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Consumer preference of food pairing tea: Sensory approach

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Abstract

Food pairing is a method for identifying the suitability of certain foods and drinks with each other. The current study aimed to investigate how many different food items can be combined with tea as well as the characteristics of these food items. The research was conducted by stages, including an online survey of the most popular tea companion food products, a focus group discussion, and sensory tests using the Check-All-That-Apply (CATA) method. The survey respondents liked the combination of sweet tea and biscuits. Approximately 30 consumer panelists tasted sweet tea and three kinds of coconut biscuit together and then determined the preferred attributes of the combination. CATA results showed that the preferred attributes of consumers in the ideal combination are buttery, creamy, coconut savory, sandy, and sweet. The product pair closest to the ideal is tea with "Biscuit B" (T-B), the combination of which can increase sweetness, raise buttery and creamy mouthfeel, and decrease sandy texture.

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Biscuit, CATA, Food Pairing, Tea

1. Introduction

Having a cup of tea has been a tradition and lifestyle among Indonesian people. Drinking tea, which is usually performed in the morning at home when gathering with family, is currently no longer only conducted this way but also in public places, such as shopping malls, cafes, or tea houses. Tea consumers currently also expect a different sensation and markedly varied taste or presentation of tea, including variations of side dishes when drinking tea. Indonesian people were previously used to drink tea with traditional snacks or fried food. Today, this habit is even markedly varied. Complementary foods of tea not only include traditional snacks and fried foods but also the preference of consumers to enjoy tea with cakes or biscuits (1).

Known complementary foods can provide additional flavor to the tea consumed. Complementary food is commonly known as food or flavor pairing, which involves pairing different foods and beverages to produce new characteristics of sensory properties than when consumed alone (2). Some contradictory foods turn out to be delicious, and their complexity when combined is intriguing; for example, a combination of cheese and wine (3,4,5), wine with meat dishes (6), wine with chocolate (7,8), wine with salami (8), beer and cheese (9,10) beer and verrines (11), or coffee with chocolate (12). Food pairing can also affect the bioactivities of food compounds. This phenomenon is called functional food pairing.

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The reaction of EGCG in green tea with food factors changes the activity of the EGCG-sensing system; thus, vitamin A, citrus polyphenols, and sulfides have an enhancing effect, whereas beef tallow saturated fatty acid can lower the bioactivity of EGCG (13).

The habit of food pairing has existed for a long time with trial–error approaches. Some experiences and habits have been frequently used but have not been written down and published in a comprehensive study. The combination of foods and beverages produces a complex interaction that can be difficult to be put in a general guideline to create a good pairing. However, chemical approaches, such as chromatography, are difficult and expensive. Therefore, sensory evaluation is a suitable choice for food pairing evaluation by determining sensory characteristics when two or more pairings are combined. One of the sensory methods that can be applied is the Check-All-That-Apply (CATA) method.

CATA is a rapid sensory profiling method that provides information regarding the sensory profile of products according to consumer perception and overall level of consumer preference and acceptance (14). The CATA method is often chosen over other methods because it only needs minimum instruction that is easily applied; this method can also be conducted quickly and easily implemented by trained and untrained consumers (15,16). Before the CATA evaluation, an online survey was conducted in this study to obtain the tea consumption pattern and complementary foods that would be evaluated and followed up with focus group discussion (FGD). This discussion is a qualitative method that can be used as an initial method to determine consumer opinions regarding product attributes to be tested later in the CATA method (17).

Most of the studies of food pairings focus on wine pairings, whereas those of tea pairings are still limited. However, most Indonesian people do not consume wine but other beverages, such as tea. They frequently combine tea with other foods. A study of food pairing on tea can be used as information for product development and marketing of tea because it can provide a combination of sensory attributes considering consumer preference. Therefore, conducting a systematic study with a sensory approach is necessary to determine which food is considered the most ideal complementary of tea based on consumer perceptions.

2. Materials and Methods

2.1. Time and Location

Online survey and FGD were conducted in Banjarnegara, Central Java, Indonesia, while sensory evaluation was conducted in Bogor, West Java, Indonesia. This study was performed for a year from January 2020 until January 2021.

2.2 Materials and Instruments

This study was conducted using Google form for the online survey. The FGD and CATA method were conducted offline and required some materials, such as black tea, sugar, water, and tea complementary food that is chosen by the majority of consumers based on the previous survey results. The selection of tea and food brands tested is based on the Top Brand Index survey by the Indonesian Top Brand Award in 2020. Some tools used in FGD and CATA are digital scales, tea brewers, water heaters, and cups.

