College Students' Preferences for Commercial Ready-To-Drink Jasmine Black Tea: Sensory Approach

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Abstract. The growth of ready-to-drink (RTD) jasmine black tea in Indonesia is increasing due to its unique flavor and convenience. This research aimed to investigate the preferences of college students, representing Gen Z as the second largest demographic proportion, across commercial RTD jasmine black teas (coded as SSX, PHZ, GLA, and KTO) using 3-point JAR (Just-About-Right) scales. As many as 101 consumers participated in assessing five sensory attributes (jasmine aroma, sweetness, bitterness, tea flavor, and astringency) and overall liking. The most penalized attributes impacting product performance were identified using penalty analysis. In contrast, the association between the JAR level of sensory attributes and overall liking across samples was explored using PCA (Principal Component Analysis). The overall penalty showed that tea aroma and astringency influenced the overall liking for all samples. Jasmine aroma and bitterness showed no effect on KTO liking, while only GLA liking was unaffected by sweetness. PCA biplot explained that the GLA sample had the strongest correlation with overall liking as represented by JAR level of tea flavor, astringency, jasmine aroma, and sweetness but was slightly influenced by JAR level of bitterness. It could be concluded that GLA was a sample with the optimum preferences perceived by college students.

1 Introduction

Tea (*Camelia sinensis*) ranks second after water as one of the most popular non-alcoholic beverages globally [1]. Tea is prevalent for its' aromatic flavor and health-promoting activities [2]. The main tea types are black, oolong, green, and white, which differ in enzymatic oxidation or fermentation degree [3,4]. Among those, black tea is one of the most consumed in Indonesia due to its unique flavor.

The tea flavor is formed through several processes, including fatty acids oxidation and degradation, as well as glycosides hydrolysis. Those steps create pleasant (fresh floral, sweet, rose-like, and caramel-like) and unpleasant aromas (grassy and fatty) [5-8]. Jasmine addition into black tea is an old practice that improve tea flavor through boosting flowery and relaxing aroma. Previous study reported that processing jasmine tea with fermentation produced products with a more pungent burnt aroma and taste, as well as robust jasmine flowers aroma [9].

Instead of direct infusion, ready-to-drink (RTD) jasmine black tea has been preferred by consumers due to its convenience and easy finding. The segment of RTD tea is growing as it is projected to increase by 10.27% during 2023-2027 for the Indonesian market [10]. Among consumers, Gen Z (individuals born between 1997-2012) might become a promising target. They are currently the second largest demographic group in Indonesia, with 28.88% of the total population [11]. This could be in line with the study in China showed that Gen Z had a changed in the tea drinking culture. Instead of choosing a traditional hot green tea served in tea house, they preferred to buy on-the-go tea [12].

Winning the market segment for Indonesian Gen Z could be addressed by understanding their preferences for jasmine black tea. The essential factors for RTD jasmine black tea development could be investigated using sensory evaluation. Sensory food science is now increasingly used due to consumer-oriented industrial needs, and this approach provides a better understanding of consumer preferences-derived factors for successful product development [13].

There is no reported study on understanding Indonesian Gen Z preferences for jasmine black tea, especially using a sensory approach. Previously, Ong et al. conducted a conjoint analysis to evaluate consumer preferences for milk tea attributes. This study used Filipino consumers and found that the most considered attributes were pearl size, followed by sugar level, the amount of ice, the type of drink, and the price, while the least considered ones were cream cheese inclusion and the brands [14]. Another study by Lin et al. investigated factors influencing milk tea preferences by Chinese college students using the choice experiment method [15]. The result showed that tea bases highly influenced consumers from famous tea companies, and fruit bases were preferred over non-dairy creamers as milk tea ingredients.

The Just-About-Right (JAR) descriptive sensory method could be useful in consumer research to investigate how products are perceived. This method evaluates how a product's attributes are perceived (too

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low, just right, or too high) [16]. The hedonic test may also accompany this method to assess the product's overall liking, followed by identifying the most preferred sensory attributes considered for product optimization through penalty analysis. The Principal Component Analysis (PCA) is a multivariate analysis helpful in evaluating the relationship between attributes [17].

