# Characterization of Ready-to-Drink Decaffeinated Coffee Enriched with Lime and Lemon

**Nita Kuswardhani*[1], Dania Mazidatul Hana[1], Andi Eko Wiyono[1]**
[1]Department of Agroindustrial Technology, Faculty of Agricultural Technology
Universitas Jember Jl. Kalimantan 37, Jember 68121, Indonesia.
Email: nita.ftp@unej.ac.id*

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**Abstract**

*This study aims to determine the physical, chemical, and sensory characteristics of and the appropriate and optimal formulation for producing ready-to-drink (RTD) robusta decaffeinated coffee variations with the addition of lime (citrus aurantifolia) and lemon (citrus limon) juice. The ingredients used for coffee preparation include decaffeinated robusta coffee powder, lemon, lime, sugar, and water. The experimental design used in this study was a completely randomized design (CRD) with three factors and two levels: citrus type (A1: lemon; A2: lime), lemon or lime juice concentration (B1: 5%; B2: 10%), and liquid sugar volume (C1: 15 ml; C2: 25 ml). These factors were designed to create 8 treatments for physical, chemical, and sensory testing. Data analysis was performed statistically using Analysis of Variance (ANOVA) at 5% significance level and further testing with Duncan's Multiple Range Test (DMRT) when any differences were found. The results showed that the interaction of the three factors affected the physical and chemical characteristics of caffeine content, pH, and antioxidant activity. The addition of lime and lemon juice did not have a significant effect on the characteristics of vitamin C content and brightness. Treatment A1B1C2, with the composition of 5 ml lemon juice and 25 ml sugar water, provides the best formulation based on the review of physical, chemical, and sensory characteristics.*

**Keywords:** *Lime, Lemon, Robusta decaffeinated coffee, RTD.*

## 1. INTRODUCTION

Robusta coffee (Coffea canephora) is favored by Indonesians for its strong flavor and aroma. Moreover, it has a higher caffeine content than arabica coffee. The caffeine content in robusta coffee ranges from 1% to 2% of the total dry weight, higher than in the arabica coffee, which ranges from 0.4% to 2.4% (Budi et al., 2020). The high caffeine content in robusta coffee can have adverse health effects, such as high cholesterol (Krispila et al., 2020), headaches, and sleep disturbances. The decaffeination process can reduce caffeine levels and, thus, reduce health risks for those who are intolerant to caffeine (Br Ginting et al., 2022).

One of the decaffeination methods is soaking. Based on the preliminary research, soaking robusta coffee beans for 3, 5, and 7 days, while replacing its water within 24 hours, can significantly decrease the caffeine content of robusta coffee up to 0.65-0.89% compared to the control sample (1.78%) with the lowest caffeine content in the 7-day soaking treatment(0.65%) (Kuswardhani, 2023).

The innovation of adding lemon (Citrus limon) and lime (Citrus aurantiifolia) to decaf coffee is an interesting innovation as it provides health benefits and flavors (Nascimento et al., 2020). Lemon and lime contain flavonoids, terpenoids, citric acid, and vitamin C that function as antioxidants, anti-inflammatories, and antimicrobials, which can reduce the risk of cardiovascular disease and improve digestive system health. According to Fatin & Azrina (2017), the vitamin C content in lemon 43.96 mg/100g and lime 27.78 mg/100g is higher than some other types of citrus. Residual bitterness from decaf coffee can be masked or balanced by its acidic and citrusy taste. Despite the fact that the caffeine or coffee content is unchanged, this may give the impression that the coffee is milder, fresher, or less strong.

Ready-to-drink (RTD) decaff coffee enriched with lime and lemon juice offers a delicious decaffeinated coffee flavor, designed for consumers who want to enjoy coffee without the effects of

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excessive caffeine. This product is convenient and can be enjoyed anytime. Moreover, it is rarely found in the market, creating a great opportunity for the development of RTD decaf coffee with lime and lemon flavors. Therefore, the combination of decaffeinated robusta coffee with lime and lemon juice results in an innovative, delicious, and healthy RTD. This study aims to determine the physical, chemical, and sensory characteristics, as well as to determine the appropriate and optimal formulation for producing ready-to-drink (RTD) robusta decaffeinated coffee variations with the addition of lime and lemon juice.

## 2. MATERIAL AND METHODS

### 2.1 Tools and Materials

#### 2.1.1 Tools

The tools used in this research are analytical scales (Ohaus), filters, pans, measuring cups, stoves, spatulas, bottles, funnels, spoons, pH meter PHS 26C Bench, General colorimeter-AMT 507, erlenmeyers, beakers, volumetric flasks, pipettes, burettes, measuring bottles, stirrers, Spectrophotometer vis 721, vortexes, and test tubes.

#### 2.1.2 Materials

The materials used for making RTD coffee are robusta decaf ground coffee that was made by soaking coffee beans for 7 days, lemon, lime, sugar, and water. The materials used for analysis are buffer solution, distilled water, tissue paper, iodine, amylum indicator, iodine, ascorbic acid, DPPH (2,2- diphenyl-1-picrylhydrazyl), 95% ethanol, distilled water, and calcium carbonate (CaCO3).

