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Consumer Perspective on Food Pairing Low-Sugar Rich in Antioxidant Tea Ponds Supplemented with Apple Vinegar

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ABSTRACT

The purpose of this study is to determine the comparison of physicochemical and sensory results of apple cider vinegar supplementation with various concentrations in low-sugar tea pores and obtain information on complementary foods in consuming the best low-sugar tea pores as food pairing. This study was designed using a Group Random Design (RAK) which consisted of 5 treatments with 5 repetitions with the addition of apple cider vinegar consisting of 5 levels a0 0 % (control), a1 0.5 %, a2 1 %, a3 1.5 %, a4 2 % The results of the food pairing analysis were carried out descriptively. The 0% treatment was declared as the best treatment with a physicochemical value of pH 5.71, TPT 7.28 °brix, L color 34.02, color a 2.52, color b 3.88, and color sensory value of 4.07 (like), Aroma 4.20 (like), acidity level (3.83) somewhat liked, and overall acceptance 4.13 (like). In food pairing, the highest percentage chosen by respondents was fried bananas (28.6%) out of 49 respondents. Comparison of physicochemical and sensory characteristics of low sugar pores of apple cider vinegar supplementation had differences in each parameter, namely pH, TPT, and the Color parameter had no significant difference. Meanwhile, the color sensory parameters had no noticeable differences, while the overall aroma, acidity, and reception sensory parameters had significantly different results in each treatment.

Introduction

Liang teh is a traditional drink that is very easy to find anywhere, both in restaurants, large restaurants, and traders who peddle carts on the side of the road, and are known for generations as a health drink (Malm et al., 2021). Liang the is a decoction of some natural ingredients other than from the tea plant (Camelia chinensis) called "cool tea" (local name for Pontianak, liang-cha in Chinese), this drink was spread from the southern part of China spread to Indonesia (Priyatnasari et al., 2024). Dewi et al. 2022 produced invention of tea pores by replacing sucrose sugar with xylitol sugar so that the calories are lower but do not change the characteristic taste of tea pores so that they can be categorized as low-sugar tea pores. The result of the invention is still in the form of

original low-sugar tea poros or without a certain flavor so that the adolescent community or millennials are still not interested in enjoying it regularly (Agustono, Rahmaniyah, Fikri, & Prastiya, 2022).

The addition of apple cider vinegar to the tea pore can add variety to this traditional drink, considering that the tea pore is very minimal with a variety of different flavors. One interesting variation to combine in low-calorie drinks in low-sugar tea plows is the tart taste of apple cider vinegar (Wahyunia & Clarestab, 2024). Apple cider vinegar or can be commonly called Apple cider vinegar, which is the result of fermentation from apple cider which has a high content of active chemicals such as phenol/phenol, pectin, flavonoids, tannins, and acetic acid (Vandorou et al., 2024). The daily habits of people in Pontianak in consuming drinks such as tea burrows are always accompanied by accompanying foods. Currently, there is no information on food pairings for tea berries (Castro, Urzúa, Rodriguez-Malebran, Inostroza-Blancheteau, & Ibáñez, 2017).

Food pairing in low-sugar tea pot drinks aims to be able to better introduce this traditional drink that is rich in benefits to the wider community, especially millennials by combining this low-sugar teapot with foods that are very familiar to the wider community daily so that a combination that provides the perfect taste is obtained so that this low-sugar teapot drink that is rich in benefits and low in calories and its accompanying foods became better known by the wider community (Devoney, 2021).

Method

Material

The raw materials for making low-sugar tea pot drinks are obtained from markets in the Pontianak area which include muje leaves, clam pineapple leaves, fragrant pandan leaves, oregano leaves, aloe vera peel, sappan wood, xylitol sugar, and the additional apple cider vinegar and mineral water.

Tool

The tools used in making low-sugar teapots are a 100°C water thermometer, a container, a 60 mesh filter, a kitchen knife, a placemat, a stove, a measuring cup, a stirring spoon, a measuring spoon, an analytical scale, a pot, a coffee maker, a measuring pipette, and other analytical tools. Then the low-sugar tea pore will be supplemented with apple cider vinegar.

