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The Effect of Manalagi Apple Peel Addition on the Quality of Celery Herbal Tea

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Abstract. Herbal tea is a refreshing drink made from dried leaves, flowers, seeds, fruit, wood, and other plants that have health benefits. The purpose of this study was to determine the ratio effect of celery with manalagi apple peel and drying time, to produce the best celery herbal tea. This study was designed using a factorial completely randomized design with 2 factors: the ratio of celery with apple peel [100:0; 75:25; 50:50; 25:75; 0:100] and drying time [2, 3, 4 hours] at 50 °C. The parameters analysed were moisture content, vitamin C content, total phenol, color, and organoleptic values (aroma, and general acceptance). The parameter observed for the best quality samples was antioxidant content. The results showed that the ratio of celery with manalagi apple peel had a highly significant effect on color °Hue, aroma, and general acceptance of organoleptic. The drying time of teas had a highly significant effect on vitamin C content. The interaction of the ratio had a significant effect on the color value (L) and a highly significant effect on total phenol. The results showed that the first and the second factors had a highly significant effect on moisture content, total phenol, and color value (L). The choice of drying method can influence the final quality of the tea, making it important to select the appropriate technique.

Keywords: apple peel, celery, drying, herbal tea

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1. Introduction

Tea is one of the refreshing drinks that has long been known and much consumed by the general public. The type of tea that is often consumed by the public is herbal tea. Herbal tea is a general term used for drinks that do not come from the tea plant (Camellia sinensis L.). Herbal teas are made from a combination of dried leaves, seeds, wood, fruit, flowers, and other plants that have health benefits. One of the plants that can be used as an ingredient in herbal teas is celery.

Celery is a plant that has potential as a natural antioxidant [1]. Celery also contains several metabolites in the form of anti-diabetic, increased fertility, anti-hypertension, anti-calculi, anti-fungal, anti-bacterial, relieves pain, and anti-inflammatory. Celery can provide a therapeutic effect because it contains bioactive phytochemicals [2]. Celery herbal tea has a tipical aroma and

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bland taste which is not liked so other ingredients are needed to upgrade the taste of celery herbal tea.

Herbal tea has been cherished for centuries as a source of comfort, relaxation, and natural wellness. Made from a variety of plant parts like leaves, flowers, roots, and seeds, herbal teas offer a diverse range of flavors and health benefits. However, to preserve the potency and longevity of these teas, the process of drying the herbal ingredients is essential. Drying herbal tea not only enhances its shelf life but also concentrates the flavours and active compounds, making it a beloved beverage worldwide [2].

In this study, manalagi apple peel variety was used as a combination to make the celery herbal tea. Manalagi apple peel is expected to improve the taste of celery herbal tea. The content of vitamin C in manalagi apple skin can reduce the bland taste of celery herbal tea. In addition, manalagi apple peel can improve the aroma of celery tea.

One of the stages in making herbal tea is the drying process. Drying is a traditional and effective method of preserving herbs and has been practiced for generations. The process involves removing moisture from the plant material to inhibit the growth of microorganisms and prevent spoilage. There are various drying techniques used, such as air drying, sun drying, oven drying, and freeze-drying. Each method has its advantages and can affect the final quality of the herbal tea [3].

Drying aims to reduce the water content in the material so as to extend the shelf life of the tea. Drying time can have an impact on the drying product. A drying process that is too long can reduce the antioxidant activity of the dried material. Antioxidant activity will decrease if the drying process is carried out too long. This is because the antioxidant compounds have been damaged by heating [3].

The purpose of this study was to determine the ratio of celery with manalagi apple peel and the proper drying time to produce the best herbal tea and to increase the utilization of local wisdom resources into products that are more varied and useful.

2. Materials and Methods

The materials used in this analysis were celery and manalagi apple peel. The tools used in this study were drying ovens, furnace ovens, scales, Erlenmeyer, beaker glass, dropper pipettes, test tubes, funnels, filter paper, autoclave, aluminum cups and others. This analysis used a Factorial Randomized Design (CRD) with two factors.