This study investigated college students' preferences as Gen Z consumer representatives for jasmine black tea using JAR scales and continued with penalty analysis. The samples were the top selling RTD jasmine black tea brands in the national market. The result of this research would provide scientific insight for developing RTD jasmine black tea in Indonesia.

2 Materials and Method

2.1 Sample preparation

Samples were the top national selling volume of RTD jasmine black tea bought from local market. Those samples were coded as SSX, PZH, GLA, and KTO. Samples were stored at refrigeration (3-4ºC) before being tested. Samples were presented alternately in randomized order and served in chilled condition.

2.2 Consumer testing

As many as 101 consumers (18-23 years old, 51% of female and 49% of male) were participated in this testing. The testers were undergraduate students at Bina Nusantara University who consumed RTD jasmine black tea at least once in a month. An online questionnaire was used to record consumer responses. Consumer demographic data (age, gender, occupations) were recorded before sensory evaluation. Testing was conducted in Sensory Evaluation Laboratory, Food Technology Department, Bina Nusantara University, Alam Sutera Campus.

The consumers were instructed to rinse their mouth with water before starting and in between sample tasting. There were two sensory testing conducted in this study. First, the degree of overall acceptance of the samples was evaluated using 7-point hedonic testing, where 1= "dislike very much" and 7= "like very much". The second part was measurement of attribute intensity and consumer acceptability using 3-point JAR scale. The scale of 1= "too little", 2= "just-about-right', and 3= "too much". The use 3-point JAR scale determined a more accurate optimum sucrose concentration than 9-point JAR and provide the closest value to preferred commercial beverages [18]. The sensory attributes evaluated using JAR scales were jasmine aroma, sweetness, bitterness, tea flavor, and astringent. Those were selected since they were essential attributes of jasmine tea [19].

2.3 Data Analysis

The JAR data was analyzed using penalty analysis, quantifying the decrease in consumer liking (mean drop)

due to a "non-ideal" or a JAR level of a specific attribute [20]. Mean drops were calculated by distracting the overall liking mean of the JAR levels with that of the "too much" or "too little" levels. This analysis determines how much non-optimum-specific sensory attributes will lower the products' overall acceptability [21]. Penalty analysis also reveals the most penalized sensory attributes which may impact product performance, which is essential for product improvement [22]. Furthermore, the association between the JAR scale evaluated attributes, and the overall liking across all samples was also explored using the Principal Component Analysis (PCA). This analysis computed the JAR percentage of sensory attributes, RTD tea samples, and overall liking as active variables, active observation, and supplementary variables, respectively.

Significant differences among RTD samples for each JAR attribute were determined using multivariate analysis. One-way ANOVA (Analysis of Variance) was used to investigate the significant differences among products' overall liking. The post hoc Tukey HSD test followed this procedure if significant differences were detected in the ANOVA test at a significance level of 5%. All the data were analyzed using XLSTAT (Lumivero, version 2023.1.2. (1406)).

3 Results and Discussion

This study assessed the appropriateness level perceived by college students, as Gen Z representative, across sensory attributes of several RTD jasmine black tea using Just-About-Right (JAR) scales. This resulted in different appropriateness levels for jasmine aroma, sweetness, bitterness, tea flavor, and astringency for each RTD jasmine black tea sample, which were categorized into three groups: too little, JAR, and too much, as shown in Figure 1.

The PZH sample was the product perceived as the highest percentage of JAR level for jasmine aroma (61%), sweetness (61%), and astringent (56%). The highest appropriateness level of tea flavor was found in the GLA sample (70%). The JAR of bitterness was highly perceived at sample SSX (48%); however, this product also had the lowest JAR level of tea flavor (60%) and astringent (38%). This investigation also revealed that the KTO sample was assessed to have the lowest appropriateness for almost all sensory attributes: jasmine aroma (39%), sweetness (35%), bitterness (34%), and astringent (38%).

