920	-0.039
6	I have more frequently sanitized packages of processed foods purchased in commercial establishments.	3.978	1.264	0.817	-0.045
7	I have taken more care with the hygienic conditions of the surfaces on which I prepare my food.	4.045	1.142	0.816	0.015
8	I will maintain my food sanitation habits even when the Covid-19 Pandemic ends.	3.968	1.030	0.359	0.356
9	I trust the safety of packaged food purchased in commercial establishments.	2.843	1.202	-0.019	0.781
10	I trust the safety of fresh food purchased in commercial establishments.	2.699	1.081	-0.026	0.909
11	I trust the safety of fruits and vegetables purchased in commercial establishments.	2.635	1.109	-0.049	0.894
12	I feel safe consuming food prepared outside the home during the pandemic.	2.596	1.186	-0.013	0.464
13	I feel safe returning to attend food establishments after quarantine.	2.827	1.291	0.078	0.213
14	I will be more judicious in selecting the food establishments I will attend after quarantine.	3.872	1.132	0.338	0.081

^a Factor loadings in bolding are significant in the axis after promax rotation. Values were obtained considering the considering the Likert scale: 1—strongly disagree; 2—disagree; 3—neither agree nor disagree; 4—agree; 5—strongly agree.

according to [Rodrigues et al. \(2021\)](#), the food information environment during the COVID-19 pandemic is changing in Brazil. The food industry, especially of ultra processed foods, changed its advertising strategy to incorporate messages of empathy, unity and partnership, in addition to investing in social responsibility actions and sponsoring online events with the objective of self-promotion. As a result, the consumer is more vulnerable to the consumption of these products. Thus, it is important to update the regulatory legislation on food marketing and its effective compliance through the accountability of the industry and supervision of the government, in order to ensure the encouragement of healthier food consumption by the population.

[Russo et al. \(2021\)](#) noted two opposite approaches to change in Italian food purchasing decisions during the Coronavirus pandemic: impulsive approach and reflective approach. The former is associated with a higher probability of changing food purchases but a lower probability to keep the changes in the long run than the latter.

Therefore, despite the changes noted on the respondent’s food consumption, the authors suggest that COVID-19 psychological pressure can be associated with an impulsive approach to buy food. Consequently, food-purchasing behavior is expected to revert to pre-COVID 19 habits when the emergency is over. Thus, studies over the different periods of the pandemic are encouraged.

4.2. Food buying and food hygiene practices habits and perceptions

The study of eating habits, as a support tool for decision-making, is essential for commercial establishments: from it, it is possible to know what the consumer wants and what factors lead him to a certain food choice, as well as why reject certain categories of products. Therefore, it is necessary to know the intrinsic (socio-demographic data) and extrinsic factors (media vehicles, food environment) that influence consumer decision-making ([FGV, 2020](#)).

Within the pandemic context, consumers are increasingly afraid to go in person to purchase their food supplies. Moreover, several countries, including Brazil, imposed several limitations to avoid crowds, encouraging delivery and take out/away services ([Oliveira, Abranches & Lana, 2020](#)). This reflects the lower frequency of going to supermarkets and the higher food volume purchased by the respondents of this research. [Bakalis et al. \(2020\)](#) also indicated a clear change in US consumer behavior or purchasing habits. There is some evidence that consumers did not “stockpile” to the extent that it was previously thought, there was an average increase of ~15% on the consumer spending in each visit, while there is a decrease in the number of visits. This change might be a result of more people preparing meals at home for themselves and their families ([Bakalis et al., 2020](#)). [Kassas and Nayga \(2021\)](#) found that compulsive food buying (panic buying) during the pandemic period in the US was more pronounced in urban areas and homes with children. This behavior was associated with feelings such as the need to be in control of the situation, believing that it is the best option to take and reducing trips to the stores. [Bracale and Vaccaro \(2020\)](#) also noticed a correlation between the increase in consumption of certain categories of food by Italian consumers, with the attempt to simulate some external habits of socialization within the family environment, such as happy hours and trips to restaurants.