Research Design

This study was designed using a Group Random Design (RAK) which consisted of 5 treatments with 5 repetitions with the addition of apple cider vinegar (a) which consisted of 5 levels, namely:

a0 = 0% addition of apple cider vinegar (control)

a1 = 0.5% addition of apple cider vinegar

a2 = 1% addition of apple cider vinegar

a3 = 1.5% addition of apple cider vinegar

a4 = 2% addition of apple cider vinegar

Then an online survey was carried out about the consumption pattern of low-sugar tea pores and suitable side foods, then low-sugar tea pore supplement foods with apple cider vinegar supplementation will be obtained.

Research Stages

The procedure for making low-sugar tea pores uses a patent by (Segneanu, 2024). The manufacturing stage is divided into two groups of ingredients, namely herbal ingredients and tea ingredients. Herbal ingredients consisting of 32 g of muje leaf slices, 4 g of oregano leaves, 4 g of pandan leaves, 14 g of clam pineapple leaves, 4 g of aloe vera skin slices, then the making of tea ingredients starts from the bark of the sappan tree which has been reduced in size and weighed as much as 4g then infused for 12 hours in cold water as much as 1000 ml then filtered and the tea infusion water is added with xylitol sugar as much as 140 g. The manufacture of herbal ingredients begins with weighing brewed in hot water at a temperature of 60-80 °C as much as 1000 ml with a brewing time of 18 minutes, then infused at room temperature for 2 hours followed by filtration. Low-sugar tea pore drinks supplement apple cider vinegar with various concentrations. Then pH, Total Dissolved Solids (TPT), and color tests were carried out and then it will be followed by sensory tests by 30 semi-trained panelists.

Survey Implementation

The survey was carried out to determine complementary foods that were suitable for low-sugar tea plows supplemented with apple cider vinegar, the survey was carried out using the Purposive sampling method which is a sample determination technique with certain considerations in (Sugiyono, 2016). Where the sample taken is respondents who are used to consuming tea drinks using Google form media.

Analysis Procedure

pH testing using a pH meter that has been calibrated with a pH 4 and pH 7 buffer solution, then the pH meter is dipped in the sample and then left until the number on the pH meter is stable and the value will be displayed on the pH meter-monitor screen. Each analyzing different sample electrodes should be rinsed 6-8 times using an aquaade.

Total Analysis of Dissolved Solids (Sudarmadji et al. 1986)

Testing Total Dissolved Solids (TPT) using a refractometer with the stages of rinsing the Daylight plate using an aqueous and then wiping it slowly using a tissue, each sample is tested one by one by dripping on a prism and making sure there are no bubbles, then the measurement results can be analyzed with eyepieces so that a dividing line between white and blue will appear which will show the results of the measurement of

the stated brix value (% weight) or Density (Citraningrum, Sari, Rahmatika, Sabarisman, & Anoraga, 2022).

Color Analysis

The color test was carried out using the AMT506 digital colorimeter, where the parameters L* for brightness, a* for reddish or greenish color, and b* for yellowish or bluish color.

Analysis of Sensory Characteristics (Tarwendah. 2017)

This analysis uses an organoleptic test carried out using the hedonic test method (preference test) using 30 semi-trained panelists who stated their level of preference on a hedonic scale of 1-5 with a value range of 1 i.e. dislike to a value of 5 i.e. very.

Data Analysis

The data from the research results were statistically analyzed with the F test (ANOVA), if it had a real effect, it was followed by the Honest Real Difference (BNJ) test with a level of 5%. The data from the hedonic test results were analyzed using the Kruskal-Wallis test method. The determination of the best treatment was carried out by comparing the values of each treatment through the Effectiveness Index test using the method (De Garmo et al. 1984). The results of food pairing will be presented descriptively.

Results and Discussion

Acidity or pH analysis aims to find out the acidity level of a product. After analyzing the diversity using ANOVA, the formulation in the tea pore that had been supplemented with apple cider vinegar with various concentrations had a real effect on the pH value of the drink, so the BNJ test at the 5% level was continued.