The first factor was comparison (P) of celery with manalagi apple peel P1 (100% : 0%) P2 (75% : 25%) P3 (50% : 50%) P4 (25% : 75%) and P5 (0% : 100 %). The second factor is the drying

time (T) T1 (2 hours) T2 (3 hours) T3 (4 hours). The first treatment has been done in the making of celery herbal teas is celery leaves with manalagi apple peel are withered for 14 hours. The third stage is mixing celery with manalagi apple peel that has been withered (P), and then dried at 50°C (T).

2.1. Moisture Content

The moisture content analysis has been done suitable with the procedure [4]. Take a 5 g of sample and take it in the aluminum cup which had been dried for 1 hour at 105 °C and the weight was known. Then the sample was dried at 55°C for 3 hours, cooled in a desiccator for 15 minutes, and then weighed again. After that, the material was reheated in the oven for 1 hour at 105 °C, then cooled again in a desiccator for 15 minutes, and then weighed. This treatment was repeated until a constant weight was obtained. The moisture content is calculated using the formula, namely.

$$\text{Moisture content (\%)} = \frac{\text{Initial sample weight (g)-Final sampel weight (g)}}{\text{Initial sample weight (g)}} \text{ x } 100\% \quad (1)$$

2.2. Vitamin C Content

Weighed of 100 mg the ascorbic acid, then be diluted with 2% oxalic acid as a solvent. The ascorbic acid solution was taken 40 µl, 80 µl, 100 µl, 120 µl, and 160 µl, into each 5 ml tera flask, up to obtained concentration of 0.008 mg/ml, 0.016 mg/ml, 0.020 mg/ml would be obtained, 0.024 mg/ml, and 0.032 mg/ml. Then 5 ml of 2% oxalic acid was added to each tera flask. The mixture was transferred into a test tube, then 10 ml of dye solution was quickly added. Then measured the absorbance with 518 nm wavelength using spectrophotometer. A blank solution was prepared by mixing 5 ml of oxalic acid and 10 ml of dye solution, then re-absorbed using 518 nm wavelength. The ascorbic acid curve is obtained from its absorbance value and concentration. Analysis of vitamin C content has done by weighing 10 g of tea into a 100 ml volumetric flask and adding 2% oxalic acid to tera. Then 5 ml was taken and transferred to a test tube, then 10 ml of dye solution was added and the absorbance was measured at a wavelength of 518 nm [5].

$$\text{Vitamin C content (mg/100g)} = \frac{\text{Ascorbic acid concentration (mg)x dilution factor x 100}}{\text{Sample weight (g)}} \quad (2)$$

2.3. Total Phenol

The total phenol of the samples was analyzed using the Follin-Ciocalteu method [6]. Weighed 2 g the sample and dissolved with 100 ml of 70% methanol, then macerated. Take 1 ml of solution into a 100 ml volumetric flask, then diluted with aquades until tera. Take 1 ml of the sample solution and put it in a test tube, then add 5 ml of 10% follin-ciocalteu and keep quiet for 3 to 8 minutes. Then 4 ml of 7.5% Na2CO3 solution was added and homogenized using a vortex for 2 minutes, then keep quiet for 50 minutes at room temperature. Read the absorbance value with 765 nm wavelength. Standard curves were prepared in the same way using gallic acid as standard. 0.110 g of gallic acid is diluted with aquades in a 100 ml volumetric flask. As much as 1 ml of

gallic acid into each test tube (a, b, c, d, e), then added with 5 ml of phenol follin-ciocalteu reagent and keep quiet for 3-8 minutes. Then added 4 ml of Na2CO3 solution, keep quiet for 50 minutes at room temperature, then measure the absorbance with 765 nm wavelength.

$$\text{Total Phenol } \left(\mu g \frac{\text{GAE}}{\text{g}}\right) = \text{Concentration x } \frac{\text{Volume}}{\text{Sample weight (g)}} \quad (3)$$