This result was considered to be affected by the different tea sources, infusion techniques, and ingredient composition within each tea sample. The sugar content of KTO, SSX, PZH, and GLA samples was 8.5%, 7.4%, 5.7%, and 4.3%, respectively. Compared to the JAR data (Figure 1), the PZH sample had the highest percentage of JAR sweetness (61%), then followed by GLA (57%), SSX (51%), and KTO (35%). This finding showed that lower sugar content tends to result in a higher JAR percentage. A product with 5.7% sugar (PZA) was perceived as the most ideal for sweetness attribute, while a product with the highest sugar content (KTO) was predominantly perceived as having too much sweetness. From this result,

it could be indicated that the Gen Z representative used in this study preferred less sweet jasmine black tea.
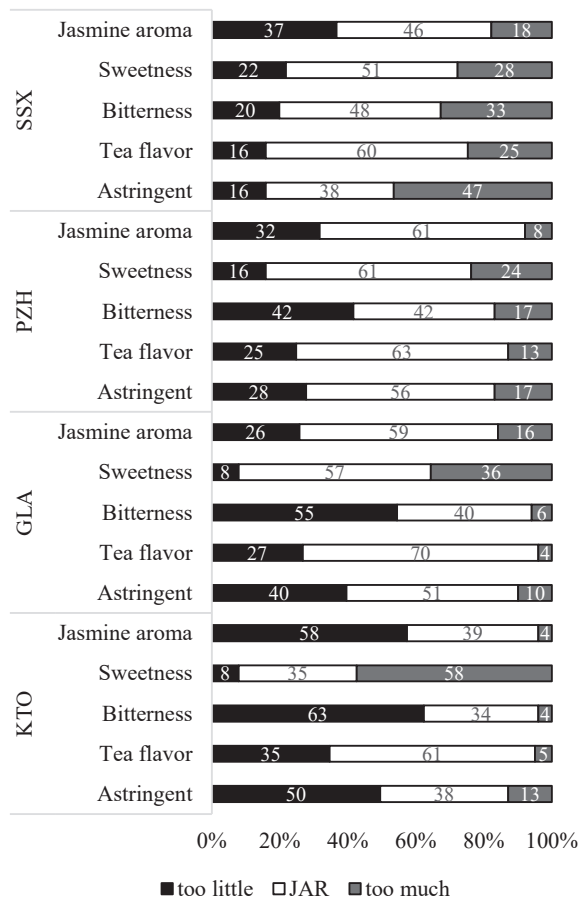
Fig. 1. The frequencies of JAR and non-JAR levels of sensory attributes for each RTD jasmine black tea samples

The penalty analysis combining the JAR scales evaluation with the overall liking assessment might provide "attribute diagnostics" to understand consumer reason for liking or disliking a product [23]. The loss of liking score for having a "too much" or "too little" for each tea sample was presented in Table 1.

The sensory attributes that need the most adjustment could be indicated by plotting the mean drops of non-JAR level (too low and too much) against their percentage, plotted as y and x axes, respectively. Those attributes could be indicated by their position in the upper right quadrant, impacting a minimum of 20% of respondents and causing a drop of a minimal 1 point. This quadrant is called the critical corner and shows the attributes with the most significant negative impact on liking [24].

Sample SSX was highly penalized when the product was considered not sweet enough and too much bitterness, tea flavor, and astringency. When the product did not have enough jasmine aroma and too much sweetness and tea flavor intensities, the PZH sample would be penalized. This condition occurred in the GLA sample when this product was considered not to have enough jasmine aroma, bitterness, tea flavor, and astringent intensities by consumers. The KTO sample was only penalized when

this product was perceived to have insufficient sweetness and too much tea flavor.

Table 1. Mean drops of sensory attributes for each RTD jasmine black tea sample.

