

Analysis of Consumer Preferences for Instant Mangosteen (*Garcinia mangostana* L.) Powder Drink in Bogor Regency and City

Fadhilah Nur'azizah¹, Dase Hunaefi¹, Tjahja Muhandri^{1,2}

¹Department of Food Science and Technology, Faculty of Agricultural Technology, IPB University, Kampus IPB Dramaga, Bogor, 16680, Indonesia

²Southeast Asian Food and Agricultural Science and Technology Center, LPPM, IPB University, Kampus IPB Dramaga, Bogor, 16680, Indonesia

*Corresponding author: Fadhilah Nur'azizah, Email: dilahnurazizah@gmail.com

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ABSTRACT

The peel of mangosteen (*Garcinia mangostana* L.) constitutes a larger proportion of the fruit in comparison to its flesh. The peel extract product manufactured by nutraceutical industries does not require using the fruit flesh. To increase the shelf life and value of the product, the development of a mangosteen powder drink can be carried out. Therefore, this research aims to determine the characterization of initial raw materials and factors influencing consumer preferences for instant mangosteen powder drink to improve the acceptance of the product. The data collected were analyzed through descriptive statistics and the chi-square test. Furthermore, the chi-square test showed that demographic regions affected mangosteen fruit price, the level of preferences for the powder drink, consumption time, as well as feelings and interests of potential customers. The results of the Total Plate Count (TPC), Total Yeast and Mold Count (TYMC), and coliform microbiological test conducted on mangosteen purée raw materials met the quality requirements established by National Standardization Body (NSB) for fruit purées.

Keywords: Chi-Square Test; Consumer Preferences; Instant Powder Drink; Mangosteen Fruit

INTRODUCTION

Mangosteen (*Garcinia mangostana* L.) is an exotic fruit known as the "Queen of the Tropical Fruit" due to its soft texture, white flesh, and unique combination of sweet and sour flavors. According to (Iswari et al., 2006), it consists of the peel, flesh, and seed, making 70%-75%, 10%-15%, and 15% to 20% of the total fruit composition. The peel contains the highest antioxidants, specifically xanthone, which contains 107.75 mg per 100 g of fruit peel. This is used in traditional Chinese medicine to treat inflammation,

diarrhea (Jamal et al., 2001), and cancer (Madury et al., 2013).

In Indonesia, the commercialization of mangosteen which is often consumed fresh, has recently focused on using the fruit peel as an herbal medicine. The fruit flesh is not optimally processed by industries and is considered a waste product. However, its processing into an instant powder drink can lead to increased value, extended shelf life, and simplified product storage.

Before processing, a raw material test on mangosteen fruit flesh must be conducted to ensure safety, particularly with respect to microbiology. Previous research developed

a mangosteen beverage product (Nur'Azizah, 2020), but consumer preferences for instant mangosteen powder drink in Bogor have never been identified. Bogor is a promising region for instant powder drink development due to the variety of instant powder drink brands available on the market and the growing popularity of such products (Habib, 2008). Therefore, this research aims to determine the microbiological characteristics of the raw materials and analyze consumer preferences for instant mangosteen powder drink in Bogor Regency and City to identify the factors influencing preferences.

MATERIALS AND METHODS

Materials

Characterization of Initial Raw Materials

This research was conducted at the Food Microbiology Laboratory of the Department of Food Science and Technology, IPB University, and the Pilot Plant of South East Asian Food and Agriculture Science and Technology (SEAFST) Center. The materials used were fruit flesh obtained from the mangosteen peel extract industry. Aquadest, Plate Count Agar (PCA) (OXOID), Potato Dextrose Agar (PDA) (OXOID), Lauryl Sulphate Tryptose Broth (LSTB) media, peptone buffer, chloramphenicol, and 70% alcohol were used for Total Plate Count (TPC), Total Yeast and Mold Count (TYMC), and coliform test.

Consumer Preferences Test

To evaluate consumer preferences primarily in Bogor Regency and City, an online questionnaire was administered using Google Forms between December 2020 and May 2021. Respondents accessed and completed the survey using a range of electronic devices such as smartphones, computers, laptops, and tablets. Statistical analysis of the data was carried out using IBM Statistics SPSS 22 and Microsoft Excel 2019.

