EFFECTS OF CONSUMERS' SENSORY ATTRIBUTES ON THEIR WILLINGNESS TO PAY AND THE OPTIMUM PRICE FOR ICED COFFEE DRINKS

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Abstract

The growing competition among coffee shops demands effective strategies, including the development of optimal pricing. An optimal pricing strategy must account for both changes in coffee ingredients and consumers' willingness to pay (WTP). This study investigated the factors influencing consumers' WTP and determined optimal prices through sensory evaluations of iced coffee. This study explored how demographic factors and sensory characteristics affect consumer WTP. This study involved direct consumer tastings, where participants provided subjective ratings of iced coffee and indicated their WTP. The coffee samples included variations in milk (white and black coffee) and sugar content (granulated sugar, palm sugar, and no sugar). To measure WTP, the Becker-DeGroot-Marschak (BDM) mechanism was employed, while a demand function was used to determine the optimal price. Stepwise backward logistic regression further analyzed the factors affecting WTP. The factors influencing willingness to pay were further analyzed using stepwise backward logistic regression. The findings reveal that optimal pricing varies, with iced coffee that includes both granulated sugar and milk commanding the highest WTP. Consumer WTP is significantly influenced by factors such as gender, frequency of coffee consumption, and individual taste preferences. There was a marked difference in WTP based on the amount of milk and sugar added, with coffee variations containing both granulated sugar and milk achieving the highest WTP. These results can serve as a valuable reference for coffee shops, helping them to determine the ideal product composition and pricing strategies to maximize revenue.

Keywords*: Willingness to Pay (WTP); Becker-DeGroot-Marschak mechanism; demand function; pricing; iced coffee drinks*

1. Introduction

Indonesia ranks fifth in global coffee consumption, with a compound annual growth rate (CAGR) of 0.6% anticipated from 2017/18 to 2020/21, projected to reach 5 million 60-kg sacks by 2021, as reported by the International Coffee Organization. According to the Center for Data and Agricultural Information Systems (2022) under the Ministry of Agriculture, annual coffee consumption growth in Indonesia is expected to rise by approximately 0.83% from 2022 to 2026. This trend is notably driven by strong consumption patterns among younger generations, particularly Generation Z (10–24 years) and Generation Y (25–39 years), who currently make up a large proportion of the Indonesian population (Toffin, 2020).

In recent years, café culture has rapidly expanded across Indonesia, especially among the country's young, urban population. A study by Toffin (2020) highlighted a nearly threefold increase in coffee shops from 2016 to 2019, reaching 2,937 locations. By 2023, Indonesia's coffee market generated revenue of 10.48 billion USD, reflecting a 6.07% growth from the previous year. According to Statista Consumer Market Insight (2024), this trend is expected to continue, with revenues projected to reach 13.53 billion USD by 2029. These figures underscore Indonesians' strong and growing affinity for coffee consumption.

Popular developments in coffee beverage presentation now include the addition of sweeteners, ice, and milk or cream, expanding the variety of available flavors. Espresso, a brewing method highly regarded in Indonesia, serves as the base for numerous coffee products, primarily categorized into black and white variations. In 2019, 27.74% of Indonesian respondents reported that their top coffee purchase was classic milk coffee, followed by cappuccino (16.13%), popular milk coffee (13.55%), latte (10.32%), and mochaccino (7.74%) (Toffin & MIX Marcom, 2019). These preferences indicate a substantial market for

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espresso-based beverages in Indonesia, providing opportunities for companies to innovate products aligned with consumer demands. Supporting this trend, a study by Hurdawaty et al. (2023) found that 73.5% of 200 participants from Generations Z and Y preferred cold coffee over hot, supporting the reports of CSP Daily News (2018), which highlighted the preference among Generations Z and Y for chilled, blended coffee.