Attribute	Level	Mean drops			
		SSX	**PZH**	**GLA**	**KTO**
Jasmine aroma	TL	0.50	**1.41**	**1.54**	0.43
	TM	1.50*	1.75*	0.42*	0.64*
Sweetness	TL	**1.52**	1.61*	1.46*	0.86*
	TM	0.68	**0.77**	0.38	**1.18**
Bitterness	TL	0.72*	0.50*	**0.80**	0.43
	TM	**1.77**	1.42	1.31*	0.40*
Tea flavor	TL	**1.00**	**0.83**	**1.05**	**0.69**
	TM	**1.18**	0.88*	0.77*	1.69*
Astringency	TL	-0.23*	0.54	**0.69**	0.57
	TM	**1.50**	1.20*	0.81*	1.10*

*TL= "too little", TM= "too much". Bold number indicates the significant differences at α 5%, while asterisk (*) indicates the test was not computed since the percentage level is lower than 20%

The overall penalty showed how many liking points would be lost when the tea sample was not as expected by the consumer [24]. The overall penalty showed that tea flavor significantly influenced the overall liking for all samples (Table 2). Lowering tea flavor intensity for SSX was recommended for the SSX sample, while PZH, GLA, and KTO should increase the intensity to improve consumer acceptance. However, the improvement of jasmine aroma (for SSX) and bitterness (for PZH) could not be described using this model.

Table 2. The overall penalty and overall liking of RTD jasmine black tea samples.

Attribute	Penalties/ p-value			
	SSX	**PZH**	**GLA**	**KTO**
Jasmine aroma	**0.019**	**<0.001**	**0.000**	0.135
Sweetness	**0.003**	**0.000**	0.052	**0.000**
Bitterness	**<0.001**	**0.011**	**0.004**	0.423
Tea flavor	**0.002**	**0.006**	**0.001**	**0.006**
Astringency	**0.003**	**0.008**	**0.014**	**0.023**
Overall liking	4.05± 1.77ᵃ	4.79± 1.51ᵇᶜ	4.96± 1.48ᶜ	4.37± 1.59ᵃᵇ

*Bold number and different letter indicate significant differences at α 5%

Astringency also significantly affected the overall liking in all samples (Table 2). This attribute intensity should be lowered and increased in SSX and GLA, respectively. Interesting phenomena were found in PZA and KTO, showing that their overall penalties were significant, but none of their mean drops were significant. This was presumably due to the model needing to be more successful in defining the direction of improvement.

The KTO was the only sample unaffected by jasmine aroma and bitterness (Table 2). Adding more jasmine aroma intensity in PZH and GLA could improve consumer preferences. In addition, lowering and increasing bitterness intensity for SSX and GLA,

respectively, were recommended for product improvement.

No improvement in sweetness intensity was needed for the GLA sample (Table 2). KTO sample should lower the sweetness intensity since it positively correlated with overall liking. Although the PZH and GLA samples had more than 50% of JAR sweetness (Figure 1), the overall penalty analysis showed that sweetness strongly influenced preference. The SSX should increase, while the PZH should lower the sweetness intensity. This indicated the presence of different consumer segments perceived the sweetness of those products as non-JAR, which was significant.

This finding corroborates the previous report showing that flower aroma and sweetness influenced overall liking of six blended tea products [25]. Sweetness had been also known to have a positive correlation with product liking [26, 27] in all products. A study conducted by Hunaefi *et al.* [28] floral aroma and sweetness strongly associated with the overall liking of several PET (polyethylene terephthalate)-packaged tea products in Indonesia. These were also considered as important attributes should be presence in an ideal tea product.

The bitterness and astringency were known as the basic taste of tea. However, the perception of these attributes was often confused; thus, sometimes was difficult to be distinguished. Astringency refers to dryness and puckering sensations after oral ingestion, while bitterness is a gustatory sense recognized by nervous signals [29].

In this study, those attributes were highly influenced decreased liking in SSX and KTO samples. This finding was in accordance with the previous study that reported that bitter taste and astringent mouthfeel significantly affected the mean drops of non-JAR categories of Robusta leaves tea brewed using an infusion technique [30]. Caffeine and phenolic compounds were known to have responsibility for tea bitterness, while astringent mouthfeel was due to tannins and condensed tannins [29, 31]. A study conducted by Fibrianto *et al.* [30] successfully revealed the strong positive correlation of those compounds to the related attributes.

The bitter taste and aftertaste were also highly associated with disliking PET-bottled tea products, as shown by the opposite position against liking properties in PCA results. Investigation into attributes responsible for an ideal tea product also revealed that those attributes should not be appeared in the product [28].