Equipment

The equipment employed included a pulper cum finisher (Armfield FT53-A), a water bath (Memmert WNE45L4), a petri dish, a glass beaker, a measuring glass beaker, an Erlenmeyer flask, test tubes and lids, a Bunsen burner, measuring pipettes, a bulb, an incubator (Yamato model IC-102), and an autoclave (Gesellschaft für 1008).

Research Stages

This research was divided into three stages: (1) characteristics of the raw material, (2) raw material preparation, and (3) data collection on consumer preferences.



Figure 1. Fresh mangosteen flesh

Characteristics of Initial Raw Materials

TPC, TMYC, and coliform tests were performed in accordance with Bacteriological Analytical Manual (BAM) (BAM, 2001) to determine the microbiological quality and safety of the raw materials (mangosteen purée after 12 months of storage in a freezer). The colony growth was calculated and recorded descriptively based on Standard Plate Count Agar (CFU/g or mL) and MPN table (in coliform test).

Preparation of Raw Materials

The raw materials were prepared by separating mangosteen fruit flesh and seed using a pulper to obtain fresh fruit flesh as presented in Figure 1. Up to 2 kg of mangosteen fruit flesh purée was wrapped in polyethylene plastic packaging and stored in a freezer for 12 months.

Consumer Preferences

Consumer preferences data were obtained through a consumer survey method, which was carried out virtually using the Google Forms application. The survey comprised four steps: 1) Questionnaire creation, 2) Questionnaire testing, 3) Sample size determination, and 4) Data collection. Then, the data collected were analyzed with the SPSS software.

Questionnaire Creation

The questionnaire was created with clear purposes aimed at the respondents. It was accessible from December 2020 to January 2021 and included questions related to consumer profiles and characteristics of mangosteen powder drink which affected consumer preferences.

Questionnaire Testing

The questionnaire was subjected to both validity and reliability testing. The validity test was performed on 50 respondents, distributed according to the normal curve (Pujihastuti, 2010). This was performed by analyzing the correlations between answers to each question and the total score using SPSS software at a 5% significance level. The questions were considered valid once the *r*-table appeared lower than the *r*-count, indicating that they were correlated with the total score at a 5% significance level. In cases where the *r*-table was higher than the *r*-count, the questions were considered invalid (Alfian & Putra, 2017; Sulistiawan et al., 2018).

The reliability test was conducted using Cronbach's alpha to measure the consistency level of the research instrument. This determined the extent to which the instrument can be trusted to produce consistent scores when tested under varying conditions (Sugiyono, 2005). The questionnaire was considered reliable once its Cronbach's alpha value exceeded 0.60 (Candradewi et al., 2020; Aryanti et al., 2013; Sulistiawan et al., 2018).

Sample Size Determination

Sample size determination was accomplished through non-probabilistic sampling with the purposive sampling method. The purposive sampling method involves the determination of specific criteria that align with the objective of this research (Etikan et al., 2016). The population data were obtained from Statistics Indonesia (SI), with the population of Bogor City and Regency being 1,081,009 (BPS, 2018) and 5,715,009 people (BPS, 2017), respectively.

The required sample size for this research in Bogor City and Regency was calculated using Slovin's formula as follows:

$$n = \frac{N}{1 + N(e)^2}$$

$$n = \frac{1,081,009 + 5,715,009}{1 + 6,796,018 (0.1)^2}$$

$$n = 99.99 \approx 100 \text{ respondents}$$

Remarks:

- n: sample size
- N: population size
- e: error margin (10 %)

Based on Slovin's formula calculation with a 10% error margin, the minimum sample size for both Bogor City and Regency was 100 respondents. The purpose of 10% error margin utilization was to make the research period more efficient.

Data Collection

The data collection was performed virtually for approximately one month, by distributing the questionnaires through various social media platforms to the respondents with suitable criteria. After obtaining responses from 100 respondents, the data were analyzed. For security reasons, ethical permit number 383/IT3.KEPMSM-IPB/SK/2021 was received from the Commission on Research Ethics Involving Human Subjects at IPB University.

Data Analysis

In this research, the descriptive and chi-square correlation analysis was conducted using SPSS 22 software. The correlation analysis aimed to observe the influence of respondent profiles on consumer preferences and determine the factors affecting consumer preferences. The survey results were further analyzed with G*Power 3.1.9.7 to measure the strength of the obtained data.