To ensure positive reception, product development must follow a well-considered strategy. Organizations shape these strategies by analyzing various factors, such as market conditions, competitive landscape, and customer preferences, leading to diverse approaches in product utilization (De Toni et al., 2017; Osano & Lutego, 2022). Among these factors, consumer preferences play a crucial role, particularly given the wide range of available products that cater to diverse tastes. Samoggia and Riedel (2018) highlight sensorial quality (aroma and flavor), functional motivations, habitual influences, and socializing purposes as the primary drivers of coffee purchasing and consumption. Consequently, subjective sensory evaluations can be leveraged to fine-tune coffee products in line with consumer preferences.

Moreover, the variety of product options directly influences coffee beverage pricing. Both price and product quality play a significant role in consumers' coffee purchase decisions. "Willingness to pay (WTP)" refers to the maximum amount a consumer is prepared to spend to acquire a product or service. This concept has been widely applied as a measure for personal goods, public goods, and shared resources (Liebe et al., 2011).

To optimize coffee product development, analyzing the factors that influence WTP is essential. Social demographic characteristics, for example, are known to impact WTP values (Di Pasquale et al., 2011). Understanding these demographic factors can improve the accuracy of product development strategies. Additionally, individual preferences significantly influence purchasing behavior, further affecting consumers' WTP. However, the full integration of sensory attributes to capture the impact of preferences on WTP has yet to be realized, suggesting room for further refinement in product development.

Numerous studies have consistently shown a strong relationship between sensory evaluation and individuals' WTP for various food and beverage products. Ohlau and Risius (2022) found that individuals who enjoyed the taste of plant-based milk alternatives provided more accurate WTP estimates for cappuccinos. Similarly, Garrido et al. (2021) observed that sensory attributes like visual appeal and flavor had a more substantial impact on WTP for pre-prepared meals than external characteristics. Vecchiato et al. (2021) highlighted the role of sensory perceptions—particularly scent and flavor—in driving customer demand for canned meat, highlighting the powerful influence these factors have on WTP.

Research has shown that variations in WTP values often reflect the impact of sensory qualities. For example, Ohlau and Risius (2022) found that

cappuccinos made with oat and pea protein milk achieved high sensory acceptability, aligning with realistic WTP levels. Mahmud et al. (2021) also identified sensory attributes like sweetness, coffee strength, aftertaste, and texture as crucial in shaping consumer approval of iced coffee drinks. Similarly, Barahona et al. (2020) reported that scent, more than taste, significantly influenced purchasing intentions for coffee products. Himawan and Rahadi (2020) further identified six key factors affecting consumer purchase decisions: flavor, product design, ambiance, brand influence, location accessibility, and pricing. The aforementioned facts highlight the significant influence of sensory qualities on an individual's WTP.

Additional studies confirm this pattern. Cusielo et al. (2019), for example, demonstrated that sweetness intensity plays a significant role in coffee acceptance, highlighting the importance of flavor profiles by experimenting with different sweeteners in espresso. Meanwhile, Barahona et al. (2020) explored various sensory characteristics in coffee—such as aroma, acidity, bitterness, body, and sweetness—revealing that olfactory elements, particularly scent, had a greater impact on purchase intent than taste alone.

However, despite the importance of sensory attributes like sweetness, bitterness, acidity, and aroma, these characteristics have yet to be fully utilized in WTP research or coffee pricing strategies. Given that sensory qualities significantly impact WTP for coffee products, exploring flavor profiles could provide crucial insights for optimal pricing. This research, therefore, introduces a novel approach by integrating subjective sensory assessments with demographic factors to estimate WTP and determine the optimal price for iced coffee products.

In summary, based on the background provided, this research aims to address the following research questions (RQs):

RQ1. What factors influence individuals' WTP for iced coffee?
RQ2. How can the optimal price for iced coffee be determined based on WTP and the factors influencing it?
RQ3. How do sensory perceptions affect WTP?

To answer these questions, this study will integrate subjective evaluations of sensory characteristics with measures of participants' WTP. The Becker-DeGroot-Marschak (BDM) mechanism will be used to assess WTP, chosen for its ability to provide fair incentives to all participants regardless of reservation rates or session sizes. This method removes competition among participants, is easy to explain, and does not require extensive training (Ginon et al., 2009). The BDM mechanism serves as an effective tool to analyze factors impacting WTP by adjusting iced coffee prices, allowing researchers to observe the influence of price fluctuations on consumer assessments and purchase intentions. These insights can then inform an optimal pricing strategy for iced coffee products.