2.3 Online Survey

An initial online survey was conducted using Google form to determine the most popular tea complementary food products that will be paired with tea in the sensory testing.

An online survey was performed with a respondent target following Slovin's formula (400 people). The criteria of respondents in this online survey include active tea consumers in Indonesia. Respondents with these criteria were obtained through an online survey with a respondent screening on the first page, revealing a question about whether the respondent is an active tea consumer. Respondents can continue the survey if they are active tea consumers. The survey was performed by sharing the online survey link to chat platforms, such as WhatsApp and Line, and social media, such as Instagram, Facebook, and Twitter.

This survey concluded the most chosen food pairs for drinking tea according to the consumers. In addition, the survey also determined the pattern of Indonesian people consuming tea, which included tea frequency and time consumption, tea consumption approach, tea expenses, and the most suitable food to be combined with tea.

Questionnaire testing was conducted with 25 respondents to 10 core questions of the questionnaire. The validity test of the questionnaire was realized using Pearson's product-moment correlation, while the reliability test using Alpha Cronbach was performed through IBM® SPSS® 24. The questions from the questionnaire are valid if the Pearson correlation is higher than the r-table at a significance level of 5%. The questionnaire is reliable if the value of Alpha Cronbach is higher than the r-table (18).

2.4. FGD

FGD (19) was conducted to determine the sensory attributes to be tested in the sensory test. The tested sample in the FGD was tea with food pairs obtained from the results of the previous online survey. The FGD was conducted by 8–12 consumer panelists, who assessed the emerging sensory attributes in the combination of tea and its food pairs. The preparation method of the tea and food in this FGD is similar to that of the consumer sensory panel conducted. The tea was prepared using 0.5 tablespoons of black loose tea and 15 g of sugar brewed in 190 mL of hot water. The first stage of FGD was determining the sensory attributes of tea and foods separately. Afterward, tea and food were paired and the sensory attributes were determined. An intensity assessment was also performed for each test. The panelists then discussed together and reached a consensus conclusion.

2.5. Consumer Sensory Panel

The tea sample was prepared by brewing 0.5 tablespoons of black loose tea and 15 g of sugar into a 200 mL glass and then pouring 190 mL of hot water. The tested tea companion food in this sensory evaluation is the result of a previous online survey and is similar to that tested during the FGD.

Sensory evaluation using the CATA method was performed on 30 consumer panelists (who gave informed consent before their inclusion in the study) based on home use test. These chosen panelists were active consumer panelists with the highest percentage of age and profession backgrounds in the online survey results. Home visits to the panelists were performed, and a sensory test was conducted in a comfortable condition as preferred by panelists. Before tasting the sample, the panelists estimated the ideal sensory profile of the tea food pairing combination based on their expectations and chose from the list of sensory attributes of previous FGD results. Furthermore, the panelists assessed the sensory attributes that emerged in the combination of tea and food after tasting the sample. Sample testing was sequentially coded with three-digit numbers.

Data were analyzed using XLSTAT 2020.1.3 with CATA Analysis tools. Cochran's Q test table was used to detect significant differences between samples through multiple pairwise comparison critical difference. If the value of $p < 0.05$, then a significant difference was observed between samples at a significant level of 5% (20). Sensory profile of the tea food pairing was represented through correspondence analysis (CA). Principal coordinate analysis (PCoA) was used to describe the correlation between sensory attributes and liking preferences of panelists. Penalty analysis was also conducted to determine the intensity attributes that must be improved, maintained, or lowered to suit consumer tastes. The attribute intensity assessment was analyzed by data tabulation and ANOVA with a significance level of 5%.

3. Results and Discussion

3.1. Online Survey

Based on the validity test results, all the core questions in this questionnaire are valid due to their Pearson correlation, which is higher than the r-table (0.396) at a significance level of 5%. The obtained Alpha Cronbach value is 0.664, which is higher than the r-table (0.396); therefore, the questionnaire is reliable. The Pearson correlation results of the questionnaire are presented in Table 1.

The online survey in this study collected 446 tea consumer respondents. Approximately 35.20% of respondents are male and the other 64.80% are female. The majority of respondents (57.62%) are 15–25 years old, which is consistent with the composition of respondents (54.48%) which includes students.