RESULT AND DISCUSSION

Characterization of Initial Raw Materials

TPC, TYMC, and coliform tests were performed on mangosteen fruit purée that had been stored in a freezer for 12 months. Meanwhile, the physical quality scores consisting of aroma, taste, and color remained normal and in accordance with NSB (2013) quality requirements for fruit purées. The appearance of frozen mangosteen purée is shown in Figure 9.

The limit of microbiological contaminations according to NSB (2013) for TPC, TYMC, and coliform count in fruit purées were 1×10^4 colony/g, 1×10^2

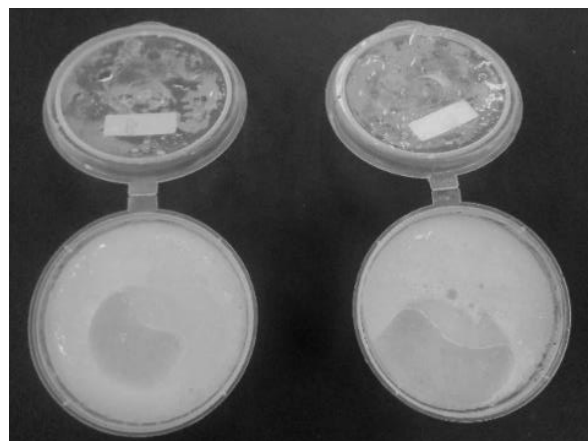


Figure 9. Frozen mangosteen purée after 12 months of storage

Table 4. Results for TPC and TYMC

Sample	Repetition	Storage time	Sp storage temperature	TPC (colony/g)	NSB 7841: 2013 requirements	TYMC (colony/g)	NSB 7841: 2013 requirements	Remarks
Mangosteen purée raw material	1	12 months	-30 °C	3.1 x 10 ¹	max. 1 x 10 ⁴	2.9 x 10 ¹	max. 1 x 10 ²	Fulfilled the requirements
	2			3.1 x 10 ¹		2.8 x 10 ¹		

Table 5. The results for total coliform count

Sample	Repetition	Storage time	Storage temperature	Total count (MPN/g)	NSB 7841:2013 requirements	Remarks
Mangosteen purée raw material	1	12 months	-30 °C	< 3	max. 20	Fulfilled the requirements
	2			< 3		

Table 1. The result of the questionnaire validity test

No.	Question	r-count
1.	How often do you consume fruit in one week?	0.634 ^(a)
2.	Do you like to consume mangosteen?	0.584 ^(b)
3.	What is the price of mangosteen fruit that you usually purchase?	0.572 ^(c)
4.	Are you interested in case instant powder drink product is available?	0.559 ^(d)
5.	Why are you interested in instant mangosteen powder drink?	0.588 ^(e)
6.	What is the appropriate price for instant mangosteen powder drink?	0.559 ^(f)
7.	What color preferences do you think are ideal for steeping instant mangosteen powder drink?	0.698 ^(g)
8.	What are the ideal taste preferences for the above-mentioned instant mangosteen powder drink product?	0.625 ^(h)
9.	How do you feel after consuming an instant mangosteen powder drink?	0.336 ⁽ⁱ⁾
10.	In your opinion, when is the best time to consume an instant mangosteen powder drink?	0.359 ^(j)

Notes: Numbers in the same column followed by different letters are significantly different at a 5% significance level from the Pearson correlation test (valid questions)

colony/g, and 20 MPN/g, respectively. The results of TPC, TYMC, and coliform count presented in Tables 4 and 5 showed that both sample repetitions fulfilled the required qualities for mangosteen purée. This implied that based on the quality scores obtained, mangosteen purée stored for 12 months in the freezer was considered acceptable and safe to be used as raw materials for instant mangosteen powder drink production.

Questionnaire Validity and Reliability Test Results

The validity of the 10-question unit was tested with a total of 50 respondents, and the r-count was

found to be higher than the r-table value of 0.2732 as presented in Table 1. Also, the reliability test conducted with Cronbach's alpha showed a value higher than 0.60, namely 0.753, indicating that the used questionnaires produced reliable and consistent results. Based on the validity and reliability test results, the questionnaires were concluded as a suitable measurement instrument for this research.