2. Research Methods

The first step in the research process is a review of the literature to compile references about iced coffee tastes and willingness to pay. The next step is designing a questionnaire to determine the willingness to pay value and the factors that influence it. The questionnaire is divided into three sections: 1) Demographic and respondent characteristics, 2) Respondent preferences, and 3) Willingness to pay value using the Becker-DeGroot-Marschak (BDM) mechanism. The next phase is a pilot study to test the experiment and the previously designed questionnaire. Adjustments to the experiment design and questionnaire are made if there are shortcomings identified in the pilot study. The following step is collecting sensory data through experimentation. **Figure 1** shows the Design of the Experiment used in this study.

Three independent variables are used; milk added, sugar added, and socio-demographic variables. While WTP, sensory evaluations, and price are the three monitored dependent variables. These variables were chosen in accordance with the findings of prior literature studies. This study involved 40 undergraduate students, evenly split between 20 males and 20 females, aged 20 to 24 years. Undergraduate students were chosen because they represent Generation Z, the major consumers of iced coffee (Hurdawaty et al., 2023). The sample size of 40 was deemed adequate based on statistical power analysis (1-β = 0.90), ensuring the study could reliably detect meaningful effects.

Initially, participants will receive a comprehensive overview of the experiment that will be carried out. Participants who comprehend the forthcoming experiment and are prepared to participate will be instructed to complete a consent form. Afterward, participants will receive a comprehensive explanation of the execution of the blind test trial and details pertaining to the Willingness to Pay (WTP). Before starting the experiment, a preparatory session will be held to ascertain the willingness-to-pay (WTP) values. This session aims to ensure that the respondents clearly understand how to allocate WTP values. After confirming that the participants understand, the experiment will proceed by offering iced coffee for assessment. Subsequently, participants will be directed to fill out a survey on sensory evaluation and willingness-to-pay (WTP) values. The experiment and questionnaire completion stages will be replicated six times, following the number of beverages offered. After completing the questionnaire, a debriefing session with the respondents is held.

The results of the experiment and questionnaire will then be used to evaluate the factors that influence willingness to pay and to determine the optimal price for iced coffee. Statistical analysis is used to assess the impact of each independent variable on the dependent variables.
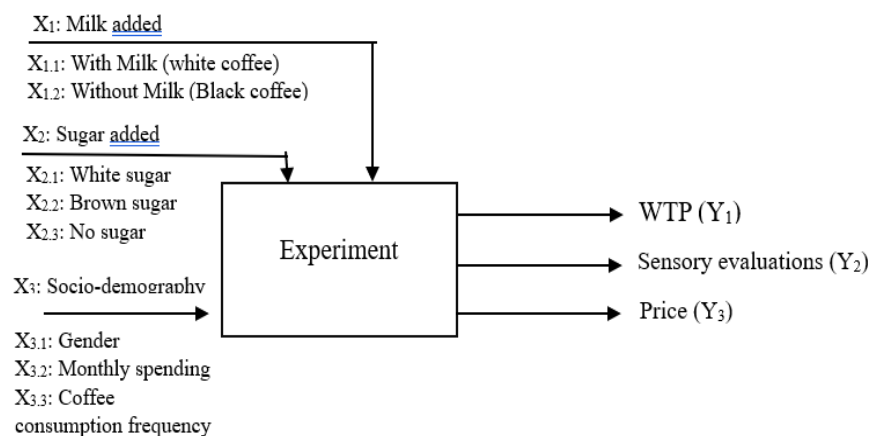

X_1: Milk added
$X_{1.1}$: With Milk (white coffee)
$X_{1.2}$: Without Milk (Black coffee)

X_2: Sugar added
$X_{2.1}$: White sugar
$X_{2.2}$: Brown sugar
$X_{2.3}$: No sugar