Table 1. Results of the Pearson correlation and online survey.

Question	Percentage (%)	Pearson Correlation
Tea drinking frequency in a week		0.560**
0–3 times	60	
4–7 times	28	
8–10 times	6	
>10 times	6	
Most often drunk tea		0.403*
Black tea	82	
Green tea	10	
Oolong tea	1	
Other	7	
Favorite tea packaging		0.415*
Loose tea	43	
Teabag tea	39	
Ready-to-drink tea	18	
Best time to drink tea		0.492*
Morning	52	
Afternoon	34	
Evening	13	
Preferred temperature for serving tea		0.408*
Hot/warm tea	80	
Iced tea	20	
Preferred sweetness level for serving tea		0.492*
Sweet	73	
Plain	27	

Cost for tea in one week (IDR)		0.496*
<10.000	67	
10.000–20.000	24	
20.000–30.000	6	
>30.000	3	
Preferred tea companion food		0.471*
Deep fried food	36	
Biscuits	35	
Chips	8	
Traditional snacks	7	
Boiled snacks	14	
Considerations in choosing tea companion food		0.486*
Taste	73	
Calories	10	
Texture	6	
Cost	3	
Other	8	
Cost for tea companion food in a week (IDR)		0.571**
<10.000	42	
10.000–30.000	47	
30.000–50.000	8	
>50.000	3	

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

Based on the survey results (Table 1), the frequency of drinking tea from the majority of respondents is 0–3 times (60%) in one week. Approximately 67% of respondents only spent <Rp. 10,000 in one week to buy tea, demonstrating that the respondents mostly do not have an excessive tea consumption. The type of tea that is most commonly drunk according to the respondents is black tea, followed by green tea and then oolong tea. Compared with other types of tea, black tea is mostly produced in Indonesia, which is around 78%, followed by green tea at 20%, and the rest is oolong and white tea (2%). Based on the type of tea packaging, respondents prefer loose tea (43%) than teabag tea (39%) and ready-to-drink tea (18%). Considering the way of presentation, respondents prefer hot/warm (80%) than iced tea (20%); considering sweetness level, respondents prefer sweet tea (73%) than plain tea (27%). According to 52% of respondents, the best time to enjoy tea is in the morning. Tea is suitable to be enjoyed in the morning to warm and refresh the body and gives a relaxing effect.

The results of the survey regarding tea companion foods show that two types of food are mostly chosen by consumers as a companion of tea: Indonesian fried snacks (36%) and biscuits (35%). They gave higher consideration to the taste (73%) when choosing the companion food product than texture, calorie, and cost. The average expenditure of respondents for tea companion foods is around Rp.0–30.000 (47%). The selected food for sensory testing were biscuits because their sensory properties were more consistent compared with fried foods and were produced by companies and sold commercially. Thus, identifying the sensory profiles of biscuits was easy.

3.2. Sensory Attributes as FGD Results

The FGD on the combination of tea and coconut biscuit was conducted. This discussion was performed with eight consumer panelists, with a proportion of 75% male and 25%

female. Table 2 presents details of the sensory attributes defined in the FGD. The sensory attributes that will be tested in the sensory test based on the FGD results include the attributes produced by tea and biscuits simultaneously, namely burned, dry, coconut savory, sweet, bitter, salty, buttery, creamy, sandy, and astringent.

Table 2. Sensory attributes as FGD result.

Tea	Biscuit	Tea + biscuit
- *Burned*	- Sweet	- *Burned*
- *Dry*	- Salty	- *Dry*
- Sweet	- Coconut savory	- Coconut savory
- Bitter	- *Buttery*	- Sweet
- *Astringent*	- *Creamy*	- Bitter
		- Salty
		- *Buttery*
		- *Creamy*
		- *Sandy*
		- *Astringent*

3.3. Pairing Sensory Profile of Tea and Coconut Biscuits with the CATA Method

The results of the Cochran's Q analysis using multiple pairwise comparison critical differences in Table 3 showed that all the attributes in each sample of the tea and coconut biscuit (T-A, T-B, T-C) did not demonstrate a significant difference ($p > 0.05$), except for the salty ($p = 0.038$), bitter (0.044), and buttery ($p = 0.038$) attributes. These insignificant results lead to poor modeling of the symmetric plot because distinguishing and identifying the sensory profile of each product is difficult. Overall, the independence test results between the attributes and the sample obtained a p-value of 0.639. Therefore, no significant difference was observed between the sensory profile of the combination between tea and the three brands of coconut biscuits tested.

