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Public perception of citrus fruit consumption during the COVID-19 pandemic in Brazil

Michael Willian Rocha de Souza[1]*, Adriana Grandis[2], Marcela Sant'Anna Cordeiro da Silva[1], Marcelo Almeida de Oliveira Junior[1] & Matheus Luís Docema[1]

SUMMARY

Adequate nutrition has become a priority for the psychologically and emotionally affected population, especially those under stress due to quarantine and people affected by Coronavirus Disease in 2019 (COVID-19). However, records on eating behavior variations due to Brazil's pandemic are still incipient, and it is crucial to know and identify frequent incentives that arouse interest in a class of products. Therefore, this study aimed to analyze the final consumer behaviors and the consumption influence of citrus fruits and their products, as a vitamin C source, in the COVID-19 pandemic in Brazil. By applying an online questionnaire prepared on the Google® Forms platform, a survey was conducted with the voluntary participation of 546 unidentified respondents. The answers obtained made it possible to trace the participants' sociodemographic characteristics and consumption habits. According to the interviewees, there was a predominance of adults between 25 and 34 years old, female, single, living in the Southeast macro-region, and people with a master's and doctorate. level education. With the onset of the COVID-19 pandemic, most of the population interviewed did not change their consumption of citrus fruits and their products, but the place of purchase changed, possibly due to social isolation. Marketing is of fundamental importance in the Brazilian citrus industry, which is facing the challenge of encouraging a healthier diet and searching for expansion of the fresh fruit market.

Index terms: lemon, nutrition assistance, orange, SARS-CoV-II, food immunity.

Percepção pública do consumo de frutas cítricas durante a pandemia da COVID-19 no Brasil

RESUMO

A nutrição adequada tornou-se uma prioridade para a população tanto psicológica, quanto emocionalmente afetada, especialmente aqueles sob estresse devido à quarentena e pessoas afetadas pela doença de Coronavirus em 2019 (COVID-19). Entretanto, os registros de variações de comportamento alimentar devido à pandemia brasileira ainda são incipientes, e é crucial conhecer e identificar incentivos frequentes que despertam o interesse por uma classe de produtos. Portanto,

[1] Departamento de Produção Vegetal, Escola Superior de Agricultura 'Luiz de Queiroz' – ESALQ, Universidade de São Paulo – USP, Piracicaba, SP, Brasil
[2] Departamento de Botânica, Universidade de São Paulo – USP, São Paulo, SP, Brasil

***Corresponding author:** Michael Willian Rocha de Souza, Escola Superior de Agricultura 'Luiz de Queiroz' – ESALQ, Universidade de São Paulo – USP, Av. Pádua Dias, 11 - Agronomia, 13418-900, Piracicaba, SP, Brasil. E-mail: michael.willian@usp.br

este estudo teve como objetivo analisar os comportamentos do consumidor final e a influência do consumo de frutas cítricas e seus produtos, como fonte de vitamina C, na pandemia da COVID-19 no Brasil. Ao aplicar um questionário online preparado na plataforma Google® Forms, foi realizada uma pesquisa com a participação voluntária de 546 entrevistados não identificados. As respostas obtidas tornaram possível rastrear as características sociodemográficas e os hábitos de consumo dos participantes. Segundo os entrevistados, houve predominância de adultos entre 25 e 34 anos de idade, do sexo feminino, solteiros, residentes na macrorregião Sudeste, e pessoas com nível de mestrado e doutorado. Com o início da pandemia da COVID-19, a maioria da população entrevistada não mudou seu consumo de frutas cítricas e seus produtos, mas o local de compra mudou, possivelmente devido ao isolamento social. A propaganda é de fundamental importância na indústria cítrica brasileira, que enfrenta o desafio de incentivar uma dieta mais saudável e buscar a expansão do mercado de frutas frescas.

Termos de indexação: limão, assistência nutricional, laranja, SARS-CoV-II, imunidade alimentar.