Respondent Profiles

The consumer survey aimed to generally identify the respondent profiles and preferences for the instant mangosteen powder drink. Furthermore, it was conducted virtually to collect data from 100

Table 2. Respondent profiles in terms of demographic factors

Demographic factors	The proportion of respondents (%)
Gender	
Male	23.00
Female	77.00
Age	
15-20 years old	4.00
21-21 years old	87.00
26-30 years old	6.00
> 40 years old	3.00
Level of education	
College	98.00
Non-college	2.00
Profession	
Employed	54.00
Unemployed	46.00
Income per month	
< IDR 1,000,000	43.00
IDR 1,000,000 to IDR 2,000,000	17.00
IDR 2,000,000 to IDR 3,000,000	6.00
IDR 3,000,000 to IDR 5,000,000	14.00
> IDR 5,000,000	20.00
Frequency of fruit consumption	
1-2 times	53.00
3-4 times	27.00
5-6 times	10.00
>6 times	10.00

respondents who met the specific criteria of previous mangosteen fruit consumption, namely 90 from Bogor Regency and 10 from Bogor City. The number of respondents was selected based on the population proportions of 84% from Bogor Regency and 16% from Bogor City. Demographic characteristics were the most fundamental factors in segmenting consumer groups based on the population map and simplifying the measurement of consumer preferences. These included gender, age, occupation, education level, income per month, and frequency of fruit consumption. Table 2 shows the respondent profiles in terms of demographic factors.

Factors Influencing Consumer Preferences for Instant Mangosteen Powder Drink

The chi-square test was conducted to analyze the correlation of demographic factors to consumer preferences in purchasing instant mangosteen powder drink. According to Table 3, the results showing a significance value below 0.05 indicated a significant correlation. To strengthen the research samples, GPower 3.1.9.7 was employed to test their data, with an effect size value of 0.5 and a total of 100 respondents. The G*Power test produced a Power (1-β *err prob*) of 0.99 (> 0.80), meaning that the samples were robust and could be trusted.

Level of Preferences for Mangosteen Fruit

Based on the chi-square test, income per month significantly affected the level of preferences for mangosteen fruit. Figure 2 shows that respondents with a monthly income < IDR 1,000,000 had preferences for mangosteen fruit either like or like very much. This was in accordance with the statement by Santosa et al. (2018) that during the peak of the harvest season, the mangosteen price became cheaper, making it seen as an affordable fruit for those with income < IDR 1,000,000.

Mangosteen Fruit Price Preferences

According to Figure 3, the chi-square analysis showed that mangosteen fruit price was influenced by the frequency of fruit consumption. Respondents who consumed fruit 1-2 times per week purchased mangosteen fruit of IDR 10,000 – IDR 15,000 and IDR 16,000 – IDR 20,000 per 1 kg (i.e. 18 and 21% of total respondents). Those who consumed 3-4 times spent up to IDR 16,000 – IDR 20,000 and IDR 21,000 – IDR 25,000 per 1 kg (10% and 13% respectively). These differences were influenced by the variations in fruit consumption frequency. The more fruit eaten, the higher the price paid compared to cases of rare consumptions.

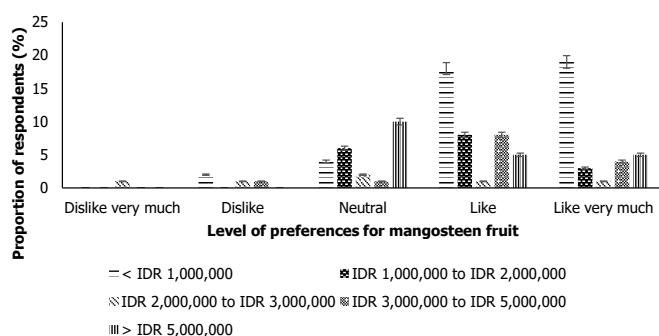


Figure 2. Level of preferences for mangosteen fruit

Table 3. Significance value results of the chi-square test for demographic factors and consumer preferences