Table 3. Multiple pairwise comparisons using critical difference.

Attributes	p-values	Tea + Biscuit A	Tea + Biscuit B	Tea + Biscuit C
Burned	0.920	0.333 (a)	0.300 (a)	0.300 (a)
Dry	0.127	0.433 (a)	0.233 (a)	0.267 (a)
Sweet	0.549	0.933 (a)	0.967 (a)	0.900 (a)
Salty	*0.038	0.300 (a)	0.300 (a)	0.533 (a)
Bitter	*0.044	0 (a)	0.167 (a)	0.167 (a)
Coconut savory	0.122	0.700 (a)	0.833 (a)	0.867 (a)
Buttery	*0.038	0.267 (a)	0.533 (b)	0.433 (ab)
Creamy	0.291	0.500 (a)	0.667 (a)	0.633 (a)
Astringent	0.264	0.433 (a)	0.300 (a)	0.367 (a)
Sandy	0.368	0.533 (a)	0.633 (a)	0.467 (a)

The sensory profile of the combination of tea and coconut biscuits with the attributes is represented through CA. The CA results visualize the relationship between products and sensory attributes in a biplot, focusing on the angular slashes between products and attributes (21). The CA results in Figure 1 indicate that the ideal combination of tea with coconut biscuits has a sweet taste and buttery, creamy, coconut savory, and sandy texture,

while the attributes that panelists disliked and did not expect on the ideal product are astringent, bitter, salty, and dry.

The best pairing product that is closest to the ideal considering its closest position is tea and biscuit B (T-B) with the dominant attributes buttery, coconut savory, creamy, sandy, and sweet. Meanwhile, the furthest pairing from the ideal is the combination between tea and biscuit A (T-A), which has a dominant astringent, one of the unexpected ideal product attributes. Therefore, T-A pairing does not cover the astringent aftertaste that most teas possess. The dominant attribute in the combination of tea and biscuit C is salty, which is also one of the unexpected attributes in the ideal product. This analysis produces a high proportion of variance described in the first two factors (91.24%), indicating a good similarity between the panelists when describing the tested sample.

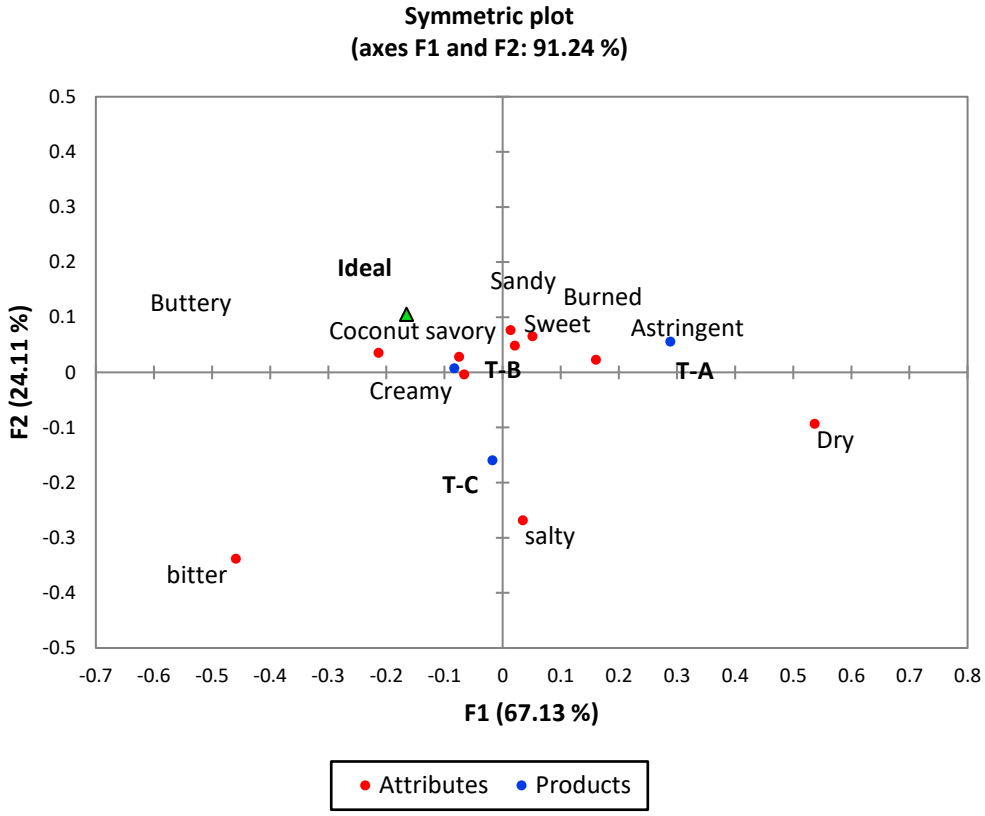

Figure 1. Sensory profile of combination between tea and coconut biscuits.