INTRODUCTION

Emerged in China, the new coronavirus (SARS-CoV-II) has rapidly expanded worldwide (Jalali et al., 2020) and was officially detected in Brazil on February 26, 2020. Moreover, as a result, the World Health Organization (WHO), on March 11, 2020, declared the COVID-19 pandemic a new and largely unknown disease. In this way, measures were implemented, and recommendations were issued. However, not all actions were based on scientific evidence (Bellavite & Donzelli, 2020).

Faced with the increase in notifications and the lack of proven effective treatments, Brazilian health competencies have implemented actions to reduce interpersonal contacts (Steele et al., 2020). Although clinical studies with antivirals and other agents are ongoing, the existence of nutrients and dietary patterns that can even alleviate its severity are also raised by the scientific community (Bellavite & Donzelli, 2020).

Unfortunately, food is a neglected or underestimated aspect. However, it is recognized that it often plays an essential role in preventing infectious diseases (Wallace et al., 2020). Nutrition is part of treating acute and chronic diseases and is particularly applicable for which an etiological treatment has not been discovered and validated yet (Laviano et al., 2020). Consumption of fruits and vegetables increased by 40% (Furlaneto et al., 2020) and sales of orange juices raised 28% (Campo & Negócios, 2021) during the first week of the publication of the decree on social isolation.

Citrus fruits, belonging to the Rutaceae family, are rich in sources of vitamin C, flavanones, and some varieties of anthocyanins. Hesperidin and naringin (flavanones) are the most abundant components, presenting several properties, including antioxidant and anti-inflammatory activities (Barreca et al., 2020; Zhu et al., 2020). Ascorbic acid, also known as vitamin C is the main antioxidant component of oranges; indeed, as part of a healthful diet contributes 15% to 30% of the total antioxidant capacity of blood plasma (Licciardello et al., 2018).

Vitamin C consumption has been used for decades to prevent common colds, influenza and, scurvy. Deficiency of this vitamin can result in scurvy, which manifests as fatigue, impaired bone growth in children, and, as a consequence of the failure of connective tissue to properly form, bleeding, including perifollicular hemorrhages, petechiae, ecchymoses and gingival bleeding (Plevin & Galletly, 2020). One of the symptoms caused by coronavirus is related to those of influenzas. Given the low cost and high safety of natural foods rich in vitamin C, it is suggested to increase the daily intake of these foods (with a rich presence of ascorbic acid) during the pandemic (Messina et al., 2020; Dresen et al., 2022). Furthermore, the prevalence of malnutrition appears to be a relevant factor influencing the outcome of patients with COVID-19 (Misumi et al., 2019).

It is necessary to assess the impact of the pandemic on agribusiness, especially the citrus industry. Brazil is the largest producer of sweet oranges and accounts for over three-quarters of global orange juice exports (Caserta et al., 2019). Orange is the main citrus fruit grown globally, with 53.7 million tons in the 2016/17 harvest, against 30.2 million tons of tangerines and 7.6 million tons of lemons and limes (Vidal, 2020). In addition, it is relevant to identify the population's eating behavior and to consider the unpredictability of the duration of the pandemic and the influence that food has on the maintenance and recovery of health (Williamson et al., 2020). However, records on variations in eating behavior due to the pandemic in Brazil are incipient (FIOCRUZ, 2020; Steele et al., 2020). Therefore, this study aimed to analyze the final consumer behaviors and the possibility of influence in

the consumption of citrus fruits and their products, as a vitamin C source, during the COVID-19 pandemic in Brazil.

METHODS

By applying an online questionnaire prepared on the Google® Forms platform, a survey was conducted from April 30 to June 29, 2021, with the voluntary participation of 546 unidentified respondents. The selection of participants was carried out randomly, using communication vehicles and social networks of digital influencers to disseminate the questionnaire, where the most significant sample heterogeneity and broad representation of consumers were sought.

The questions addressed possible changes in the pattern of purchase and consumption of citrus fruits and their products before and during the COVID-19 pandemic and the participants' comprehension of food on health maintenance and recovery. The questions were based on surveys and scientific papers applied to public opinion regarding dietary changes in Brazil during the pandemic. The data obtained were analyzed using descriptive statistics.