Table 1
pH of tea pores supplemented with apple cider vinegar of various concentrations

Tea pore supplementation apple cider vinegar (%)	Ph
0	5.71±0.12e
0,5	4.93±0.04d
1	3.88±0.03c
1,5	3.75±0.04b
2	3.64±0.04a
BNJ 5% = 0.06	

BNJ test results on the Table. It shows that the lowest pH is found in apple cider vinegar supplementation with a concentration of 2%, which is 3.64, while the highest is found in apple cider vinegar supplementation with a concentration of 0% (control), which is 5.71. The results of the pH analysis of the tea pore supplemented with apple cider

vinegar showed that the higher the % concentration of apple cider vinegar supplemented in the tea pore, the lower the pH of the tea pore drink. This can be affected because apple cider vinegar contains acetic acid, gallic acid, and other compounds formed from the fermentation of apples so that the sugar in the apple cider is processed into alcohol and makes apple cider vinegar have a strong sour taste that This affects the decrease in pH in drinks supplemented with apple cider vinegar (Samanta & Singhee, 2023).

Total Dissolved Solids (TPT)

The results of the ANOVA TPT analysis on tea pores that have been supplemented with apple cider vinegar with various concentrations had a real effect on the total value of dissolved solids in the beverage so the BNJ 5% test was continued.

Table 2
TPT test results on low-sugar tea pores with various concentrations of apple cider vinegar

Tea pore supplementation apple cider vinegar (%)	Total Dissolved Solids (°brix)
0	7.28±0.15d
0,5	7.20±0.17c
1	7.10±0.09b
1,5	7.04±0.10ab
2	6.98±0.12a
BNJ 5% = 0.09	

Based on Table 5. It was shown that tea pores supplemented with apple cider vinegar had a real effect on the concentrations of 0%, 0.5%, and 1% while the treatment of 1.5% and 2% had no real effect with an average total dissolved solids of 7.04-6.98 °brix. The smallest total dissolved solids value was found in apple cider vinegar supplementation with a concentration of 2% with a total average of 6.98°brix while the largest total dissolved solids value was found in apple cider vinegar supplementation with a concentration of 0% (control) which was 7.28°brix. This can be due to the higher or higher % of the solution added, the lower the total dissolved solids. According to Tampubolon (2001), the decrease in total dissolved solids can be caused by the reduction of sugar content in the diluted solution.

Color

Color testing is carried out using an instrument colorimeter. The measurement results are divided into three parameters, namely L (lightness), a (Redness), and b (yellowness).

Table 3
Results of color measurement in low-sugar tea pores with various concentrations of apple cider vinegar addition

Tea pore supplementation apple cider vinegar (%)	L+	A+	B+
0	34.02±0.69	2.52±0.59	3.88±1.16
0,5	34.00±1.24	1.22±0.86	3.06±0.68
1	34.66±0.30	1.68±0.79	3.56±0.52
1,5	35.10±0.96	1.92±1.12	4.10±0.28
2	35.20±1.18	2.20±1.02	3.82±0.56

The results of the ANOVA test on the color of the tea pore of apple cider vinegar supplementation at L+, a+, and b+ values did not have a real effect so it was not continued with a real difference test of 5%, from the data in the table. Then we can note that the lowest L+ value is in the treatment of adding 0% apple cider vinegar while L+ is found in the treatment of adding apple cider vinegar by 2% where L+ (lightness) which is the level of brightness according to the percentage of adding apple cider vinegar to the apple cider vinegar tea pore where the higher the percentage of adding apple cider vinegar to the low sugar tea pore, the higher the brightness level. When the value of a+ (Redness) there was a decrease in the addition of apple cider vinegar which showed that the addition of apple cider vinegar could affect the level of red color in the tea hole, at the value of a (Redness) if positive (+) it could be interpreted as red and if negative (-) it meant green so that the a value in the tea hole was low in sugar and apple cider vinegar supplementation had a tendency to be red. Meanwhile, the value of b+ (yellowness) has an unstable number in each treatment so it cannot be concluded whether with the addition of apple cider vinegar the value of b+ has increased or decreased. B (yellowness) positive (+) can be interpreted as yellow while negative (-) can be interpreted as blue so that the b value in the tea pore of low sugar apple cider vinegar supplementation tends to be yellow.

Sensory Characteristics

Sensory tests are carried out to show consumer acceptance of a food ingredient carried out with sensory devices. The sensory method used was a preference test (hedonic test) conducted by 30 researchers. The analysis method used is the Kruskall-Wallis test. The quality characteristics tested in this study are mainly taste, color, texture, aroma, and overall.