X_3: Socio-demography
$X_{3.1}$: Gender
$X_{3.2}$: Monthly spending
$X_{3.3}$: Coffee consumption frequency

Experiment

WTP (Y_1)
Sensory evaluations (Y_2)
Price (Y_3)

Figure 1. Design of Experiments

Table 1. The Relationship Between Gender and WTP

Gender	N	%	WTP (IDR)						Median
			White coffee			Black coffee			
			Granulated sugar	Brown sugar	No sugar	Granulated sugar	Brown sugar	No sugar	
Female	20	50	25,000	22,650	22,100	22,300	20,325	20,350	22,200
Male	20	50	24,025	22,550	20,700	21,000	20,550	19,550	20,850

Table 2. The Relationship Between Monthly Spending and WTP

Monthly spending	N	%	WTP (IDR)						Median
			White coffee			Black coffee			
			Granulated sugar	Brown sugar	No sugar	Granulated sugar	Brown sugar	No sugar	
Less than IDR 2,153,970	26	65	24,865	22,462	20,865	21,962	20,327	19,885	21,413
More than IDR 2,153,970	14	35	23,857	22,857	22,393	21,071	20,643	20,071	21,732

Table 3. The Relationship Between Coffee Consumption Frequency and WTP

| Coffee consumption frequency | N | % | WTP (IDR) | | | | | | Median |
| | | | White coffee | | | Black coffee | | | |
			Granulated sugar	Brown sugar	No sugar	Granulated sugar	Brown sugar	No sugar	
Never	0	0	-	-	-	-	-	-	-
Once a month	3	8	24.000	25.667	20.000	23.667	21.333	19.000	22.500
Several times a month	6	15	24.667	21.167	20.583	21.167	17.833	17.833	20.875
Once a week	4	10	22.000	22.000	19.875	21.500	18.875	17.750	20.688
Several times a week	14	35	24.786	21.857	21.214	20.714	20.643	19.500	20.964
1 – 2 times a day	11	28	24.591	23.545	22.545	22.364	21.909	22.091	22.455
More than 2 times a day	2	5	27.500	23.500	24.000	23.000	20.500	23.500	23.500
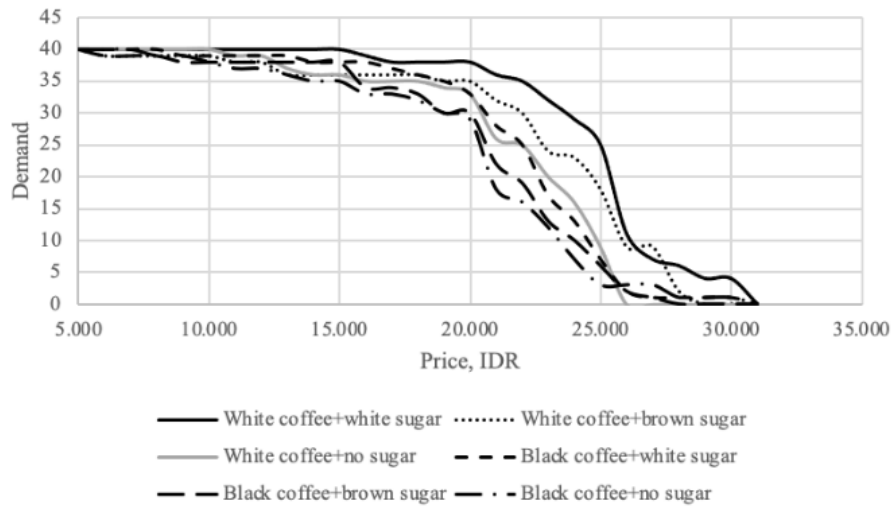
Figure 2. The Relationship Between Price and Demand