RESULTS

It is crucial to recognize and identify frequent incentives that arouse interest in product classes, which may occur through collecting information from several consumers (Kotler, 2000). Buying behavior begins with identifying a problem or a need by the buyer. Therefore, it is acceptable to expect that behaviors will change with the COVID-19 pandemic, one of them being alimentation, due to greater care in consuming beneficial foods to expand immune defenses.

From this perspective, the data from this research can constitute a fundamental input for marketing processes and contribute to the development and orientation of the Brazilian citrus market, which constitutes a complete understanding of consumers' desires and needs.

Sociodemographic characteristics

It was possible to trace the sociodemographic characteristics of the participants from the elaborated questions. There was a predominance of adults between 25 and 34 years old (52.20%), woman (62.30%), single (65.02%), living in the Southeast macro-region (86.63%), and people with higher education (master's and doctorate) (32.23%). On the other hand, the absolute number of participants is low among older people with more than 65 years old (n = 4), residents of the macro-regions of the North (3) and Midwest (18), and people with incomplete primary education (4) (Table 1).

Table 1. Number of responses according to sociodemographic variables, gender, macro-region of residence, age group, marital and education status

Variables	Number of responses	Percentage
Gender		
Male	203	37.20
Female	340	62.30
Prefer not to answer	3	0.50
Macro-region of residence		
North	3	0.55
North East	30	5.49
Midwest	18	3.30
Southeast	473	86.63
South	22	4.03
Age group (years)		
18-24	122	22.30
25-34	285	52.20
35-44	68	12.50
45-54	38	7.00
55-64	29	5.30
above 65	4	0.70
Marital status		
Single	355	65.02
Married/Stable union	171	31.32
Divorced	12	2.20
Widower	5	0.91
Prefer not to answer	3	0.55
Education status		
Incomplete Middle School	4	0.73
Middle School	18	3.31
Incomplete High school	5	0.92
High school	62	11.36
Incomplete Higher Education	70	12.82
Higher Education/Technician	124	22.71
Specialization (MBA)	78	14.26
Master's/Ph.D.	176	32.23
Other answers	9	1.66
Total	546	100

The data can be divided into two major groups regarding the current occupation status, where 42.12% of the participants are employed and working full-time, and 39.19% are students (Table 2). Family income before the COVID-19 pandemic was represented by 7.70%, 32.10%, 23.40%, and 36.80% receiving around one, one to three, three to five, and above five minimum wages, respectively, with most households occupied by 2 to 4 residents (74.50%). Family income during the pandemic did not change significantly, with an increase of 1.60% and 1.80% for incomes of up to one salary and above five minimum wages, respectively. However, decreases of 2.40% and 1.10% were observed for incomes of one to three and from three to five minimum wages.

Table 2. Number of responses according to current occupancy status and resident number of residents in the household

Variables	Number of responses	Percentage
Current occupancy status		
Employee/Full-time	230	42.12
Employee/Reduced	20	3.66
Retired	8	1.47
Unemployed	27	4.95
Students	214	39.19
Housewife	7	1.28
Other answers	40	7.33
Residents in the household		
Only 1	83	15.20
2-4	407	74.50
4-6	50	9.20
Above 7	6	1.10
Total	546	100

Comparison of consumption of citrus fruits (family Rutaceae) and their products before and during the COVID-19 pandemic

The onset of the COVID-19 pandemic resulted in 61.90% of the participants reporting no change in consumption of citrus fruits and their products. However, 28.20% reported an increase, versus 9.90% who reported a decrease in consumption. Participants were asked which citrus fruits were commonly consumed, with orange (n=503) and lemon (488) being the most cited in the responses, followed by other fruits, such as tangerines *Citrus reticulata* Blanco (366) and *C. deliciosa* Tenore (166), consumed mainly in the fresh form (481) and in juices (452), frozen pulps (39) and jams (37).