2.4. Color

Color analysis was done by taking the sample on a white paper or in white container. Then taked the sample using a camera. Look for color scores L, a, b samples by applying Photoshop CS6. The L score reflects (brightness with a value between 0 = black – 100 = white). A score (red to green with values 0 to +100 indicating red while 0 to -80 indicating green), and a score b (blue to yellow with results between 0 to +70 indicating blue, and 0 to -80 indicating yellow). If the results are obtained 18^o - 54^o (red), 54^o - 90^o (yellow red), 90^o - 126^o (yellow), 126^o - 162^o (yellow green), 162^o - 198^o (green), 198^o - 234^o (blue green), 234^o - 270^o (blue), 270^o - 306^o (blue purple), 306^o - 342^o (purple), and 342^o - 18^o (red purple). The results of the L*, a*, b* values obtained are then used to determine the °Hue value [7], applying the following formula:

$$°\text{Hue} = \tan \frac{\text{b}}{\text{a}} \quad (4)$$

2.5. Organoleptic

This analysis used the hedonic test for the sample. The panelists were 100 people and all of them were students from the Department of Food Technology, Faculty of Agriculture, Universitas Sumatera Utara. Analysis has been done on color, taste, aroma, and general acceptance of celery herbal tea combined with manalagi apple peel. Each sample was served in a small glass containing 10 ml of tea, then the panelists drank it immediately. Score values range from 1-7 as a reference. A score of 1 indicates a very disliked value, while a score of 7 indicates a very good value [8].

3. Results and Discussion

The ratio of celery with manalagi apple peel has a very significant effect on the moisture content, vitamin C, total phenol, color L, color °Hue, and organoleptic value of aroma and general acceptance (Table 1). In addition, the drying period affected the celery's herbal characteristics as presented in Table 2.

Table 1. Changes in the Physico-chemical Characteristics of the Celery Herbal Tea Before and After Manalagi Apple Peel Addition

Parameter	Celery: Manalagi apple peel				
	P_1	**P_2**	**P_3**	**P_4**	**P_5**
Moisture content (%)**	7.8674^{aA}	7.5694^{bB}	7.4575^{bB}	7.5314^{bB}	7.1333^{cC}
Vitamin C (mg/100g)**	5.1753	5.1747	5.1749	5.1751	5.1751
Total phenol (µg GAE/g)**	50.3208^{aA}	48.6180^{bB}	37.3894^{cC}	31.3322^{dD}	5.6516^{eE}
Color L**	54.7037^{cB}	56.1852^{cB}	61.0000^{bA}	61.9630^{abA}	63.6296^{aA}
Color (°Hue)**	74.7116^{cB}	74.8185^{bcB}	75.0074^{bcB}	77.0457^{aA}	76.0880^{abB}
Organoleptic value					
• Aroma**	5.1744^{dC}	4.1433^{dC}	4.6978^{cB}	5.2922^{bA}	5.7556^{aA}
• General acceptance**	5.0989^{cC}	5.3511^{bcBC}	5.9800^{aA}	5.7256^{abAB}	5.8811^{aAB}

Description: P_1 = 100%:0%, P2 = 75%:25%, P3 = 50%:50%, P4 = 25%:75%, P5 = 0%:100%. Different letter notations in the same row showed significant effect on level 5% (lowercase) and highly significant level 1% (uppercase) with 3 replications.

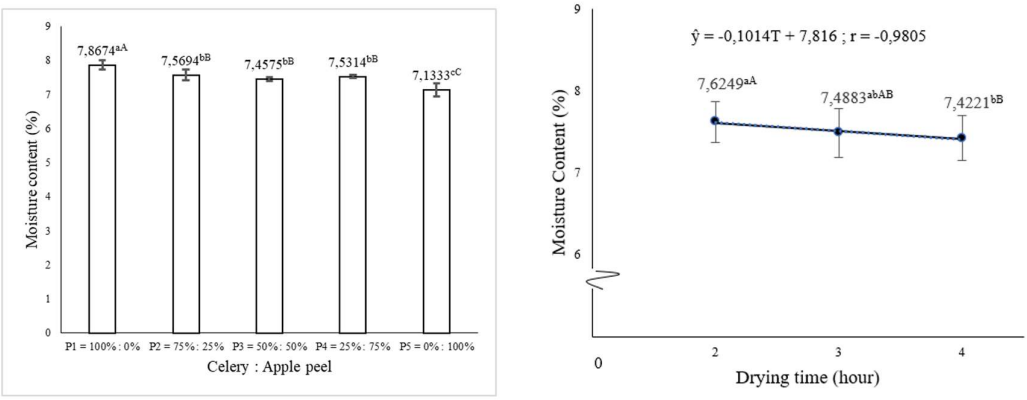
Table 2. Changes in the Physico-chemical Characteristics of the Celery Herbal