The association between JAR percentage of RTD jasmine black tea JAR attributes and the overall liking is shown in the PCA biplot (Figure 2), representing 92.48% of data variability for two principal components. Figure 2 explains that overall liking positively correlates with bitterness, sweetness, jasmine aroma, astringency, and tea flavor.

The PCA biplot explained that all samples were clustered in different characteristics. The SSX sample was associated with the slightest JAR tea aroma, while the KTO sample strongly correlated with the least JAR bitterness. The PZH was the sample that positively correlated to JAR of all attributes. The GLA sample had somewhat similar characteristics with the PZH, but

slightly influenced by JAR bitterness. Among all samples, The GLA showed the strongest correlation with overall liking perceived by college students, represented by JAR tea flavor, astringency, jasmine aroma, and sweetness. Based on these results, GLA was considered the most optimum in college students' preferences among RTD jasmine black tea samples.
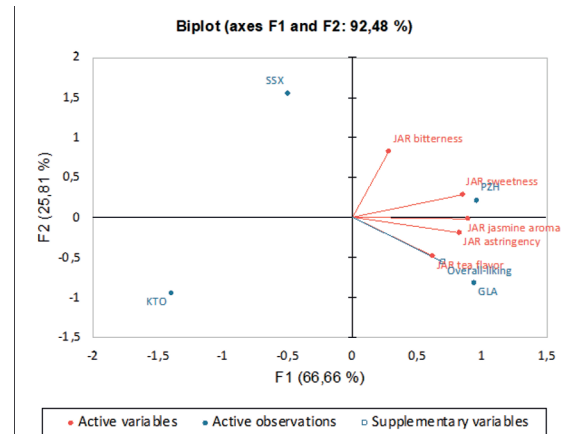
Fig. 2. The PCA of sensory attributes (JAR percentage) and overall liking for each RTD jasmine black tea samples

From this result, the jasmine black tea development should pay more attention to achieving the ideal level of tea flavor, astringency, jasmine aroma, and sweetness since those attributes strongly correlated with the preferences of the Gen Z representative used in this study. This finding could complement previous studies had been conducted to investigate the preferences of tea product using consumers representing Indonesian Gen Z. Hunaefi *et al.* [28] evaluated the emotional sensory mapping for PET-bottled tea products using the CATA (Checked-All-That-Apply) method. The participating testers were adolescent (19-22 years old). This study found the emotion of a free and satisfied feeling was highly correlated with a floral aroma. The sweetness attribute was responsible for the emotion of happy feeling and fulfilled. The attribute of bitterness and the bitter aftertaste was also found in PET-packaged tea products, and those attributes were highly correlated with emotions of flat and mild feelings.

Another sensory approach-research was also performed to assess the Indonesian young consumers' (15-25 years old) preferences for food pairing tea. The testers were served three different coconut biscuits, together with sweet tea, then asked to determine the preferred attributes of the combination. The ideal combination observed using the CATA method should have the attributes of buttery, creamy, coconut savory, sandy, and sweet. Among combinations, the tea pairing with "Biscuit B" was the closest to the ideal combination, representing the increased sweetness, buttery, and creamy mouthfeel, and decreased sandy texture.

However, several models developed in this study were unsuccessful in providing the appropriate improvement for consumer preferences. This limitation may be improved by using larger consumers to increase research

power. Further cluster analysis could be conducted using a broader Gen Z group to achieve a better understanding of Gen Z expectations.

4 Conclusion

This study found that all samples were mapped in different characteristics based on the JAR level of sensory attributes and overall liking. The GLA sample found as the optimum RTD jasmine black tea product as highly preferred by consumers. The attributes of tea aroma, astringency, jasmine aroma, and sweetness powerfully drove this preference. The investigation also revealed that product liking was slightly affected by bitterness. The suggestion to significantly affect the overall liking was to improve the intensity of tea flavor and jasmine to reach their JAR level. These findings were expected to provide valuable insight for developing jasmine black tea products that are highly accepted, especially by Indonesian Gen Z consumers.

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