Before the pandemic, only 6.96% of the participants consumed some citrus fruit daily, and the predominant consumption was regularly once or twice a week (50.55%) (Figure 1). When considering the pandemic period, there was a smaller 1% increase in daily consumption. However, the highest number is consumption once or twice a week (39.4%) (Figure 1). Regarding the establishment, the direct purchase from the producer and door-to-door sales increased during the pandemic (Table 3).

The behavior regarding orange juice consumption can be characterized in the same manner, where the majority 61.72% and 57.14% of the participants, consume in natura and processed orange juice once or twice a week. The daily consumption increased by 0.54% and 0.19% in natura and industrialized juice during the pandemic, respectively. However, in the same period, there was an increase in the number of people who stopped consuming such products, mainly industrialized juice 3.29%, and 0.55% in natura juice (Figure 2). Considering the average expenses with the consumption of citric fruits and orange juice, 58.8% of the interviewees could not answer. On the other hand, 22.8%, 11.4%, 4.6%, and 2.7% spend an average of 5, 10, 20, or 30% of their monthly budget on the acquisition of such products.

Table 3. Number of responses according to a place of purchase of citrus fruits and their products before and during the COVID-19

Establishment	Before the pandemic	During the pandemic
	Number of responses	
Direct with the producer	59	70
Street markets	187	122
Hypermarket/ Supermarkets	430	412
Small markets	138	116
Greengrocer	292	274
Door-to-door	28	34
Other locations	6	10

Reasons for behavioral changes in the face of the COVID-19 pandemic

Stratifying the reasons for the increased consumption of citrus fruits, the main reason is the search for vitamin

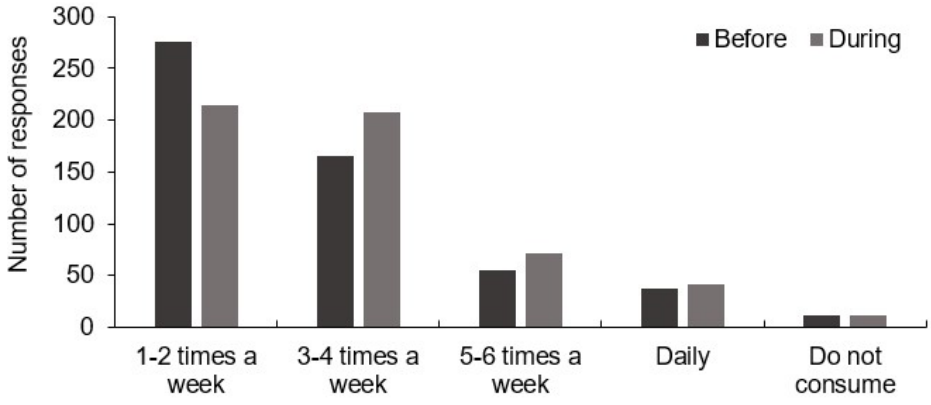

Figure 1. Number of responses according to the frequency of consumption of citrus fruits (Rutaceae family) before and during the COVID-19 pandemic.