### 2.2 Research Design

This research used the Complete Randomized Design (CRD) technique. The following are the treatment variations applied in this study. The three factors are varied to get optimal results with the following formulation on Table 1:

Factor A: Type of citrus used
- A1 : Lemon
- A2 : Lime

Factor B: Concentration of lime or lemon juice (%)
- B1 : 5% of brewed coffee
- B2 : 10% of brewed coffee

Factor C: Liquid sugar (ml)
- C1 : 15 ml
- C2 : 25 ml

Table 1. Experimental design

| Code | Coffee Bean (mL) | Lime Juice (mL) | Lemon Juice (mL) | Sugar Solution (mL) | Water (mL) |
|---|---|---|---|---|---|
| A1B1C1 | 100 | 0 | 5 | 15 | 100 |
| A1B1C2 | 100 | 0 | 5 | 25 | 100 |
| A1B2C1 | 100 | 0 | 10 | 15 | 100 |
| A1B2C2 | 100 | 0 | 10 | 25 | 100 |
| A2B1C1 | 100 | 5 | 0 | 15 | 100 |
| A2B1C2 | 100 | 5 | 0 | 25 | 100 |
| A2B2C1 | 100 | 10 | 0 | 15 | 100 |
| A2B2C2 | 100 | 10 | 0 | 25 | 100 |

## 2.3 Research Stages

### 2.3.1 Making RTD Decaf Coffee with the Addition of Lime and Lemon Juice

The process of making the drink began with brewing decaffeinated coffee grounds, which can be seen in Figure 1.

### 2.3.2 Physical, Chemical, and Sensory Testing

Hedonic methods were used for conducting sensory tests. The sensory test used 30 untrained panelists (BSN, 2006). Then, physical (pH, lightness) and chemical characteristics (vitamin C, antioxidants, and caffeine) were measured in duplicate.

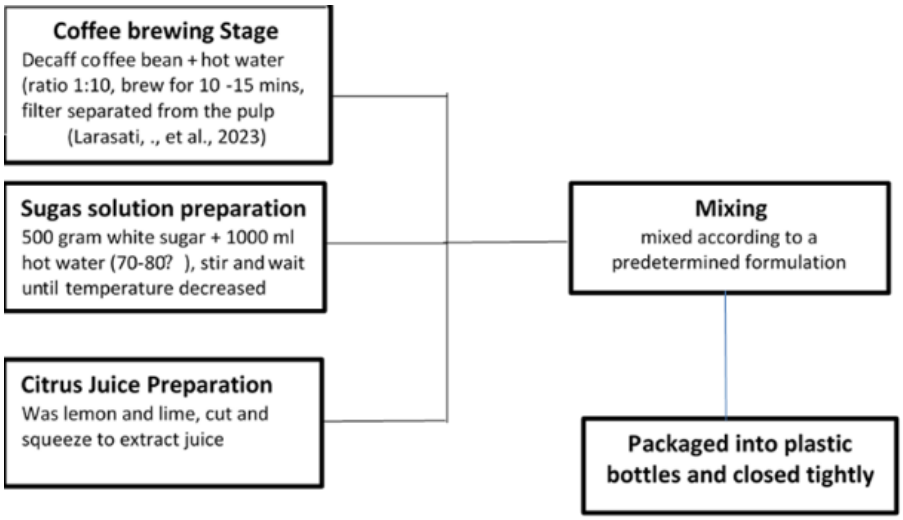


Figure 1. RTD decaf coffee enriched with lime and lemon

### 2.3.3 Determination of the Best Formulation

The best formulation of RTD decaffeinated coffee with lime and lemon juice was determined by using the exponential comparison method, based on the results of physical and sensory tests. According to Rangkuti (2011), it quantifies the opinion of one or more people on a certain scale. The exponential comparison method steps include:

1. Determination of decision alternatives.
2. Formulation of decision criteria to be assessed.
3. Determination of the relative importance of each criterion with a certain conversion scale.
4. Determination of the relative degree of importance of each decision alternative.
5. Ranking the value of each decision alternative.

The formulation of the Exponential Comparison Method for score calculation was shown as equation 1:

$$Total\ Value\ (TNi) = \sum_{j=1}^{m} (RKij)^{TKKj} \quad (1)$$

Where:

Total value I : Total final value of the i-th alternative
$RK_{ij}$ : Degree of importance of the j-th relative criterion in decision option i
$TKK_j$ : Degree of importance of the j-th relative criterion TKK j > 0
N : Number of decision options
M : Number of decision criteria

## 2.4 Data Analysis

The data collected were analyzed using the SPSS version 23 program. Physicochemical tests were carried out using the univariate Analysis of Variance (ANOVA) method at the α = 0.05 level to determine differences between treatments. If there was a difference, it was followed by the Duncan

Multiple Range Test (DMRT). Sensory tests were analyzed using the chi-square test at the α = 0.05 level to determine differences in data. The data were presented in the form of bar charts and interpreted descriptively.

## 3. RESULTS AND DISCUSSION

The physical, chemical, and sensory characteristics of RTD decaffeinated coffee are closely interrelated, as the additional lime and lemon during processing can influence the beverage's color (lightness), pH, caffeine content, antioxidant activity and vitamin C, which in turn affect key sensory attributes such as color, aroma, taste and after taste; thus, understanding these interactions is essential for maintaining product quality and consumer satisfaction on the RTD decaff coffee.

### 3.1 Physical, Chemical, and Sensory Characteristics of RTD Decaf Coffee Enriched with Lime and Lemon

#### A. Lightness

Color is an important factor in product acceptance as it is the first sensory property seen by the consumer. Lightness analysis of RTD coffee using a color reader showed the degree of lighness between 76.0-84.8 (where 0 is black and 100 is white). The ANOVA test on the degree of brightness showed that the interaction between the variables (A*B*C) did not have a significant effect (P>0.05). However, the concentration of lime and lemon (factor B) had a significant effect on the degree of lighness. The concentration of lime, lemon, and sugar solution did not significantly change the color of the RTD decaf coffee. Since the ANOVA test results were not significant, further testing with DMRT was not conducted. The results of this test can be seen in Figure 2.