Parameter	Drying period (hours)		
	T1	T2	T3
Moisture (%)**	7.6249^{aA}	7.4883^{abAB}	7.4221^{bB}
Vitamin C (mg/100g)**	7.5271^{aA}	5.1753^{bB}	2.8227^{cC}
Total phenol (g GAE/g)**	38.6715^{aA}	34.0769^{bB}	31.2388^{cC}
Color L**	60.9778^{aA}	59.3111^{bAB}	58.2000^{bB}

Description: Different letter notations in the same row showed significant effect on level 5% (lowercase) and highly significant level 1% (uppercase) with 3 replications.

3.1. Moisture Content

The ratio of celery with manalagi peel (A) and drying time *B) had a highly significant effect ($P<0.01$) on the moisture content of the resulting celery herbal tea. The effect of LSR results can be seen in Figure 1A and figure 1B.



(A) (B)

Figure 1. Changes in Moisture Content of Celery Before and After the Addition of Manalagi Apple Peel (A) and at Different Drying Time (B). Error Bars Represent the Standard Error of Means of Three Replications. Letter Notations Showed Significant Level 5% (Lowercase) and Highly Significant Level 1% (Uppercase)

It can be seen from Figure 1A that the average value of the moisture content obtained was around 7%, it is still in accordance with the packaged quality requirements for dry tea, which is a maximum of 8%, so it is suitable for consumption [6]. Celery leaves have a high water content. [9] The highest content produced by celery leaves is water which is 93% based on the total weight of celery so that the more celery used, the moisture content obtained will be increase.

Figure 1B shows that the drying time results are done can decrease the moisture content. The longer drying time will make the celery herbal tea receive more heat, so that total evaporate the water will be higher and the moisture content obtained will decrease [10]. Drying time had a highly effect for shelf life. Improper drying time result make highly moisture content, it was can accelerate the material being damaged [11].

3.2. Vitamin C Content

Drying time had a highly significant effect (P<0.01) for vitamin C content of the resulting celery herbal tea. The effect of LSR results can be seen in Figure 2.

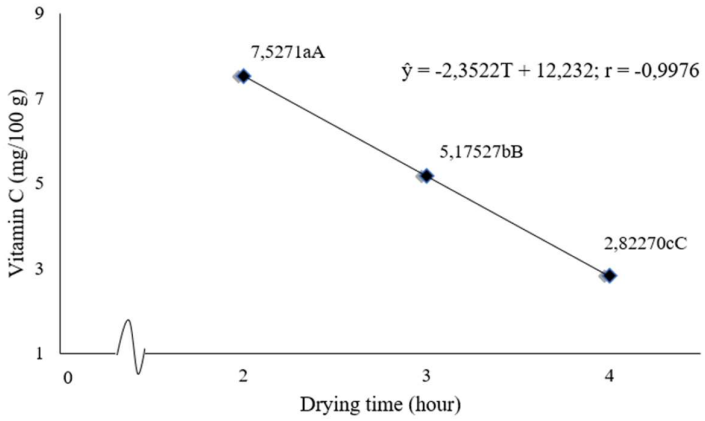


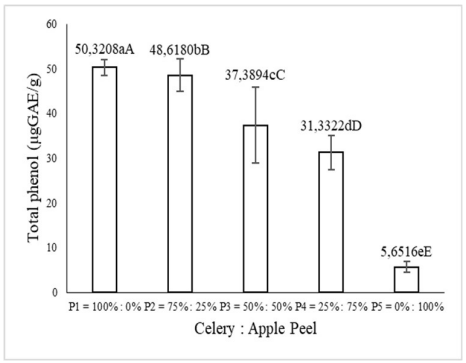
Figure 2. Changes in Vitamin C of celery at the Different Drying Time. Error Bars Represent Standard Error of Means of Three Replications. Letter Notations Showed Significant Level 5% (Lowercase) and Highly Significant Level 1% (Uppercase)

Figure 2 shows that the value of vitamin C has decreased along with the longer drying time. [12]. In addition with the drying period, the temperature results in a lot of vitamin C being oxidized into dycetogulonate compounds (DKG) and also causes water evaporation. As ascorbic acid is a water-soluble vitamin, the reduction of moisture content during drying leads to lower the vitamin.