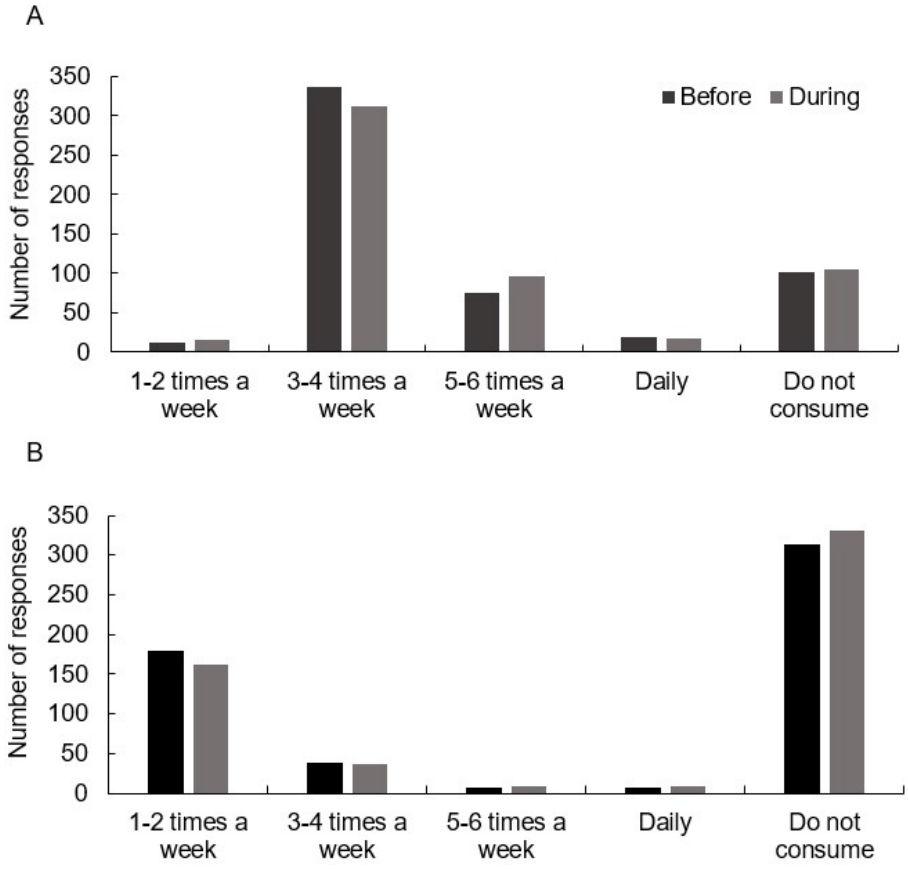

Figure 2. Number of responses according to the frequency of consumption of *in natura* (A) and industrialized (B) orange juice before and during the COVID-19 pandemic.

C intake, general health care, and disease prevention (Figure 3). Instigating the possible relationship between increased consumption and the COVID-19 pandemic, 37.20% of the participants stated a relationship in the behavior change, versus 26.90% who did not see a relationship, the others would not know how to answer.

On the other hand, segregating the reasons for a decrease in the consumption of citrus fruits and orange

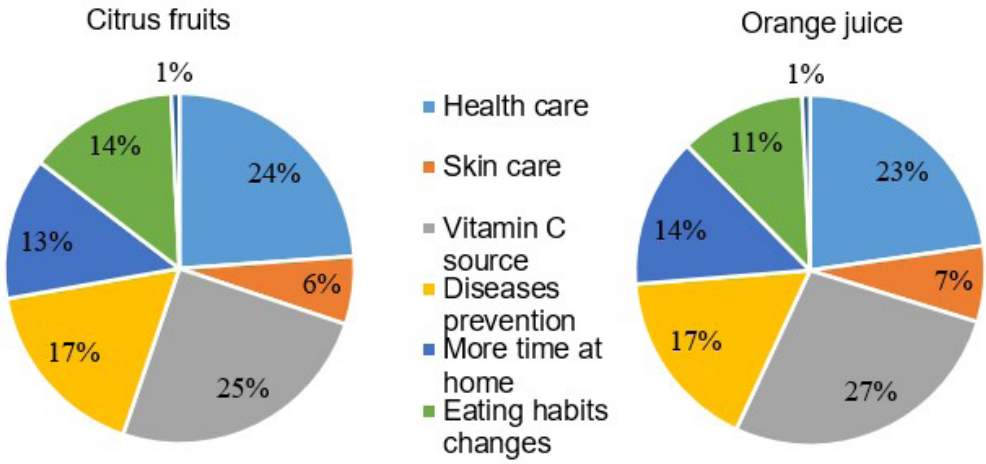

Figure 3. Distribution of possible reasons that led to increased consumption of citrus fruits (Rutaceae family) and orange juice in the COVID-19 pandemic.

juice, the increase in value, the difficulty of access to the place of purchase, and the availability of products are the main factors.