Table 4. Revenue function and optimum price

Variant of Coffee	Revenue function	Optimum Price (IDR)
White coffee + granulated sugar	$R= -0,000000168p^3 + 0,00483p^2 + 6,615p$	19,845
White coffee + brown sugar	$R= -0,000000139p^3 + 0,00322p^2 + 23,803p$	18,537
White coffee + no sugar	$R= -0,000000240p^3 + 0,00656p^2 - 4,839p$	17,829
Black coffee + granulated sugar	$R= -0,000000082p^3 + 0,00105p^2 + 40,286p$	17,724
Black coffee + brown sugar	$R= -0,000000127p^3 + 0,00229p^2 + 31,116p$	16,810
Black coffee + no sugar	$R= -0,000000049p^3 - 0,00009p^2 + 44,941p$	16,936

3. Result & Discussions
3.1. Factors affecting WTP

The experiment results indicate that each type of coffee has a different average WTP. Additionally, male respondents tend to have lower WTP values than females, as shown in **Table 1**. Moreover, **Table 2** shows that although 65% of the respondents have an income of less than Rp2,153,970 (Yogyakarta Minimum Wage), there is no significant difference in WTP values among respondents with monthly allowances less than or greater than the Yogyakarta Minimum Wage (p-value = 0.63). Meanwhile, based on the frequency of coffee purchases, it can be observed that respondents with a purchase frequency of at least once a day tend to have higher WTP values compared to other respondents, as shown in **Table 3**.

3.2. Optimal pricing

The data used for estimation is the WTP values from 40 respondents for each type of coffee. In this study, it is assumed that respondents will purchase coffee if the offered price (IDR) is less than or equal to their respective WTP. Therefore, the cumulative number of respondents willing to buy at a particular offer value can be seen in **Figure 2**.

The offer values used range from the minimum value (IDR 5,000) to the maximum Willingness to Pay value for each respondent. Demand function estimation is employed to determine the likelihood of the number of respondents who will purchase coffee at a specific price. Estimations are conducted using the data from **Figure 2** for each type of coffee. **Table 4** shows the revenue function for each type of coffee and its corresponding optimum price.

3.3. Sensory perception effects on WTP

The data used in this analysis consists of responses from 40 participants regarding the six types of coffee, resulting in a total of 240 data points for all coffee types. Based on the collected data, the estimation of the variables influencing the probability of WTP is performed using logistic regression models. The dependent variable used is classified WTP data into two

Table 5. Response variable structure

Variable	Response	
WTP (Y)	0 = not willing to buy	1 = willing to buy
Gender	0 = male	1 = female
Coffee consumption frequency	1 = never	5 = several times a week
	2 = once a month	6 = 1-2 times a day
	3 = several times a month	7 = more than 2 times a day
	4 = once a week	
Monthly spending	0 = less than IDR 2,153,970	
	1 = more than IDR 2,153,970	
Bitterness level	Range 1 to 9 with	
	1 = not bitter at all	
	9 = extremely bitter	
Aroma	Range 1 to 9 with	
	1 = not aromatic at all	
	9 = extremely aromatic	
Acidity	Range 1 to 9 with	
	1 = not sour at all	
	9 = extremely sour	
Sweetness level	Range 1 to 9 with	
	1 = not sweet at all	
	9 = extremely sweet	
Liking	Range 1 to 9 with	
	1 = not tasty at all	
	9 = extremely tasty	

Table 6. Response Variable Structure

Variable	B	Sig.	Exp(B)	95% CI
Liking		0,001		
Liking (1)	2,402	0,018	11,043	1,501 – 81,235
Liking (2)	2,5000	0,011	12,181	1,765 – 84,058
Liking (3)	23,518	0,997	1,636E+10	0,000
Liking (4)	4,112	0,001	61,039	5,665 – 657,684
Liking (5)	4,551	0,000	94,692	9,351 – 958,876
Liking (6)	6,188	0,000	486,826	32,014 – 7403,076
Liking (7)	22,478	0,997	5779807795	0,000
Liking (8)	4,869	0,001	130,244	7,457 – 2274,805
Gender	-3,151	0,000	0,043	0,010 – 0,190
Coffee consumption frequency		0,039		
Coffee consumption frequency (1)	-2,689	0,068	0,068	0,004 – 1,225
Coffee consumption frequency (2)	-3,286	0,036	0,037	0,002 – 0,812
Coffee consumption frequency (3)	-2,983	0,038	0,051	0,003 – 0,846
Coffee consumption frequency (4)	-0,662	0,662	0,516	0,026 – 10,089
Coffee consumption frequency (5)	17,691	0,999	48227172,46	0,000
Constant	2,786	0.037	16,208	