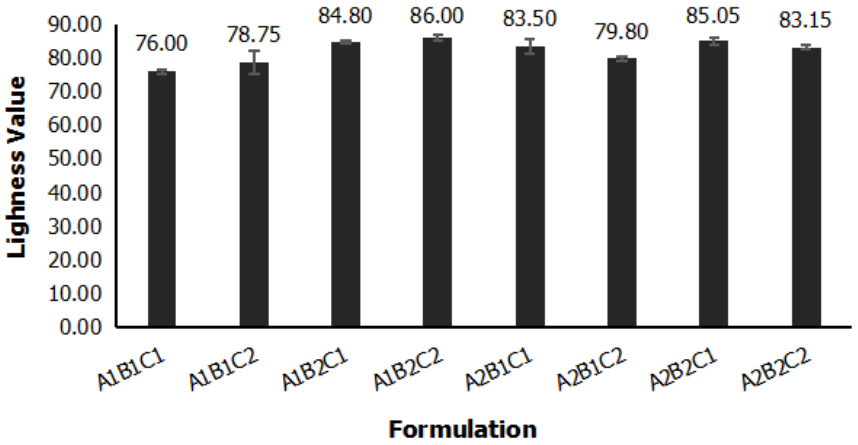


Figure 2. Degree of Brightness of RTD Coffee Drinks

Treatments with the addition of 10 ml lemon juice (A1B2C1 and A1B2C2) and lime juice (A2B2C1 and A2B2C2) produced higher lightness values compared to the addition of 5 ml. The addition of more lemon or lime juice increases the degree of brightness of the coffee drink. The addition of lime and lemon juice to coffee pulp juice drinks produces a bright brown color (Arpi et al., 2018). The more lemon juice used, the more yellow the color of the beverage due to the natural color of the lemon (Geri et.al., 2019).

#### B. Caffeine

The caffeine content in robusta coffee ranges from 1% to 2% of total dry weight (*Budi* et al., 2020). In this research, caffeine levels in robusta coffee were 1.78 mg/100 mL. Meanwhile, the caffeine level of RTD decaf coffee varied between 0.33-0.74 mg/100 mL. The interaction between lime, lemon, and sugar concentration showed significant differences in caffeine levels. Further tests with DMRT confirmed the significant difference in caffeine levels between treatments. Since Non-decaf RTD coffee products use coffee as the primary source of caffeine, the caffeine content of RTD decaf coffee drinks compared to non-decaf coffee can be seen in Figure 3.

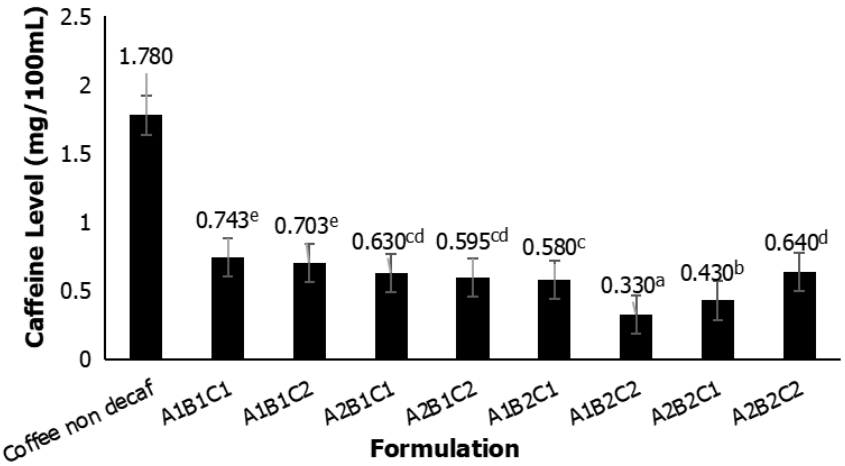


Figure 3. Caffeine Levels of RTD Coffee Drinks

The A1B2C2 and A2B2C1 treatments showed significant differences compared to the other treatments. The addition of lime and lemon affects caffeine levels in coffee drinks, with the higher the concentration of lime and lemon, the lower the caffeine levels. The addition of 5 ml of lime and lemon produced caffeine levels of 0.743-0.595 mg/100 ml, while 10 ml of lime and lemon reduced caffeine levels to 0.640-0.330 mg/100 ml. The flavor was changed by lime and lemon, which lessen bitterness or modify the scent, giving the impression that caffeine's effects are less potent. But the caffeine level remains constant unless water or citrus juice is used to dilute the coffee. The quantity will be increased by adding lemon or lime juice, but the overall caffeine content will remain the same, even if the caffeine concentration per milliliter is reduced. Caffeine's solubility may be somewhat influenced by the acidity of citrus fruits (low pH). The lower the caffeine level, the lower the acidity (pH) of the drink (Aini et.al., 2021).

**C. pH**

The results showed that the pH of RTD decaf coffee drinks with the addition of lime and lemon ranged from 2.92-3.24. The value of the degree of acidity of RTD coffee drinks can be seen in Figure 4.