Asked about contact with any disclosure of technical-scientific communication associating the consumption of citrus fruits and their products with the acquisition of vitamin C and COVID-19, 297 participants had no contact with such communications. However, 145, 88, and 50 respondents found any association between citrus fruit/vitamin C/COVID-19 consumption on TV, in newspapers, or scientific articles. The number of participants who contacted this association through the internet/social networks was 59 responses.

DISCUSSION

Although the online questionnaire was disseminated by mass communication vehicles and social networks with regional and national reach, the participants have a sociodemographic profile different from that expected of the Brazilian adult population. Due to the research's dissemination and purpose, a low number of responses from people over 65 years old was expected, and a high number of students with a higher education level. Such data is important to highlight, as the level of education can interfere with the type of product consumed, as the habit of consuming fruits can be formed spontaneously or through access to information (Samara & Morsch, 2006). However, in comparison with the expected frequencies according to the 2010 Demographic Census prepared by the Brazilian Institute of Geography and Statistics (IBGE, 2010), it is noteworthy, in addition to a lower men proportion (37.20%, in this research, against 48.20% in the Census), a marked underrepresentation of the North macro-region (0.55% against 7.40%). The north of Brazil has a low level of internet access compared to other regions (Silva et al., 2020), representing an obstacle to obtaining more responses in opinion polls through this medium.

In addition to a greater representation of workers or students, the household income shown in this research has not changed significantly with COVID-19. Several companies have adopted measures to contain expenses, such as adopting the remote work system, therefore expect a lower number of demises. Indeed, the Brazilian government released emergency aid plans for the population and companies to mitigate the economic effects of the pandemic. In Brazil, *per capita* family income changes impact household consumption of specific foods. In the case of fruits, there is a reduction in consumption of those considered more popular, such as bananas, oranges, tangerine, and papaya, and an increase in consumption of those considered more noble, such as melon and grape (Hoffmann & de Jesus, 2021). It is known that with the loss of dynamism of the national economy, the level of informality in the Brazilian labor market has increased, and people with low and irregular incomes can be more intensely affected by economic crises (Costa, 2020).

Higher oranges and lemons consumption may be linked to greater production and consumer familiarity. Citrus plants are widely cultivated globally, with great relevance within Brazilian agribusiness due to the annual turnover

of more than US$ 6.5 billion (Neves & Trombin, 2017), with Brazil considered the world's largest producer of oranges (FAO, 2019). The lemon, with several cultivars, is produced in different regions of Brazil and can be consumed throughout the year (Chaves Neto et al., 2018). The Southeast region, for example, is responsible for 83,7% and 81,3% of the national production of oranges and lemons, respectively (IBGE, 2021). The predominance of volunteers residing in the Southeast macro-region (86.6%), linked to the region with the highest production of oranges and lemons, can influence and facilitate the access and purchase of these fruits.

The extended stay at home, combined with the establishment closes, increases the volume of meals produced at home and a search for more beneficial foods to increase immune defenses (Steele et al., 2020). Changes in the purchase places of citrus fruits and their derivatives evidenced in this research can be explained by the reduction of interpersonal contacts, the establishments closing, and the increase in delivery services. Moreover, the direct purchase from the producer and the door-to-door sale allows bargaining on the final price of the goods, different from what happens in supermarkets that have their fixed values.

During the experimental period, there was an increase in the number of people who stopped consuming industrialized and fresh orange juice. Steele et al. (2020), highlight that the influence of several factors on eating behavior can be modulated by cultural, educational, and economic attributes of populations and individuals. For example, in a food consumption survey in Brazil, only juice intake is higher with an increasing frequency of food consumption outside the home (Andrade et al., 2020). This fact may be linked to the time needed to make the natural juice and wash the used utensils; items not considered in meals outside the home. Such behavior corroborates the data presented in this paper considering the pandemic period, with a drop in juice consumption due to the need to be indoors for an extended period and preadaptation of the usual routine that can eventually lead to conditions that reflect in their diet. American consumers, the biggest in the world, purchased 1.1 billion liters of orange juice in large retail chains from March to October 2020, a volume 22% higher than in the same period in 2019, while in Brazil, consumption had a high of 20%. Brazilians consume is close to 260 million liters of orange juice, an average of 1.2 liters per year per person, while in the United States, the average consumption is 3 billion liters, 9.1 per person (Zafalon, 2020).