According to [Botelho et al. \(2020\)](#), the context of physical distancing contributes to the adoption of food delivery, as long as food services follow hygienic-sanitary guidelines. Thus, more Brazilians are choosing to receive food at home, considering that using this technological solution is safer than going out to eat. What’s more, the apps have been investing in strategies like discounts, promotions and free shipping during this period. An overall increase in the use of online platforms to order food, share recipes and substitute social interactions around food was noted as made by other studies ([Bakalis et al., 2020](#); [Guissoni, Ferraro & Schunck, 2020](#); [Rezende, Marcelino & Miyaji, 2020](#)). [Rezende et al. \(2020\)](#) also indicated that large companies of the food delivery business, such as Ifood, Rappi and Uber Eats, had a bigger growth than usual. Additionally, its customers started to buy larger quantities per order, more frequently and at times different from those when consumption peaks usually occurred, including breakfast, afternoon and lunch ([Botelho et al., 2020](#)). In this context, it is important to highlight the need for public health measures to discourage the consumption of ultra-processed foods, such as the adoption of packaging with frontal warning, the taxation of sugary drinks and the regulation of advertising and environments ([Swinburn et al., 2019](#)). However, despite the rapid rise of the food delivery industry, which may be being boosted in the context of the pandemic, there are still no proposals for specific measures to encourage the purchase of culinary preparations based on fresh or minimally processed foods, and to discourage purchase of those based on ultra-processed foods ([Botelho et al., 2020](#)).

According to Qualibest, a market research institute, in the first round of research to understand the impact of the pandemic on consumer behavior (conducted between April 2 and 6), 95% Brazilians

interviewed were staying at home for fear of being contaminated, and because of these, 93% were cooking at home (Rodas, 2020a). This can be linked to the high level of respondents that think food is a “possible route of virus contamination”. Byrd et al. (2021) noted in their study that consumers were less concerned about contracting COVID-19 from food in general than restaurant food and its packaging, with consumer restaurant concern highest for food served in restaurants, and lowest for hot/cooked restaurant food followed by restaurant food from carrying out. Moreover, the risk perceptions of consumers varied with financial concern for food, gender, and being in a high-risk category of COVID-19. This reinforces the need for awareness campaigns on coronavirus contamination and food consumption.

Despite indicating that they are more attentive and concerned with personal and food hygiene, respondents did not agree that they are being more discerning when choosing their food suppliers. Moreover, they indicated that would not feel safe in frequenting food supply establishments after quarantine. Therefore, actions to raise awareness among consumers, as well as food merchants, in order to guarantee the supply of safe food to the population are needed. The study of Hakim et al. (2021) indicate that consumers’ trust in a restaurant and brand, fair price, solidarity with the restaurant sector, disease denial, and health surveillance trust predict intention to visit a restaurant during the COVID-19 pandemic. Age has significant moderated effects, reducing disease denial effects. The authors also noted that special attention to consumers’ trust and fair price perception is fundamental, given consumers’ solidary inclination toward helping the restaurant sector. These aspects must be recognized by restaurant owners and managers to be improved and be used to attract consumers.

Information on the correct way to handle and store food and about which and how to use chemicals (sanitizers, detergents and disinfectants) should be addressed to the population. Chen (2020) suggests that these guidelines protect the population from the SARS-CoV-2 and from unnecessary exposure to hazardous compounds. Moreover, commercial establishments, such as those intended for food supply, need to ensure the safety of their customers at their physical stores during and after the pandemic. Limit the number of people inside the establishments, establish a minimum distance in the queues, keep the shopping carts sanitized, as well as provide equipment and training to employees are recommended during this period.

The engagement of companies in projects and social causes is part of a movement known as Social Responsibility. This movement consists of actions taken by companies that benefit both their employees and the community around them. It also includes a concern on the environment preservation (Silva & Filho, 2020; Freitas & Rezende, 2010). The consumers of this study indicated that they did not prioritize products from companies engaged in social causes, as well as in combating the new coronavirus. In view of this, it is important to further publicize the importance of these actions for their recognition by consumers. The majority of respondents indicated that they were certain to return frequently to food stores after the pandemic, as well as that they will be more careful when choosing these establishments. Therefore, it becomes more difficult to meet customer expectations regarding quality standards, whether in relation to the products offered or services provided. Oliveira, Santos, Quintão, Ferreira, and de Oliveira (2018) indicated that meeting these demands is essential for a company to be successful in its field, given the individual experiences of each client. Thus, companies must seek marketing strategies to publicize the quality and safety offered by them.