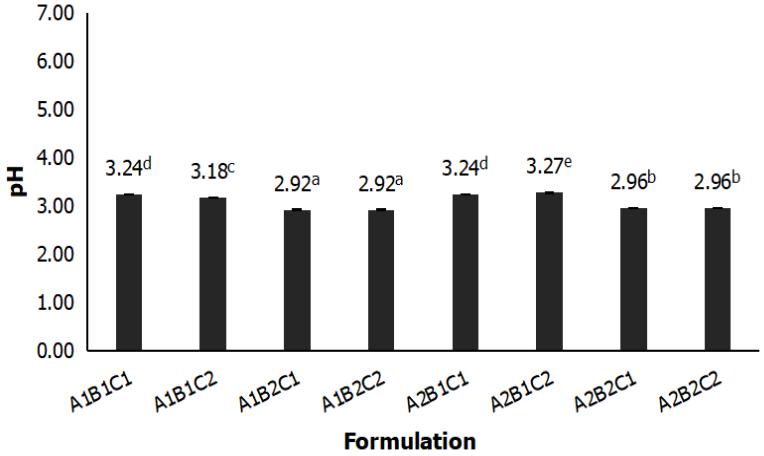


Figure 4. pH of RTD Coffee Drink

ANOVA test results showed that the interaction of the three factors affected the acidity of RTD coffee drinks. DMRT testing confirmed significant differences between treatments. The addition of lime and lemon juice decreased the acidity of the beverage, with a more significant decrease in the addition of lime juice due to the lower pH. The addition of 10 mL of lemon or lime juice showed the lowest pH value. These results are consistent with previous research (Agustin et.al., 2014), which stated that the addition of lemon or lime can reduce the pH of the drink due to an increase in

hydrogen ions from ascorbic acid. Therefore, the more citrus juice added, the lower the pH of the RTD coffee drink (Elfrida & Sarjani, 2021).

## D. Antioxidant

Antioxidant activity testing on RTD decaf coffee drinks using the DPPH method showed values ranging from 1.44-1.78 mmolTE/100ml. ANOVA test results showed that the interaction between citrus type, citrus concentration, and sugar concentration had a significant effect on antioxidant activity. The antioxidant activity values can be seen in Figure 5.

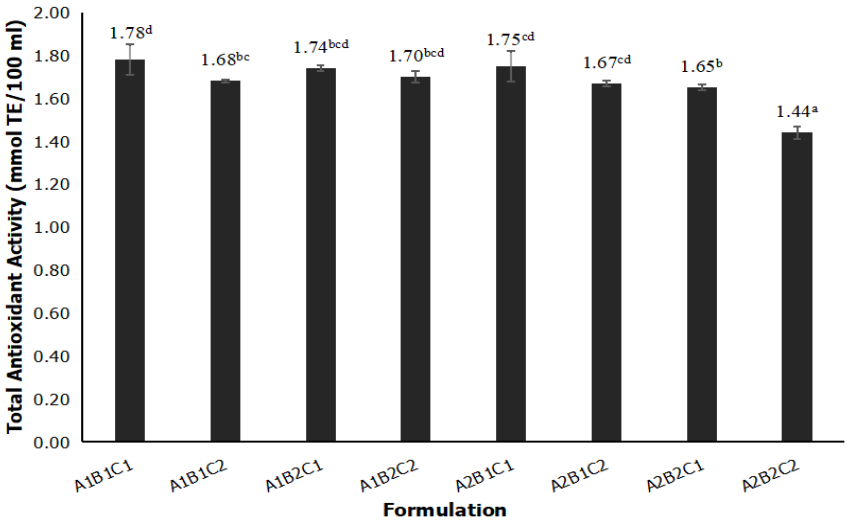


Figure 5. Antioxidant activity of RTD coffee drinks

The results showed that the total antioxidant activity in coffee drinks with the addition of lemon juice ranged from 1.78-1.68 mmol TE/100 ml, while in coffee drinks with the addition of lime juice ranged from 1.75-1.44 mmol TE/100 ml. Lemon has a higher antioxidant activity than lime, in line with previous research findings. The addition of sugar in coffee drinks also affects the antioxidant activity, where the more sugar added, the lower the antioxidant activity level (Permanasari & Aslam, 2021).

## E. Vitamin C

The results of the analysis showed that the vitamin C in coffee drinks ranged from 5.13-10.26 mg/100 ml. The interaction between the factors of lime or lemon addition at various compositions did not give statistically significant differences in vitamin C. The vitamin C content of RTD coffee drinks can be seen in Figure 6.

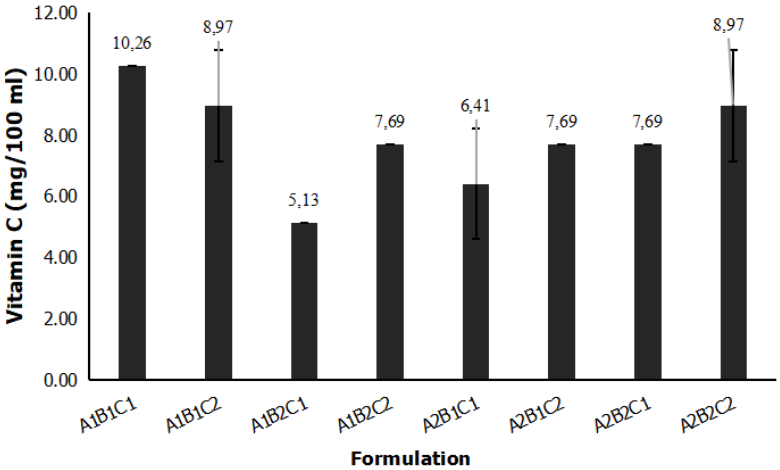


Figure 6. Vitamin C content of RTD coffee drinks

The study showed that the addition of lemon juice resulted in a higher vitamin C content than the addition of lime juice. In comparison to limes, lemons often produce a larger juice yield per 100 grams of fruit and have bigger juice vesicles. Because of its greater juice content, the edible part has more soluble vitamin C. Lemons contain more vitamin C due to otheir unique metabolic characteristics, greater juice yield, and biochemical pathways that promote the production and retention of ascorbic acid (Lee & Kader, 2000; USDA, 2023; Iqbal et al., 2004). In addition, there were differences in vitamin C content between treatments. Factors such as respiration, oxidation and storage processes can also affect vitamin C levels in beverages, including coffee drinks and citrus-based RTDs ((Lee, S. K., & Kader, A. A. ,2000); Davey, M. W., et al.,2000; Bates, R. P., Morris, J. R., & Crandall, P. G., 2001; Ekanayake, S., et al., 2004; Fennema, O. R.,1996).