Consumer preferences factors	Demographic factors					
	Gender	Age	Level of education	Profession	Income per month	Frequency of consumption
Level of preferences for mangosteen fruit	0.233 ^(a)	0.748 ^(b)	0.111 ^(c)	0.054 ^(d)	0.001 ^(g)	0.848 ^(f)
Mangosteen price	0.343 ^(a)	0.73 ^(b)	0.330 ^(c)	0.394 ^(d)	0.303 ^(e)	0.034 ^(e)
Interest in instant mangosteen powder drink	0.825 ^(a)	0.901 ^(b)	0.922 ^(c)	0.005 ^(e)	0.019 ^(h)	0.090 ^(f)
Reasons of interests	0.281 ^(a)	0.798 ^(b)	0.099 ^(c)	0.248 ^(d)	0.226 ^(e)	0.357 ^(f)
Color preferences	0.351 ^(a)	0.684 ^(b)	0.824 ^(c)	0.591 ^(d)	0.929 ^(e)	0.861 ^(f)
Taste preferences	0.525 ^(a)	0.714 ^(b)	0.975 ^(c)	0.994 ^(d)	0.532 ^(e)	0.742 ^(f)
Feeling preferences	0.263 ^(a)	0.002 ^(a)	0.355 ^(c)	0.987 ^(d)	0.497 ^(e)	0.127 ^(f)
Consumption time	0.734 ^(a)	0.028 ^(c)	0.590 ^(c)	0.308 ^(d)	0.430 ^(e)	0.517 ^(f)

Notes: Numbers in the same column followed by the same letter are not significantly different at the 5% significance level from the chi-square test or no relationship exists between demographic and consumer preferences factors

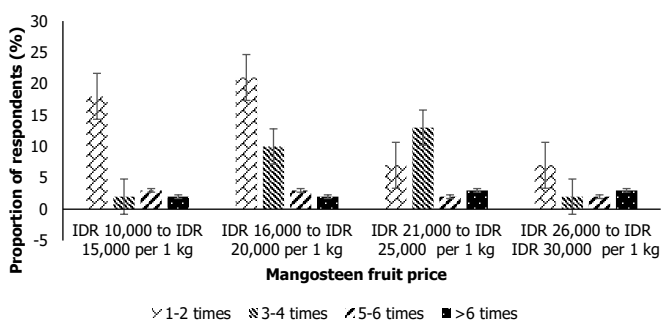


Figure 3. Mangosteen fruit price based on the frequency of consumption

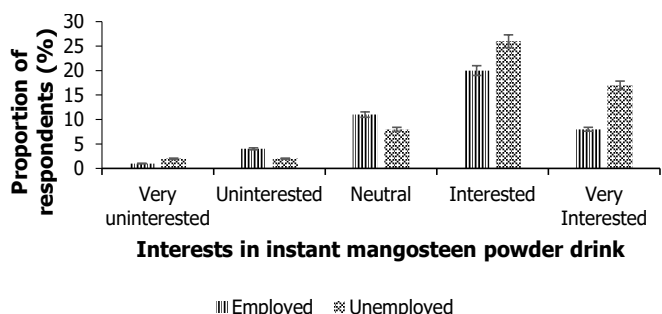


Figure 4. Interest in instant mangosteen powder drink based on employment status

The Interest of Potential Customers in Instant Mangosteen Powder Drink

Based on the chi-square test results, the interest of potential customers in instant mangosteen powder

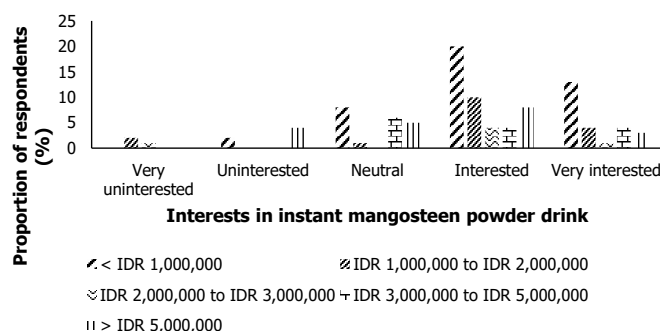


Figure 5. Interests in instant mangosteen powder drink based on income per month

drink was strongly influenced by employment status and income per month.

Employment status

The influence of professions on the interest of potential customers can be seen in Figure 4. Both employed and unemployed respondents showed interest and high interest in instant mangosteen powder drink. The unemployed were dominated by students and college students aged 21 to 25 years old.