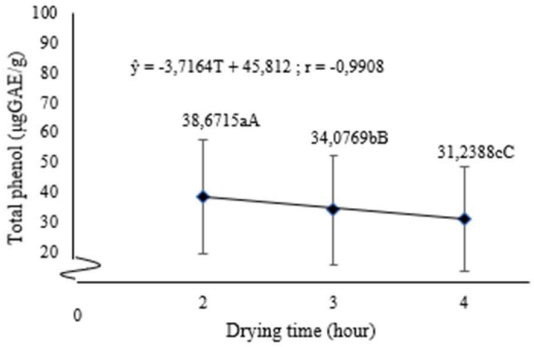
3.3. Total Phenol

The ratio of celery with manalagi apple peel (A) and drying time had (B) as well as the interaction between the two (C) had a highly significant effect (P<0.01) to total phenol of the resulting celery herbal tea. The effect of LSR results can be seen in Figure 3. Changes in total phenol of celery before and after the addition of manalagi apple peel (A), at different drying time (B) and the interaction of both treatments (C). Error bars represent standard error of means of three replicates.

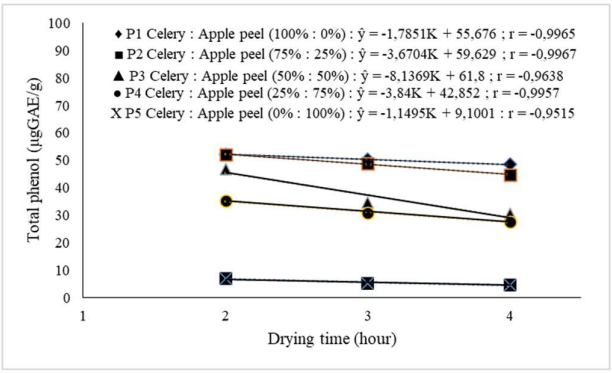
Letter notations showed significant level 5% (lowercase) and highly significant level 1% (uppercase).



(A)



(B)



(C)

Figure 3. Changes in Total Phenol of Celery and After the Addition of Manalagi Apple Peel (A) at Different Drying Time (B) and the Interaction of Both Treatments (C). Error Bars Represent Standard Error of Means of Three Replicates. Letter Notations Showed Significant Level 5% (Lowercase) and Highly Significant Level 1% (Uppercase)

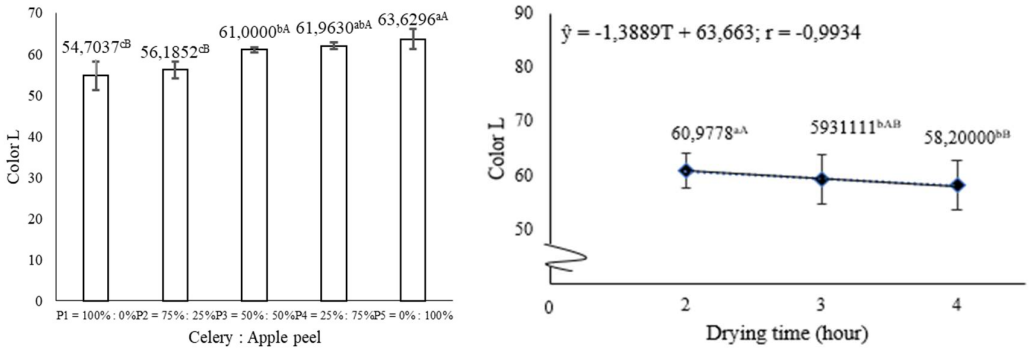
Figure 3A shows that the total phenol has decreased with the addition of more manalagi apple peels and the less celery. This is because the amount of additional celery is getting smaller [13]. The total phenol in fresh celery was higher, i.e 111.60 µg GAE/g extract, compared to that of the total phenol of manalagi apple peel, 8.86 µg GAE/g [14]. Higher amount of phenol in celery dominates the phenol in products, so that more added celery result in the increase in the phenol content.