**F. Sensory Characteristics**

A panel of thirty untrained individuals used a 5-point scale in a hedonic test to assess the acceptability of RTD decaffeinated coffee with citrus flavor. Under the sensory science literature's advice for early-stage product assessments (Lawless & Heymann, 2010; Stone et al., 2012; ISO 11136:2014), this sample size was determined to be sufficient for preliminary screening with a 95% confidence level. Panelists were asked to rate the color, aroma, taste, and aftertaste attributes on a Likert scale from strongly dislike to strongly like.

1) Color

Color is one of the important aspects in the physical assessment of a food product. As the main visual, color is often the main factor in consumer assessment of a food product (Arifin & Widia Putri, 2020). The total value of panelists' liking for the color of RTD coffee drinks can be seen in Figure 7.

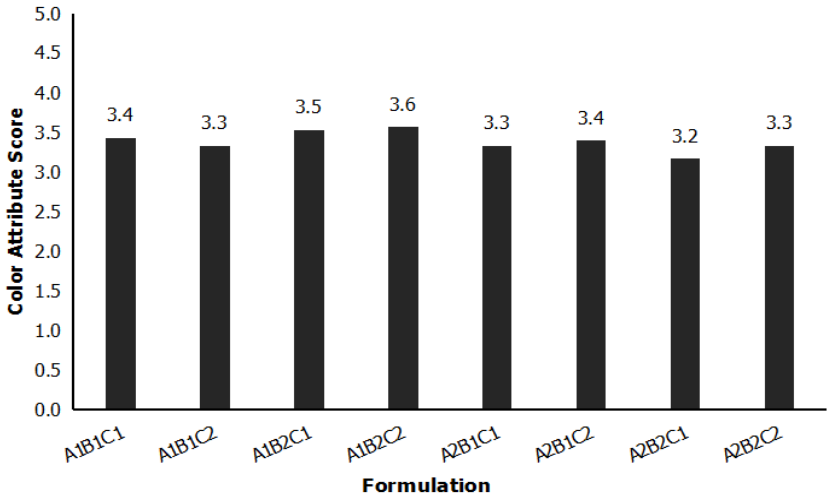


Figure 7. Color Attribute Score

The results showed that the color liking scores of RTD coffee drinks ranged from 3.2-3.6, with panelists showing a neutral reaction. Lemon juice received a slightly higher color rating (3.6-3.3) than lime juice (3.4-3.2). Citrus type had a significant effect on the color rating of the coffee drink, while citrus and sugar concentration had no significant effect. The use of larger amounts of lemon juice, especially 10 ml, tended to give better color ratings, as more lemon juice gave the beverage a more striking yellow color.

2) Aroma

The panelists gave RTD coffee beverage aroma favorability scores ranging from 3.4-2.9, indicating variation in scent ratings. The total value of panelists' liking for the aroma of RTD coffee drinks can be seen in Figure 8.

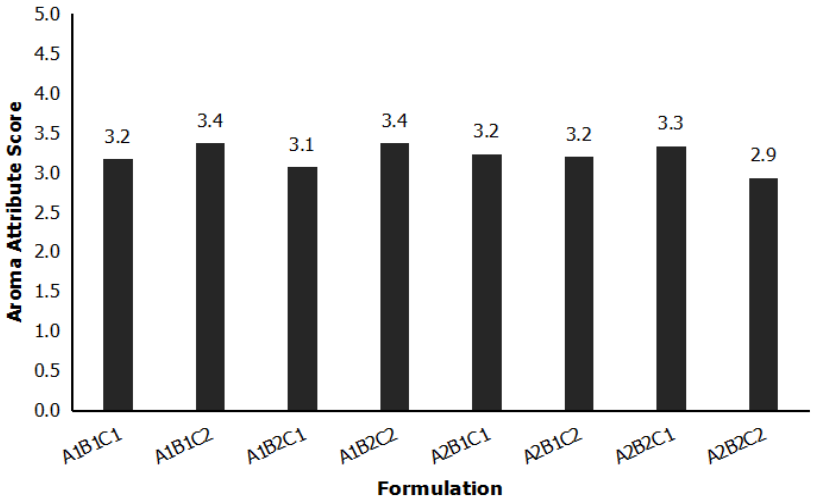


Figure 8. Aroma Attribute Score

The panelists rated the aroma of ready-to-drink coffee beverages with a favorability range between 3.4 (neutral) to 2.9 (dislike), with an average of 3.2 (neutral). The most preferred treatments were A1B1C2 and A1B2C2, with the addition of 5 ml and 10 ml of lemon juice. The least preferred treatment was A2B2C2, with the addition of 10 ml of lime juice, as the strong lime aroma eliminated the coffee scent. Previous studies have shown that the addition of lemon to other beverages can enhance distinctive aroma and reduce less desirable scents. (Oktavia et.al., 2017).

3) Taste

Panelists rated the taste of ready-to-drink coffee with a range of favorability scores between 3.4 and 2.2. The average panelists' liking of the RTD coffee beverage flavor is shown in Figure 9.