Income per month

Figure 5 shows that income per month significantly influenced the interest of potential customers. Overall, respondents with a monthly income of < IDR 1,000,000 to > IDR 5,000,000 were interested in instant mangosteen powder drink, with the highest interest

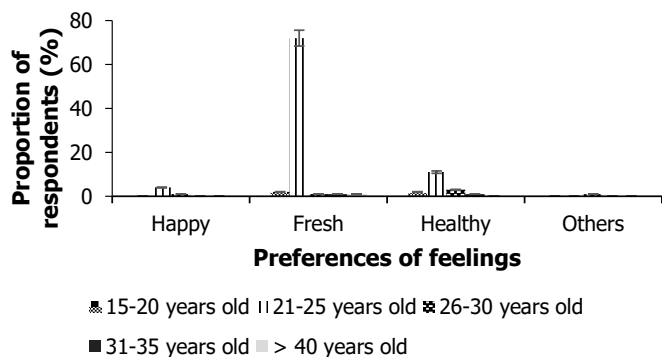


Figure 6. Feeling preferences in instant mangosteen powder drink consumption

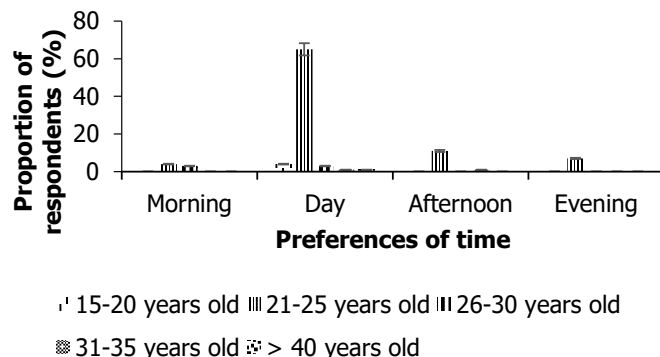


Figure 7. Consumption time preferences for instant mangosteen powder drink

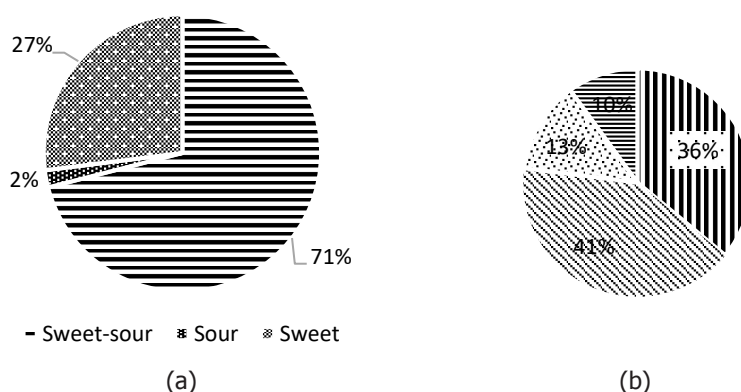


Figure 8. Preferences of taste (a) and color (b) in instant mangosteen powder drink

percentage coming from those earning approximately < IDR 1,000,000.

The lack of an existing instant mangosteen powder drink product in the market might have contributed to the interest. This was supported by the research of Nur'Azizah (2020) on mangosteen fruit drink formulation, as all formulations were well-liked by the panelists, with score ratings of 5.36 - 5.74 out of a point scale ranging from 1 (disliked extremely) to 7 (liked extremely).

Feelings and Consumption Time Preferences for Instant Mangosteen Powder Drink

Feeling and consumption time preferences for instant mangosteen powder drink were found to be influenced by age as indicated in Figures 6 and 7. Respondents of 21-25 years old preferred a fresh feeling and the daytime as the most suitable period to consume the product. This could be attributed to the tropical climate in Indonesia, which is relatively hot to very hot during the day. Therefore, daytime was considered the most appropriate for consumption in order to obtain a subsequent fresh feeling.

Ideal Taste and Color Preferences in Instant Mangosteen Powder Drink

According to Figure 8, most of the respondents preferred the sweet-sour taste and white color in instant mangosteen powder drink. Specifically, up to 71 persons selected sweet-sour taste, and 41 selected white color preferences. This choice was due to the unique sweet-sour taste and white-colored fruit flesh of fresh mangosteen. Additionally, preferences for a product could be further explored based on consumption experiences and sensations (Boesveldt et al., 2018).

CONCLUSION

The microbiological characteristics (TPC, TYMC, and coliform count) of mangosteen purée stored in a freezer for 12 months met NSB (2013) requirements. Additionally, consumer preferences were found to be influenced by demographic factors, namely mangosteen fruit price, level of preferences, consumption time,

feelings towards instant mangosteen powder drink, and interest of potential customers.

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CONFLICT OF INTEREST

The authors declare no conflict of interest.

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