The main reasons for the increase in fruit consumption are general health care and disease prevention. Citrus fruits, especially oranges, are an excellent source of vitamin C, with potent antioxidant activity, and are rich in dietary fiber, which helps prevent diabetes and reduce cholesterol levels. In addition, they are abundant in micronutrients such as potassium, vitamin B6, riboflavin, and calcium, which are essential for maintaining health (Ma et al., 2020). In human biology, vitamin C plays a vital role in synthesizing catecholamines, collagen, cortisol, neurotransmitters, and peptide hormones, the immune cell functions, maintaining endothelial vasodilation and barrier, and the iron and folic acid metabolism. Moreover, vitamin C acts as a scavenger of reactive oxygen species (ROS) and inhibits proinflammatory cytokines (Berger & Oudemans-van Straaten, 2015). Adequate nutrition has become a priority for the psychologically and emotionally affected population, mainly under stress due to quarantine and people affected by COVID-19 (Cruz Leão & Sales Ferreira, 2021). Evaluating the research on eating habits developed in Brazil, 27.30% (Pellegrini et al., 2020) and 29% (Martinotto et al., 2020) of the participants reported eating more fruits and/or vegetables than before the pandemic period. Poor nutrition can directly affect the reduction of the body's defenses, making the population more susceptible to illness (Almeida Brasiel, 2020). It is impossible to prove a food or healthy behavior that fights the contagion of SARS-CoV-II, but it is essential to maintain a good health state (Cunha, 2020). Inadequate nutrition can lead to malnutrition and obesity, which is associated with worse outcomes in patients affected by COVID-19, with a higher risk of hospitalization, more extended hospital stays, and mortality (Misumi et al., 2019; Czapla et al., 2021).

On the other hand, the increase in value, social isolation, and the availability of products are the main reasons for a drop in consumption. Social isolation and changes in the economic environment affected the production, marketing, supply, and consumption of food. These factors significantly affected the population in a situation of socioeconomic vulnerability due lower supply of fresh food, and an increase in the consumption of ultra-processed foods due to the price and more accessible acquisition (Ribeiro-Silva et al., 2020).

The internet and social networks promote changes in consumer behavior, especially concerning healthy eating. Over the past few years, there have been declines in fresh food consumption due to marketing intensification strategies encouraging food industrialization (Buainain et al.,

2016). In addition, advertising of food products has been increasingly targeted at encouraging the consumption of ultra-processed foods, focusing on the benefits of fortified foods. Such questions lead consumers to believe that fortified industrialized products are healthier (Silva, et al., 2019). In this sense, it is crucial to conduct market studies that analyze consumer preferences and factors related to product acquisitions to provide subsidies for public policies and marketing strategies (Cardoso, 2020). Furthermore, Ribeiro-Silva et al. (2020) recommend food and nutrition education initiatives using educational programs on television, virtual, or radio, which guide and encourage the adoption of healthy eating habits. Marketing is of fundamental importance in Brazilian citriculture in the face of the challenge of encouraging a healthier diet and in the search for the search to expand the fresh fruit market and, mainly, new foods, such as juices with differentiated characteristics.

CONCLUSION

Research aimed at understanding consumer preferences for citrus and their products has made relevant contributions, as they provide information on preferred shopping locations, reasons that influence purchases, and consumption habits.

With the onset of the COVID-19 pandemic, most interviewed people did not change their consumption of citrus fruits and their products. However, purchases were made in other establishments due to social isolation and concern when buying the products. However, as nutrition has become an essential factor in the recovery and treatment of many patients affected by COVID-19, not in isolation but as a support that is directly linked to the immune system, marketing strategies can be applied to leverage the citrus industry and promoter a better quality of life for the population.

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