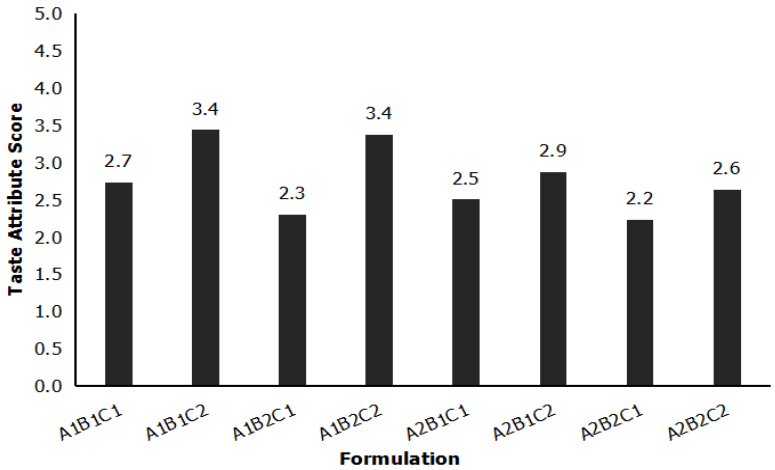


Figure 9. Taste Attribute Score

Treatments A1B1C2 and A1B2C2 scored the highest (3.4), indicating neutral. The addition of 25 ml of sugar, 5 ml of lemon in A1B1C2, and 10 ml of lemon in A1B2C2 made the coffee drink balanced with a strong touch of lemon. However, panelists liked the A1B2C1 and A2B2C1 treatments less due to the addition of less sugar (15 ml) and more citrus (5 ml lemon/lime). The panelists' preference was for lemon over lime in the coffee drink. The lemon provided a more favorable taste, and the addition of sugar helped to create a balance of taste with the sourness and bitterness of the product (Arpi et al., 2018). The addition of orange juice can also enhance the taste of coffee pulp juice drinks, melon juice, and hard candy (Daniela et al., 2022; Valentine et al., 2023; Muzaifa et al., 2022).

4) After Taste

The results of the chi-square test showed significant differences in favorability of aftertaste between treatments in RTD coffee drinks. The factors of lemon and lime addition, along with concentration of added sugar, significantly affected the aftertaste (Likumahua et.al., 2022). However, the concentration of citrus added did not significantly affect the aftertaste. The average panelists' liking of the aftertaste of RTD coffee drinks is shown in Figure 10.

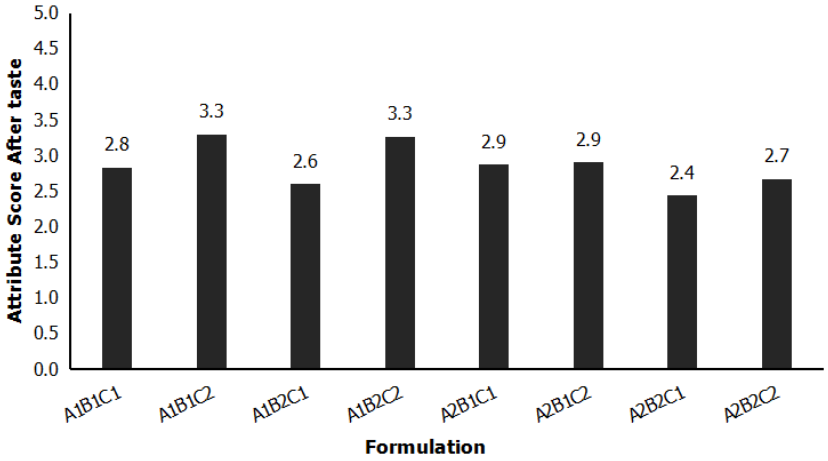


Figure 10. After Taste Attribute Score

The liking for the aftertaste of RTD coffee beverages ranged from neutral to dislike. The level of liking was influenced by the sugar concentration, as the more sugar was added, the higher the level of liking for the aftertaste.

### 3.1.1 Best Formulation of RTD Coffee Beverage

The first step was to determine the decision alternatives; The Decision Alternatives used were eight formulations or treatments that have been carried out. The second step was to prepare the decision criteria. This study used eight parameters: taste, aroma, color, aftertaste, caffeine, antioxidants, vitamin C, and pH. The third step was to determine the weight of importance of each decision criterion. The determination of the relative importance of each decision criterion were obtained from the results of the interviews with coffee experts (consisting of 5 people, namely coffee researchers, baristas, and trained panelists) are shown in Table 2.

Table 2.The weight of importance of each criterion

| No. | Criteria | Weight of important |
|---|---|---|
| 1 | Taste | 5 |
| 2 | Aroma | 5 |
| 3 | Color | 4 |
| 4 | After taste | 4 |
| 5 | Caffeine | 3 |
| 6 | Antioxidants | 3 |
| 7 | Vitamin C | 3 |
| 8 | pH | 3 |

The fourth step was to assess all alternatives on each criterion in the form of a total score for each alternative. The results of the research for all the parameters are shown in Table 3.

Table 3. Result of each parameter

| Alternative | Criteria | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Taste | Aroma | Color | After taste | Caffeine | Antioxidant | Vitamin C | pH |
| A1B1C1 | 2,73 | 3,17 | 3,43 | 2,83 | 0,74 | 1,78 | 10,26 | 3,24 |
| A1B1C2 | 3,30 | 3,37 | 3,53 | 3,30 | 0,70 | 1,68 | 8,97 | 3,18 |
| A1B2C1 | 2,60 | 3,07 | 3,10 | 2,60 | 0,58 | 1,74 | 5,13 | 2,92 |
| A1B2C2 | 3,27 | 3,37 | 3,57 | 3,27 | 0,33 | 1,70 | 7,69 | 2,92 |
| A2B1C1 | 2,87 | 3,23 | 3,33 | 2,87 | 0,63 | 1,75 | 6,41 | 3,24 |
| A2B1C2 | 2,90 | 3,20 | 3,40 | 2,90 | 0,60 | 1,67 | 7,69 | 3,27 |
| A2B2C1 | 2,43 | 3,33 | 3,17 | 2,43 | 0,43 | 1,65 | 7,69 | 2,96 |
| A2B2C2 | 2,67 | 2,93 | 3,33 | 2,67 | 0,64 | 1,44 | 8,97 | 2,96 |