CATA analysis also describes the correlation between sensory attributes and the liking preferences of panelists through the PCoA presented in Figure 2. Based on the PCoA results in Figure 2, the liking score is positively correlated with salty attributes and negatively correlated with dry, astringent, and buttery attributes. Interestingly, on the CA results, saltiness is one of the unexpected attributes in the ideal product, while PCoA results show that this salty attribute has a positive correlation with the liking value. Therefore, the flavor of tea can be effectively combined with salty/savory foods.

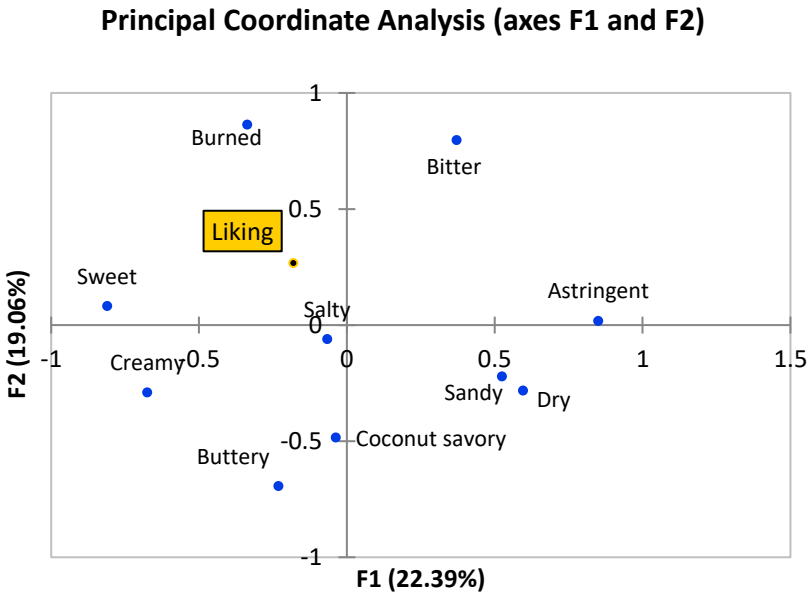

Figure 2. Principal coordinate analysis between attributes and liking preferences.

This analysis produces a relatively low proportion of variance from the first two factors (F1 and F2), which is 41.45%, indicating a high individual variation between consumers in assigning a liking score to the samples. This finding is attributed to the different tastes of each panelist. The value of this variation also indicates the quality of the PCoA model, which is a good PCoA, producing a relatively high eigenvalue and a cumulative value of variation above 50% on two to three dimensions. The cumulative variability value in the F1–F3 factors is 54.42%, which indicates that the PCoA model is good.

Penalty analysis shows the relationship between the scores of pairing samples and the sensory description of the CATA test. Consumers are asked to indicate whether the intensity of the sensory attribute is too strong, too weak, or just-about-right (JAR) to determine which attribute may affect overall product acceptance (22). Penalty analysis classifies attributes by analyzing the description of the ideal product according to the CATA test by evaluating the liking preference value of panelists on the sample pair. These classifications include “must have,” “nice to have,” “doesn’t influence,” “doesn’t harm,” and “must not have”(23). The results of the penalty analysis can be interpreted from *the mean drops vs %* graph, which identifies the attribute as a “must have.” Mean drops are calculated as the difference between the average liking score for an attribute at JAR level (chosen as ideal and appears in product [1,1]) and too much level (not selected as ideal but appears in product [0,1]) or too little (selected as ideal but does not appear in product [1,0]). The mean drops are represented by plotting the Y-coordinate against the percentage of respondents from the non-JAR group at the X-coordinate. Attributes located in the upper right (quadrant 1) will be selected as attributes that must be improved (22). The graph of *mean drops vs %* in this test is presented in Figure 3.