categories: respondents accepting the price (y = 1) or not accepting the price (y = 0). The price used is the optimal price derived from the first derivative of the revenue function obtained earlier (**Table 4**). Meanwhile, the independent variables used include respondent characteristics (gender, coffee consumption frequency, and monthly allowance) and respondents' subjective assessments of coffee beverages (bitterness level, aroma, acidity, sweetness level, and liking). The response variable structure can be seen in **Table 5**. The analysis is conducted using logistic regression with categorical independent variables for sensory analysis. Data processing involves the selection of candidate variables through chi-square tests. Subsequently, analysis with stepwise backward logistic regression is performed.

The multivariate analysis employed is Stepwise Backward Wald (logistic regression analysis with backward selection). This method is used to effectively filter the independent variables under investigation.

Based on the results of the multivariate analysis, the independent variables significantly associated with Willingness to Pay (WTP) are the liking for the taste of iced coffee, gender, and coffee consumption frequency, as seen in **Table 6**. These variables were obtained after four stages, with each stage eliminating independent variables with p>0.05. This indicates that the variables related to bitterness level, aroma, and sweetness level in iced coffee do not significantly impact the decision to purchase iced coffee.

There are nine distinct rating categories for the "Liking" variable. With a value of 1, the liking variable represents the preference for the flavor of coffee. Next, liking variable (1) indicates a liking score of two for the coffee ingested, and so on until liking variable (8) indicates a liking score of nine for the coffee. The same is true for the variable measuring coffee consumption frequency, which displays categories like drinking coffee roughly once a month, several times a month, and so on, up to coffee consumption frequency (5),

Table 7. Confusion Matrix

Actual	Prediction		Total	Accuracy Percentage (%)
	Not willing to pay	Willing to pay		
Not willing to pay	19	10	29	65,5
Willing to pay	4	207	211	98,1
	Overall percentage			94,2

which denotes the category of drinking coffee three to five times a day.

The findings of the logistic regression indicate that, except for liking (3) and liking (7), higher liking variable values have significant levels below 0.05 when compared to the lowest liking value. This implies that willingness to pay is influenced by liking. Liking (1) has an odd ratio (Exp(B)) of 11.043, which means that respondents with a liking value of 2 are 11.043 times more likely to purchase iced coffee than respondents with a liking value of 1. Similarly, respondents who indicate a liking value of 9 are 130.244 times more likely to purchase iced coffee than respondents who indicate a liking value of 1. Adding one point to the like variable for iced coffee generally results in respondents intending to purchase more.

The gender variable can be interpreted as follows: men (1) want to purchase iced coffee at a rate 0.043 times higher than women (0). This can be taken to mean that women are more likely than men to purchase iced coffee. Regarding the general pattern of the coffee consumption frequency variable suggests that the chance of purchasing iced coffee is influenced by the amount of coffee that consumers eat. Coffee consumption frequency variable (4), or consuming 1-2 times daily, has an odd ratio of 0.516. This suggests that compared to people who drink coffee around once a month, those who drink it 1-2 times per day are expected to have a 0.516 times reduced chance of purchasing iced coffee. The likelihood of purchasing iced coffee is highest among consumers who consume coffee roughly once per month (coffee consumption frequency variable). Furthermore, the likelihood of purchasing iced coffee increases with the amount of coffee consumed by individuals.

Based on the confusion matrix formed from the built model, the actual number of respondents not willing to pay and predicted not willing to pay is 19, while those predicted willing to pay is 10. The actual number of respondents willing to pay and predicted willingness to pay is 207, while those predicted not willing to pay are 4. Furthermore, the formed logistic regression model has an accuracy of 94.2%, sensitivity of 65.5%, and specificity of 98.1% for predicting the willingness to pay for iced coffee. This can be seen in **Table 7**.