From the table above, the formula with the best analysis results was given a ranking of 1, while the formula with the lowest analysis results was given a ranking of 3, with the criteria that the bigger the better for the parameters of taste, aroma, color, after taste, antioxidant activity, vitamin C and pH, while for the caffeine content parameter; the smaller the better. The fifth step was to calculate the Total Value (TN) of each alternative using equation (1). The example of calculation for each alternative was:

$$A1B1C1 = (2)^5 + (1)^5 + (1)^4 + (2)^4 + (2)^3 + (1)^3 + (1)^3 + (1)^3 = 61$$

$$A1B1C2 = (1)^5 + (1)^5 + (1)^4 + (1)^4 + (2)^3 + (2)^3 + (1)^3 + (1)^3 = 22$$

And the last step was to sort the Total Value (TN) that had been calculated. The greater the alternative Total Value (TN), the higher the priority order or the best formulation. The Exponential Comparison Method result was described in the following Table 4.

Table 4. The Exponential Comparison Method Result

| Alterna-tive | Criteria | | | | | | | | Decision Value | Rank |
|---|---|---|---|---|---|---|---|---|---|---|
| | Taste | Aroma | Color | After taste | Caffe-ine | Antioxi-dants | Vitamin C | pH | | |
| A1B1C1 | 2 | 1 | 1 | 2 | 2 | 1 | 1 | 1 | 61 | 3 |
| A1B1C2 | 1 | 1 | 1 | 1 | 2 | 2 | 1 | 1 | 22 | 1 |
| A1B2C1 | 2 | 1 | 1 | 2 | 1 | 1 | 3 | 2 | 95 | 6 |
| A1B2C2 | 1 | 1 | 1 | 1 | 1 | 1 | 2 | 2 | 38 | 2 |
| A2B1C1 | 2 | 1 | 1 | 2 | 2 | 1 | 3 | 1 | 87 | 5 |
| A2B1C2 | 2 | 1 | 1 | 2 | 2 | 2 | 2 | 1 | 75 | 4 |
| A2B2C1 | 3 | 1 | 1 | 3 | 1 | 2 | 2 | 2 | 351 | 8 |
| A2B2C2 | 2 | 2 | 1 | 2 | 2 | 3 | 1 | 2 | 125 | 7 |
| Weight of Import-ant | 5 | 5 | 4 | 4 | 3 | 3 | 3 | 3 | | |

The results of the exponential comparison method calculation showed that the selected treatment was A1B1C2, with the lowest total score of 22. This treatment gave an overall good decision criteria score, with no maximum score of 8. Thus, the A1B1C2 formulation, which used 5ml lemon juice and 25ml liquid sugar, is the best combination for RTD robusta decaf coffee drinks.

This selected formulation gave the best results in terms of physical, chemical, and sensory properties. The physical and chemical properties of the best formulation included caffeine 0.70 mg/100 ml; pH 3.18; antioxidant 1.68 mmol TE/100 ml; vitamin C 8.97 mg/100 ml; and color (*L) 78.75. Sensory testing showed good panelist liking scores on the parameters of color (3.53), aroma (3.37), taste (3.43), and aftertaste (3.30).

## 4. CONCLUSIONS

Based on the research conducted, it was found that the addition of lime and lemon juice to robusta decaf coffee affects the physical and chemical characteristics of caffeine levels, pH, and antioxidant activity. In the characteristics of vitamin C and lightness, the addition of citrus juice does not have a significant effect. Sensory characteristics of taste and aftertaste have a significant effect with the addition of citrus juice, while color and scent do not have a significant effect statistically.

Among the various formulations tested, the treatment A1B1C2 with the composition of 5 ml lemon juice and 25 ml sugar water provides the best formulation in terms of physical, chemical, and sensory properties. The physical and chemical content of the best formulation of RTD coffee is caffeine 0.70; pH 3.18; antioxidant 1.68; Vitamin C 8.97; and color (*L) 78.75. In sensory testing, the panelists' favorite scores were obtained in the parameters of color 3.53, aroma 3.37, taste 3.43, and aftertaste 3.30.

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## REFERENCES

Agustin, F., & W.D.R, P., 2014. Making of Jelly Drink Averrhoa Blimbi L. (Study About Belimbing Wuluh Proportion : The Water And Carrageenan Concentration). Jurnal Pangan Dan Agroindustri, 2(3), 1–9.

Aini, A. F., Saripah, S., Manfaati, R., & Hariyadi, T., 2021. Effect of Peeling and Fermentation Time on Caffeine Content, pH Value, and Ethanol Content of Fermented Arabica Coffee Beans. In Prosiding Industrial Research Workshop and National Seminar (Vol. 12, pp. 145-150).

Arifin, M. Z., & Widiaputri, S. I., 2020. Physicochemical Properties and Organoleptic Test of Yoghurt Ngeboon Panorama Indonesia. Edufortech, 5(1).

Arpi, N., Rasdiansyah, R., Widayat, H. P., & Foenna, R. F., 2018. Utilization Of Arabica Coffee (Coffea Arabica L.) Pulp Waste Into Coffee Pulp Juice With The Addition Of Lime (Citrus Aurantifolia) And Lemon (Citrus Limon) Juice. Jurnal Teknologi dan Industri Pertanian Indonesia, 10(2), 33-39.

Badan Standarisasi Nasional (BSN)., 2006. Organoleptic and/or sensory testing instructions (Petunjuk Pengujian Organoleptik dan atau sensori). Jakarta.