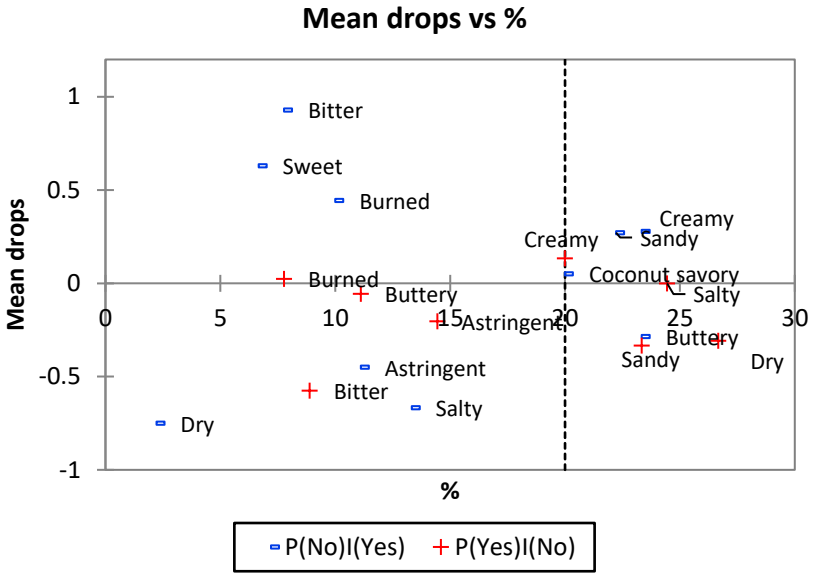

Figure 3. Attribute mapping on mean drops.

According to (24), attributes that are included in the "must have" attribute are sensory attributes that have an X-coordinate value (%P (No)|(Yes)) more than 20% and have a positive Y-coordinate value (mean drops). Attributes that include "nice to have" and "must not have" are those that have the coordinate X (P (Yes) | (No)) more than 20%. Attributes with the potential to be "nice to have" are those with positive mean drops, while other attributes with negative mean drops have the potential to be "must not have" attributes. However, the level of significance indicates that an attribute is included as "does not influence" and "does not harm" when it is insignificant (p-value < 0.05). The "does not influence" attribute has an X-coordinate value (%P (No) | (Yes)) of more than 20%, while the does not harm attribute has an X-coordinate value (%P (No) | (Yes)) less than 20%, both demonstrating positive and negative mean drops.

The results of penalty analysis in Figure 3 and the summary in Table 4 reveal that the attributes are included in the "does not influence" and "does not harm" criteria. The attributes that do not influence consumer preference are coconut savory, buttery, creamy, and sandy. Meanwhile, attributes that are included in "does not harm" are burned, dry, salty, bitter, and astringent. Therefore, the existing attributes do not have considerable effect on consumer preferences according to consumer perceptions. Attributes that must exist (must have) or must be avoided (must not have) can affect consumer preferences.

Table 4. Classification of attribute based on consumer preference.

Must have	Nice to have	Does not influence	Does not harm	Must not have
		Coconut savory	Burned	
		Buttery	Dry	
		Creamy	Salty	
		Sandy	Bitter	
			Astringent	

Several attributes of tea and coconut biscuits during their interaction with each other can increase or decrease these attributes individually. The sweetness of sweet tea and

coconut biscuits, as well as the roasted aroma of coconut biscuits with the burned aroma of sweet tea, can both interact. Sweetness in biscuits can also mask the bitterness and strong astringent of the tea. Sweet and salty taste is a good combination because it complements each other and creates a savory taste. According to (25), black tea is usually combined with food that has a sweet and rich/complex taste. This finding is in line with this study that sweet–savory rich and tasty coconut biscuits compared with the flavor of tea is light.

This study determined the effect of the combination on the intensity of the attributes (whether it decreased, remained, or increased), as shown in Figure 4. This figure reveals that the rightmost position indicates a high agreement percentage of panelists regarding an increase in intensity on the attribute, while the leftmost position indicates a high agreement percentage of panelists regarding a decrease in intensity on that attribute.

The results in Figure 4 reveal that the most common attributes that emerge in the combination of tea and biscuit A (T-A) are sweet, coconut savory, creamy, and sandy. This combination increases the sweet taste and creamy texture, reduce the sandy texture, and does not affect the coconut savor. The dominant attributes in the combination of tea with biscuit B (T-B) include sweet, savory coconut, buttery, creamy, and sandy. This combination increases the sweetness, buttery and creamy mouthfeel, lowers the sandy texture, and does not affect the coconut savor.