Based on Figure 3B it can be seen that the total phenol has decreased due to the longer drying time. [15] The longer drying process is being done, the phenolic compounds can be damaged. The drying process make the phenolic compounds oxidationed caused heat treatment which can damage the phenolic compounds. [16] High temperatures and long drying times can result in high inactivation of polyphenol oxidase enzymes so that the enzyme activity becomes so low, and the phenol becomes damaged.

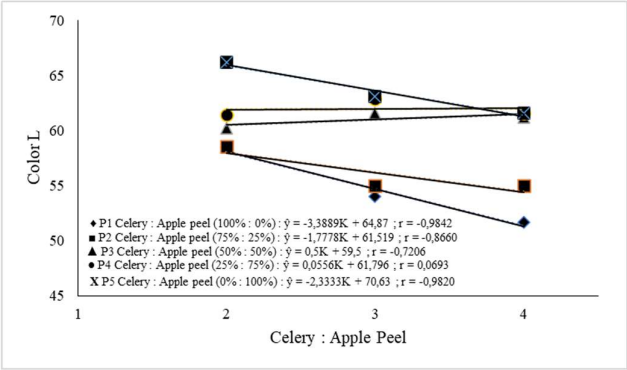
Figure 3C shows that there is an interaction between the ratio of celery and manalagi apple peel with drying time. The less celery and longer the drying time, make the total phenol will be lower. The total phenolic of celery is higher than apple peel. In addition, the heating process during drying process also affects the total phenolic, because phenolic compounds are easily oxidized with over heat. So if the drying time is longer, the total phenolic will be decreased [15].

3.4. Color L

The ratio of celery with manalagi apple peel (A) and drying time (B) had a highly significant effect (P<0.01) as well as the interaction between the two (C) had a significant effect (0,01>P>0,05) to color L of the resulting celery herbal tea. The effect of LSR results can be seen in Figure 4.



(A) (B)



(C)

Figure 4. Changes in color L of Celery Before and After the Addition of Manalagi Apple Peel (A), at Different Drying Time (B) and the Interaction of Both Treatments (C). Error Bars Represent Standard Error of Means of Three Replicates. Letter Notations Showed Significant Level 5% (Lowercase) and Highly Significant Level 1% (Uppercase)

The color L in the picture 4A has increased, which shows that the resulting color is getting brighter. The getting brighter color due to the less celery used. [17] Celery contains chlorophyll compounds. Oxidized chlorophyll will change color to brown. This is because chlorophyll is a compound that is not fixed and tends to be sensitive to light it so difficult maintaining a stable green color. Therefore, if you add more celery, you can get the maximum dark brown color.

Based on Figure 4B, the result shows that the color L decreases, indicating that the color L is getting darker. [3] The longer drying time will cause the various pigments contained in the material to undergo an oxidation process and the resulting pigments change to yellow and brownish yellow from previously green. Therefore, the resulting color L is lower due to the longer drying time so that the resulting color is darker.

Figure 4C show that there is an interaction between the ratio of celery and manalagi apple peel with drying time. The more apple peels added and faster the drying time, then higher the L value. [18] The L parameter indicates the brightness level, then higher the L value, the color will be bright and then smaller the L value, the color will be dark.

3.5. Color °Hue

The ratio of celery with manalagi apple peel (A) and drying time (B) had a highly significant effect ($P<0.01$), while drying time had no significant effect to color °Hue of the resulting celery herbal tea. The effect of LSR results can be seen in Figure 5.