Bates, R. P., Morris, J. R., & Crandall, P. G., 2001. Principles and Practices of Small- and Medium-Scale Fruit Juice Processing. FAO Agricultural Services Bulletin 146 https://www.fao.org/3/y5022e/y5022e00.htm

Br Ginting, S. S., Astiarani, Y., Santi, B. T., & Vetinly, V., 2022. Level of Knowledge of the Effects of Caffeine Consumption and Caffeine Intake on Students. Journal of Nutrition College, 11(4), 264–271.

Budi, D., Mushollaeni, W., Yusianto, Y., & Rahmawati, A. 2020. Characterization Of Robusta Coffee (Coffea Canephora) From Tulungrejo Fermented With Saccharomyces Cerevisiae. Jurnal Agroindustri, 10(2), 129–138. https://doi.org/10.31186/j.agroindustri.10.2.129-138

Daniela, C., Sitohang, A., & Goretty, P. M., 2022. Pengaruh Penambahan Sari Buah Jeruk dan Sari Andaliman serta Konsentrasi Sukrosa terhadap Uji Organoleptik, Kadar Vitamin C, dan Kadar Air Permen (Hard candy). Jurnal Riset Teknologi Pangan Dan Hasil Pertanian (RETIPA), pp.44-50. https://doi.org/10.54367/retipa.v3i1.2244

Ekanayake, S., et al., 2004. Effects of storage on vitamin C content of ready-to-serve citrus-based beverages. Journal of Food Science and Technology, 41(3), 254–256.

Elfrida, M. P., & Sarjani, T. M. 2021. Level Of Resistance Of Infused Lemon Water With The Addition Of Cinnamon And Cloves Against Duration Of Immersion. Jurnal Jeumpa, 8(2), 577-590.

Fatin Najwa, R., & Azrina, A., 2017. Comparison of vitamin C content in citrus fruits by titration and high performance liquid chromatography (HPLC) methods.

Fennema, O. R., 1996.Food Chemistry (3rd ed.).Marcel Dekker, Inc

Geri, J. D., Ayu1a, D. F., & Harun, N., 2019. Combination of Carbonated Aloe Vera Drink with Lemon Juice. Jurnal Agroindustri Halal5(2): 132–140. https://doi.org/10.30997/jah.v5i2.1816

Kuswardhani, 2023. Engineering of Herbal Coffee Products "Decaf" as an Effort to Diversify Agro-Industrial Products in Jember Regency. Research Report. LP2M University of Jember (Unpublished).

Krispila, A., Kahanjak, D. N., & Mutiasari, D. 2022. Literature Review : The Effect of Coffee Consumption on Cholesterol Levels in Coffee Consumers. Jurnal Kedokteran Universitas Palangka Raya, 10 (2), 36–40. https://doi.org/10.37304/jkupr.v10i2.5522

Larasati, T., Ganda Putra, G., Suhendra Program Studi Magister Teknologi Pangan, L., & Teknologi Pertanian, F. 2023. The Effect of Coffee Powder to Water Ratio and Temperature on Cold Brew Method on The Characteristics of Arabica Coffee Drink. Media Ilmiah Teknologi Pangan (Scientific Journal of Food Technology, 10(1), 24–38.

Lawless, H. T., & Heymann, H. 2010. Sensory Evaluation of Food: Principles and Practices (2nd ed.). Springer.

Lee, S. K., & Kader, A. A. 2000. Preharvest and postharvest factors influencing vitamin C content of horticultural crops. Postharvest Biology and Technology, 20(3), 207–220.

Davey, M. W., et al. 2000. Plant L-ascorbic acid: chemistry, function, metabolism, bioavailability and effects of processing. Journal of the Science of Food and Agriculture, 80(7), 825–860. https://doi.org/10.1002/(SICI)1097-0010(20000515)80:7<825::AID-JSFA598>3.0.CO;2-6

Likumahua, M. H., Moniharapon, E., & Tuhumury, H. C. D. 2022. Effect of Sugar Concentration on Physical and Organoleptic Characteristics of Lime (Citrus aurantiifolia S.) Marmalade. J. Sains dan Teknologi Pangan (JSTP).

Muzaifa, M., Rohaya, S., & Sofyan, H. A., 2022. Physicochemical and Organoleptic Quality Characteristics of Coffee Skin Tea (Cascara) with the Addition of Lemon and Honey. Agrointek : Jurnal Teknologi Industri Pertanian, 16 (1), 10–17.

Nascimento, T. F., da Silva, G. M., de Lima, J. C. S., Dantas, M. D. M., & de Almeida, E. T. 2020. Citrus Flavonoids: An Overview of Sources, Biotechnological Applications, and Potential Health Benefits. International Journal of Molecular Sciences, 21(21), 8149.

Oktavia, Y., Budaraga, I. K., & Hermalena, L., 2017. Corens Fresh Quality Study Questions with The Use of Various Types of Orange. UNES Journal Mahasiswa Pertanian, 1(1), 009-020.

Permanasari, D., Sari, A. E., & Aslam, M., 2021. The Effect of Sugar Concentration with Antioxidant Level in Bir Pletok. AcTion: Aceh Nutrition Journal, 6(1), 9-14.

Rangkuti, A. H., 2011. Multi-Criteria Decision Making Techniques Using The BAYES, MPE, CPI and AHP Methods. ComTech: Computer, Mathematics and Engineering Applications, 2(1), 229-238.

Stone, H., Bleibaum, R. N., & Thomas, H. A., 2012. Sensory Evaluation Practices (4th ed.). Academic Press.

Valentin, G. F., Suhaidi, I., & Yusraini, E., 2018. The Effect of Red Ginger Juice Addition and Lime Juice on The Quality of Melon Juice Drinks. Jurnal Rekayasa Pangan dan Pert, 6(3), 426-433.