Table 4
Sensory characteristics of tea pores supplemented with apple cider vinegar with various concentrations

Tea pore supplementation apple cider vinegar (%)	Color	Aroma	Acidity Level	Overall Acceptance
0	4.07±0.740	4.20±0.610	3.83±0.805	4.13±0.776
0,5	3,97±0,730	3.47±0.571	3.67±0.809	3.80±0.661
1	4.03±0.669	3.10±0.712	3.37±0.890	3.57±0.817
1,5	3.87±0.629	3.17±0.592	3.10±0.712	3.23±0.568
2	4.23±0.679	3.03±0.765	3,03±0,850	3.30±0.702
	KW 5,876	KW 45,508	KW 19,063	KW 25,720

The sensory characteristics of low-sugar tea pore apple cider vinegar supplementation include color, aroma, acidity level, and overall acceptance. The number of panelists in this study was carried out by 30 people who stated their level of liking on a hedonic scale of 1-5 with a range ranging from dislike to very like.

Color

Color is one of the physical sensory attributes that is assessed using the sense of vision. According to Winarno (2008). The results of the Kruskal Wallis test of color parameters showed P<0.05, H0 was accepted so that there was no real difference in the treatment (0%, 0.5%, 1%, 1.5%, and 2%) of the color of the tea pore of low sugar supplemented with apple cider vinegar so that the Mann-Whitney follow-up test was not carried out. By 0.5% and 1.5% with the criteria of somewhat like, while the highest value was in the treatment of adding apple cider vinegar of 2% with the criteria of like. The addition of apple cider vinegar to low-sugar tea pores up to a certain pH according to (Segneanu, 2024) causes a discoloration of the system. The lower the pH (acid), the more apple cider vinegar is added, causing the color of the teapot to be brighter from brownish-purple to yellowish-purple. Visually, the color factor greatly determines the quality and has an important role as an attraction for consumers in considering the quality of a product.

Aroma

Aroma is one of the important factors for consumers in choosing their favorite food and beverage products. Winarno (2004), said that in many cases the deliciousness of food is determined by the aroma or smell of the food and drink. Aroma is a very subjective taste and smell that is difficult to measure, because everyone has different sensitivities and preferences, although they can be detected, each individual has different preferences. The results of the Kruskal Wallis test showed that the color parameters showed P<0.05, and H0 was rejected so there was a real difference in the treatment of the aroma of low-sugar tea pores supplemented with apple cider vinegar. The results of the Mann-Whitney test showed that the level of preference for the aroma of low-sugar tea poros supplemented with apple cider vinegar was not significantly different (P> 0.05) in samples of 0.5% and 1.5%, 1% and 1.5%, 1% and 2%, and 1.5% and 2%. However, there were significant differences (P< 0.05) at 0% and 0.5%, 0% and 1%, 0 and 1.5%, 0% and 2%, and 0.5% and 1% in the level of preference for the aroma of low-sugar tea cavitation supplemented with apple cider vinegar. From the results of the panelists' preference for the aroma of tea pore low sugar supplementation apple cider vinegar, the average preference of the panelists was obtained of 3.03-4.20 where this data showed the lowest value, namely the treatment of adding apple cider vinegar of 2% with the criterion of somewhat liking, while the highest value was the treatment of adding apple cider vinegar of 0% with the criterion of liking.

Acidity Level

The results of the Kruskal Wallis test showed that the acidity level parameter showed P<0.05, and H0 was rejected so there was a real difference in the treatment of the acidity level of low-sugar tea pores supplemented with apple cider vinegar. To see which groups are different, Mann-Whitney further tests were carried out. The results of the Mann-Whitney test showed that the preference level of the acidity level of low-sugar tea pore supplemented with apple cider vinegar was not significantly different (P> 0.05) in the samples of 0% and 0.5%, 0.5%, and 1%, 1% and 2%, and 1.5% and 2%. However, there was a noticeable difference (P< 0.05) at 0% and 1%, 0% and 1.5%, 0% and 2%,

0.5%, and 1.5%, and 0.5% and 2% in the level of preference for the acidity level of low-sugar tea pore supplementation with apple cider vinegar. From the results of the panelists' preference for the acidity level of tea pores low sugar supplementation of apple cider vinegar, the average preference of the panelists was 3.03-3.83 where this data showed the lowest value, namely the treatment of adding apple cider vinegar of 2% with the criterion of somewhat liking, while the highest value was the treatment of adding apple cider vinegar of 0% with the criterion of somewhat liking. Each treatment of adding apple cider vinegar to low-sugar tea pores greatly affects the level of preference of the panelists, because the higher the concentration of apple cider vinegar, the higher the acidity level of low-sugar tea pores, this is because apple cider vinegar from fermentation has a pH of 3.13 which has a very acidic taste.