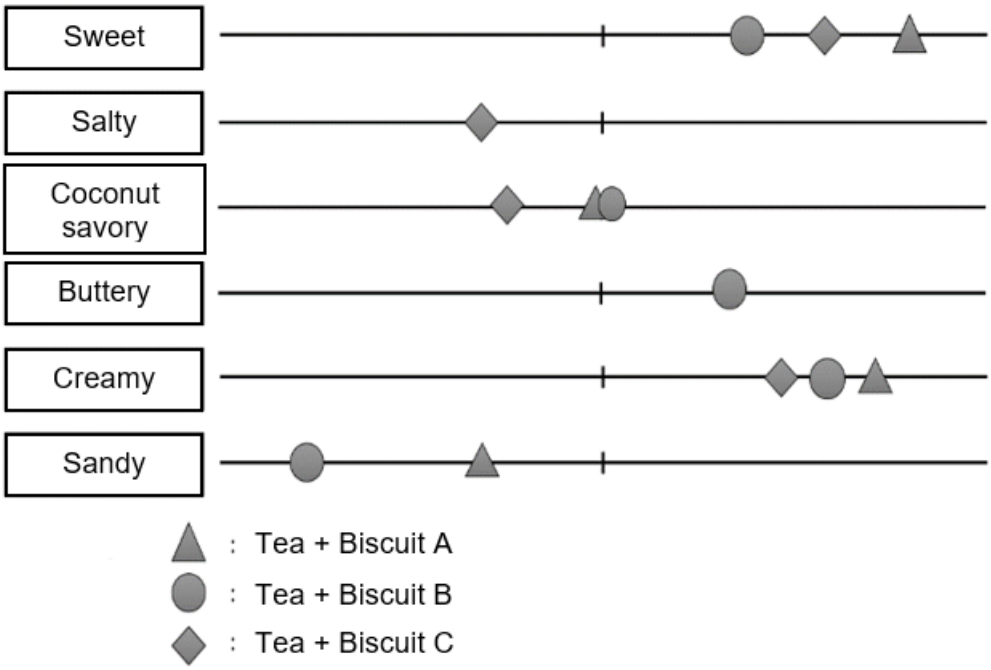

Figure 4. Effects of combination on the intensity of several dominant attributes.

Table 5. ANOVA of attribute intensity.

	Sum of Squares	Df	Mean Square	F	Sig.
Between Groups	.065	2	.032	.042	.959
Within Groups	253.035	326	.776		
Total	253.100	328			

The dominant attributes in the combination of tea with biscuit C (T-C) include sweet, salty, coconut savory, and creamy. This combination tends to increase the sweetness and creamy mouthfeel and reduce the salty and coconut savory. Sweetness increases because tea and biscuits have a sweet taste, thereby enhancing each other when combined. The creamy mouthfeel of coconut biscuits increases because the addition of water from tea can wet the biscuits rapidly; therefore, the texture is soft and creamy. Correspondingly, the sandy texture of biscuits also decreases due to its interaction with water. However, the result of ANOVA at the 5% level (Table 5) indicate that the change in attribute intensity did not show any significant difference ($p = 0.959$) between the products tested.

4. Conclusions

The results of the online survey show that consumers frequently consume tea with various complementary foods, such as biscuits, fried foods, boiled snacks, traditional snacks, and chips. CATA analysis revealed that tea combination with biscuit B is considered by consumers to be the ideal pairing due to its attributes, such as creamy, buttery, and sandy texture and sweet and coconut aroma. This result also proves that consumers prefer the combination of tea with a light and aromatic flavor with coconut biscuits, which can add other flavors, such as buttery and creamy texture, sweet taste, and coconut aroma, when consumed together.

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Author Contributions

D.H, I.Z designed and performed the experiments; D.H., I.Z., Z.N.H., P.F., I.S. also analyzed the data and wrote the paper; D.H. and I.S. are the supervising lecturers.

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Institutional Review Board Statement

The human research protocol has been approved by IPB University’s Commission on Research Ethics Involving Human Subjects with number 329/IT3.KEPMSM-IPB/SK/2021.

Data Availability Statement

Available data are presented in the manuscript.

Conflicts of Interest

The authors declare that there is no conflict of interest.

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