The COVID-19 pandemic generated a new era in the food supply chain and the food industry (Rizou et al., 2020), with consequences for humanity, economy, and food safety (Galanakis, 2020). According to Farias and Araújo (2020), the different periods of the COVID-19 pandemic generated large variations in the prices of products sold by Ceasas of different regions of Brazil, impacting both consumers and producers. Thus, at a time when global health is threatened, it is essential that the Brazilian agencies create measures to ensure the

proper functioning of food production chains, in order to guarantee the country’s food security during the current crisis. For this, studies on the impacts of COVID-19 on the food production chain and its effects on the economy are necessary.

Rizou et al. (2020) indicated that researchers and professionals in the food sector have many challenges ahead, e.g., ensuring food safety, detecting SARS-CoV-2 in environments where food is produced, processed and delivered, sanitizing surfaces and working environments adequately, and others. Djekic et al. (2021) found that, based on 16 European countries, the level of development of the food safety measures established before the COVID-19 pandemic are decisive in responding to the challenges brought in this period. Employee awareness and hygiene procedures were revealed as the main actions related to SARS-CoV-2 within the scope of food companies, which also affirmed the implementation of stricter hygiene protocols and the purchase of additional protective equipment. In general, food companies in 2021 see that there was no compromise of food safety at any time during the pandemic. In addition, according to Bakalis et al. (2020), it is believed that in the future we will continue to see similar pressures in the food system, e.g., comparable pandemics, effects of climate change on food production, and that resilience will become of major importance. Food system is defined as ‘capacity overtime of a food system and its units at multiple levels, to provide sufficient, appropriate and accessible food to all, in the face of various and even unforeseen disturbances’ (Tendalla et al., 2015). For this, an interconnection of several factors is required, especially with regard to the greater complexity of the formulations of new food products, generating dependence on a global scale. In order for the food system to adapt to new future threats, government entities suggest actions such as expanding food assistance programs, encouraging small producers and adapting to e-commerce, developing strategies to reduce food loss and waste, among others (Han et al., 2021). Therefore, studies indicating the food consumption habits of the population are important.

4.3. Limitations and practical implications of this study

Since Brazil is a vast country and in many regions technology and internet access is still limited, the online survey and the sample size do not allow the results to be generalized for all Brazilian population. Moreover, it is important to point out that Brazilian’s perceptions and attitudes were the basis of this study. However, the results present relevance and can serve as a first guideline for Brazilian industry and government regards food consumption during the COVID-19 pandemic. The COVID-19 pandemic has affected how households buy, prepare and consume food. These impacts have not yet been properly understood, especially in the context of developing countries, and few studies are comprising the Brazil scenario. A better understanding of the first impacts of COVID-19 on Brazilian’s on food consumption and purchase attitudes and perceptions will guide government actions and will assist companies in establishing safe food marketing and commercialization strategies that meet the desires and needs of the population.

5. Final considerations

Respondents indicated that COVID-19 pandemic context (assessed in May 2020) changed their food consumption and purchase. Brazilian consumers stated that they are eating and buying a greater amount of food, indicating a perception of a less healthy diet, mainly by women. On other hand, they are prioritizing homemade preparations and fresh food. Moreover, they reduced their shopping trips to markets and are starting to use delivery services and shopping platforms. Basic animal, vegetal and bakery products are being preferred during this period, in addition to economical packaging and products. Brazilians also indicated that they are more concerned with food safety and hygienic practices. However, at a time when global health is threatened, it is essential that Brazilian government agencies create measures that

ensure the food safety supply and consumer's awareness, in order to guarantee the country's food security during the current crisis.

This study may encourage future studies focusing on the impacts of COVID-19 on the Brazilians' food consumption habits and their effects on the population's healthy diet, as well as on the economy of the corresponding sector, not only in Brazil but also in other regions of the world. Moreover, the results of this study may guide government actions and assist companies in establishing safe food marketing and commercialization strategies that meet the desires and needs of the population.

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