Overall Acceptance

The results of the Kruskal Wallis test showed that the overall acceptance parameter showed P<0.05, and H0 was rejected so there was a real difference in the treatment of the overall acceptance of low-sugar tea pores supplemented with apple cider vinegar. To see which groups are different, Mann-Whitney further tests were carried out. The results of the Mann-Whitney test showed that the overall acceptance rate of low-sugar tea pore supplemented with apple cider vinegar was not significantly different (P> 0.05) in samples of 0.5% and 1%, 0.5% and 2%, 1% and 1.5%, and 1.5% and 2%. However, there were significant differences (P< 0.05) at 0% and 0.5%, 0% and 1%, 0% and 1.5%, 0% and 2%, and 0.5% and 1.5% in the level of preference of the panelists for the overall acceptance of low-sugar tea with apple cider vinegar supplementation. From the results of the panelists' preference for the overall acceptance of low-sugar tea pores supplemented with apple cider vinegar, the average preference of the panelists was obtained of 3.23-4.13 where this data showed the lowest value, namely the treatment of adding apple cider vinegar of 1.5% with the criterion of somewhat liking, while the highest value was the treatment of adding apple cider vinegar of 0% with the criterion of liking. This can be because the taste and aroma of apple cider vinegar still feel unfamiliar to the average panelist.

Test the Effectiveness Index

Based on the physicochemical and sensory characteristics of the tea pore low-sugar apple cider vinegar supplementation above, the best determination analysis was carried out with an effectiveness index test.

Table 5
Effectiveness Index Test Results

Tea pore supplementation apple cider vinegar (%)	Treatment Value (NP)
0	0,92
0,5	0,69
1	0,30
1,5	0,10
2	0,16

Based on Table 5. The best treatment was found in low-sugar tea porosity with 0% apple cider vinegar supplementation with a treatment value (NP) of 0.92%, therefore the best treatment was not by the hypothesis proposed by the author so the hypothesis was rejected. So the 0% treatment was declared as the best treatment with a physicochemical value of pH 5.71, TPT 7.28 °brix, color L 34.02, color a 2.52, color b 3.88, and color sensory value of 4.07 (like), aroma 4.20 (like), acidity level (3.83) somewhat liked, and overall acceptance 4.13 (like).

Consumer Profile

Profiles of 49 respondents who were met directly at Tanjungpura University. The gender of the respondents was dominated by women at 83.7% and males at 16.3%. With the vulnerable age of respondents being 17-20 years old as much as 24.5%, 21-29 years old as much as 69.4%, and < 30 years old as much as 6.1% so the vulnerable age of respondents is dominated by respondents with the age of 21-29 years.

Table 6
Consumer Profile

Criterion	Number of Respondents	Percentage (%)
Man	8	16,3
Woman	41	83,7
Age Range		
17-20 Years	12	24,5
21-29 Years	34	69,4
>30 Years	3	6,1

Survey Results

Based on the results of an online survey on the consumption patterns of tea pores from 49 respondents, the following data were obtained: the results of the survey on the types of tea pore complementary foods are as follows: the highest percentage chosen by respondents is fried bananas (28.6%), bakwan (18.4%), sweet cookies (10.2%), steamed sponge cakes and salted sponge cakes (8.2%), baked sponge cakes (6.1%), original atomic beans and salted atomic beans (4.1%), Peanuts, spicy atomic beans, salted banana chips, spicy cassava chips, fried tempeh, and salted cookies only scored (2%) each. The complementary foods chosen by the majority of respondents are a reflection of various factors, especially environmental eating habits (peers, family, and others), and the availability of food in each respondent's area.

Conclusion

Based on the results of the study, it can be concluded that the comparison of physicochemical and sensory characteristics of low-sugar pores supplemented with apple cider vinegar with various treatments of adding apple cider vinegar, has differences in each parameter, namely pH, TPT, and Color. In food pairing, the data from the survey of

the types of food accompaniment to the tea scene are as follows: the highest percentage chosen by the respondents is fried bananas (28.6%) out of 49 respondents.

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