Discussion

This study aims to determine the variables influencing the willingness to pay for different types of iced coffee based on adding milk and sugar. Three variables significantly affect the decision to purchase iced coffee: gender, frequency of coffee consumption, and liking for the taste of iced coffee. Meanwhile, five other variables (monthly spending, bitterness level, aroma, acidity level, and sweetness level) do not

significantly influence the decision to purchase iced coffee. The lack of significance in the monthly spending variable may be due to its relatively consistent average WTP values across different levels, as shown in **Table 3**. In this study, bitterness and sweetness levels also do not have a significant impact on WTP. These findings align with the results of Tozer et al. (2015), which indicated that sweetness and bitterness had minor impact on WTP. However, these findings are different from Cusielo et al. (2019) that concluded that sweetness intensity is a significant factor in determining consumer preferences. Unlike Cusielo et al. (2019) that focused on assessing the levels of sweetness by incorporating various sweeteners into espresso, our experiment conducted two level of sweetness: with sugar and without sugar. Therefore, the variations in research findings are due to the specific variations in sweetness levels.

The gender variable significantly influences the decision to pay for iced coffee. This corresponds with the current study's findings that women are more likely to buy ice coffee than men. The high likelihood of women buying iced coffee may be attributed to their current substantial coffee consumption. Selvi and Ningrum (2020) conveyed in their research that the current coffee-drinking lifestyle is not only dominated by men but has also become dominated by women, who are a potential market in the future.

To determine the preferred type of coffee based on gender, an analysis was conducted using RM ANOVA. For males, the analysis results showed that there is no difference in the liking or preference between milk-added (black coffee and white coffee) options ($F=3.463$, $p>0.05$). Additionally, the RM ANOVA analysis also indicated that there is no significant difference in the preference for drinks with added granulated sugar, palm sugar, or without sugar among males ($F=0.371$, $p>0.05$).

Meanwhile, the analysis results for females showed a significant difference in preference among coffee with granulated sugar, palm sugar, or without sugar ($F=4.630$, $p <0.05$). Similarly, the analysis results for milk addition indicated a significant difference between coffee with and without milk in terms of coffee drink preferences for females ($F=13.084$, $p<0.05$).

Based on the above explanation, the coffee preferences among males do not show any differences between the addition of milk or sugar. In contrast, preferences among females indicate differences in liking between coffee with sugar and milk. In this case, coffee with milk and granulated sugar showed the highest liking among females.

Another variable significantly affecting the willingness to pay decision is the frequency of drinking coffee. The frequency of coffee consumption can be interpreted as how often respondents consume coffee

within a certain period. The higher the frequency of coffee consumption, the higher the willingness to pay. In terms of taste preference, the experiment results that liking significantly influences consumer willingness to pay decisions. Liking here can be interpreted as respondents' preferences for the presented iced coffee. In this study, there are six types of iced coffee with variations in the addition of milk and sugar. This study shows a significant difference in the willingness to pay for respondents given different milk options (black coffee and white coffee).

4. Conclusion

The results of this study indicate that gender, coffee consumption frequency, and coffee preference are the variables that have the greatest impact on the willingness to pay. Gender can significantly influence willingness to pay, with females having a higher willingness to pay decisions compared to males. This could be attributed to the current lifestyle of women, who are also coffee consumers. Furthermore, the significant impact of coffee consumption frequency on willingness to pay may be due to the desire to fulfill emotional needs in consuming coffee. Additionally, for the preference level, the more consumers like the taste of coffee, the higher their willingness to pay. Based on the analysis using RM ANOVA, it is evident that the presentation of coffee with the addition of milk and sugar can affect the willingness to pay value. Coffee served with milk and granulated sugar can yield a higher willingness to pay than other compositions. Moreover, it was found that there is no difference in preference for the addition of milk and sugar among males. Based on the WTP for each type of coffee, the optimum price can also be determined. The WTP is determined through sensory evaluation in this study. However, the respondents subjectively assess the sensory evaluation. To objectively determine the WTP for the subsequent study, the concept of customer neurobiology may be incorporated into the measurement of consumer preference.

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