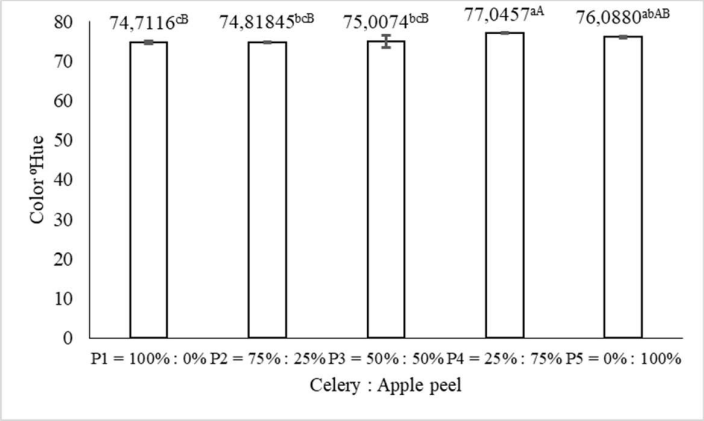
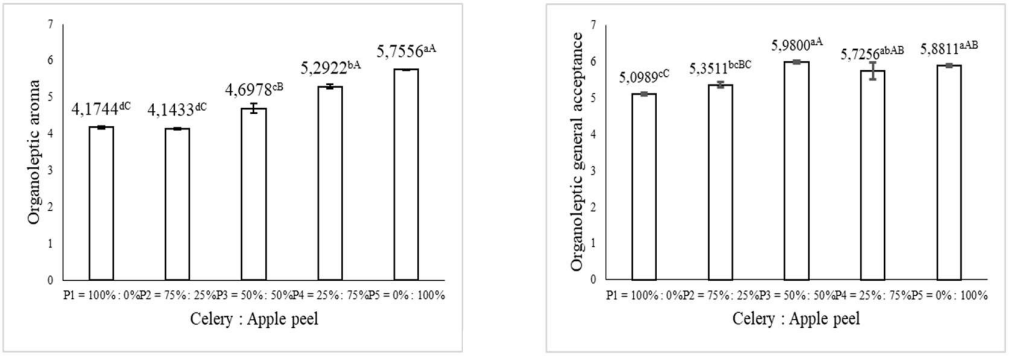


Figure 5. Changes in Color °Hue of Celery Before and After the Addition of Manalagi Apple Peel (A). Error Bars Represent Standard Error of Means of Three Replicates. Letter Notations Showed Significant Level 5% (Lowercase) and Highly Significant Level 1% (Uppercase)

Based on Figure 5, it shows that the celery herbal tea has a Yellow Red color °Hue value [7]. Celery herbal tea goes through the same process as green tea, so the brew color is yellow. Other than that tea is also has a color range of yellow red or reddish yellow, this may be caused by amount of chlorophyll being oxidized when heated. [19] The chlorophyll color decrease causes the green color brew decreased and then change from yellow by carotene.

3.6. Organoleptic Aroma and General Acceptance

The ratio of celery with manalagi apple peel had a highly significant effect ($P<0.01$) to organoleptic aroma (A) and general acceptance of the resulting celery herbal tea. The effect of LSR results can be seen in Figure 6A and Figure 6B.



(A) (B)

Figure 6. Changes in Organoleptic Aroma (A) and General Acceptance (B) of Celery Before and After the Addition of Manalagi Apple Peel (A). Error Bars Represent Standard Error of Means of Three Replicates. Letter Notations Showed Significant Level 5% (Lowercase) and Highly Significant Level 1% (Uppercase)

Figure 6A show that the highest hedonic value of aroma was produced in the P5 treatment, it is 100% apple skin. Apple peel has a refreshing aroma with a bit of acid that is many panelists like. The low hedonic value of aroma is due to the addition of celery. Celery produces a strong aromatic odor due to its high content of volatile compounds. [20] Aroma is closely related to the volatile content contained in a material, so that the many volatile elements result in a sharp and strong aroma.

The highest general acceptance value is in the P3 treatment can see on Figure 6B. [21] General acceptance is the final assessment that becomes the result through various scoring on the form of taste, aroma, and color. From the analysis, the average mean value of the panelists on celery herbal tea ranged from 5.0989 to 5.9800 with the criteria of rather liking. Overall, celery herbal tea was acceptable for panelists.

4. Conclusion

In conclusion, the process of drying herbal tea is a crucial step in preserving the natural goodness and efficacy of these delightful brews. The results showed that the ratio of celery with manalagi apple peel had a highly significant effect on moisture content, total phenol, color value (L), color °Hue, aroma, and general acceptance organoleptic. The drying time of teas had a highly significant effect on moisture content, vitamin C, total phenol and color value (L). The interaction of the ratio had a significant effect on the color value (L) and highly significant effect on total phenol.

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