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EFFECT OF BREWING TEMPERATURE AND TIME ON VITAMIN C CONTENT AND ANTIOXIDANT ACTIVITY OF EDIBLE FLOWER INFUSES

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ABSTRACT

Dried chrysanthemum, jasmine and butterfly pea are raw materials for dip infused with antioxidant and vitamin C content. This study aimed to determine the effect of temperature and infusion time on vitamin C content and antioxidant activity. A two-factorial design was used with the first factor being the infusion temperature of 30, 50 and 70 °C. The second factor was infusion time of 1, 3 and 5 minute. Vitamin C content was determined by UV spectrophotometric method (*Thermo Scientific Genesys* 10 S UV), antioxidant activity by DPPH method, and moisture content by moisture analyzer. The optimum results of vitamin C content of dry samples at 30 °C brewing temperature for 3 minutes and 70 °C brewing temperature for 5 minutes was 0.29%. The vitamin C content of the wet flower control at 70 °C for 5 minutes was 0.53%. The optimum antioxidant activity of the dry sample at 50 °C brewing temperature for 3 minutes was 34.61% and that of the fresh flower control at 70 °C brewing temperature for 5 minutes was 94.14%. The moisture content of dried Chrysanthemum was 7.30%, dried Jasmine was 6.25% and dried butterfly pea was 7.24%.

Keywords: Antioxidant, *Edible flower*, Temperature, Time, Vitamin C

INTRODUCTION

The consumption of *edible flowers* is a cultural legacy that has persisted globally for some time. It has become a popular trend due to increasing awareness of its benefits (Demasi *et al.,* 2021). Edible flowers have been used in Asian, European, Indian, and Middle Eastern cuisine, often in association with local traditions, parties, banquets, natural remedies, and as decorative accompaniments to food offerings (Rop *et al.,* 2012). *Edible flowers* comprise a variety of species that can be consumed, adding a distinctive aroma and unique flavour, with no toxic effects. *Edible flowers* are rich in bioactive compounds like phenolics and flavonoids, which serve as antioxidants (Kushargina *et al.,* 2022). Utilizing edible flowers as raw materials for producing food products has enormous potential for diversifying food and presents exciting possibilities for developing functional foods, such as dip *infused* products (Gostin & Waisundara, 2019).

The *edible flowers*' vitamin C and antioxidant content has the ability to prevent disease-causing free radicals in the body. Free radical compounds are molecules or ions with unpaired electrons that result from intricate chemical processes in the body. Antioxidants can put off or stop oxidation damage. The way antioxidant compounds tackle free radical attacks works by lowering and capturing free radicals, as well as chelating metals (Wang *et al.,* 2021).

The raw materials used in the research were 3 types of flowers, namely purple chrysanthemum flowers, jasmine flowers and butterfly pea flowers, which have the advantage of antioxidant compounds and vitamin C that can provide health benefits. Purple chrysanthemum (*Chrysanthemum indicum L*.) is used because it contains vitamin C and flavonoid antioxidants such as quercitrin and myricetin, has a very strong aroma, and raw

materials are readily available (Wang *et al.,* 2021; Ye & Deng, 2009). Jasmine flowers (*Jasminum sambac L*.) are used as an ingredient that can provide a distinctive aroma derived from z-jasmone, indol, neurolidol, linalool, indol and benzyl benzoate compounds, and has antioxidants in the form of flavonoids, phenols and essential oils (Kunhachan et al., 2012). Butterfly pea flower (*Clitoria ternatea*) has a high content of antioxidants in the form of flavones and flavonols as well as vitamin C. The availability of edible flowers (chrysanthemum) is very high. The availability of edible flowers (purple chrysanthemum, jasmine and butterfly pea flower) is quite a lot so it is easy to find in the market (Marpaung, 2020) Edible flowers chrysanthemum, jasmine and butterfly pea contain antioxidant compounds and vitamin C which are quite high, this has been proven by several studies. Bioactive compounds in chrysanthemum flowers in the form of essential oils have the potential to be significant antioxidants with an IC50 value of 2.21 ppm in the DPPH test (Youssef et al., 2020). Jasmine flowers are a source of natural antioxidants that can help fight free radicals in the body with their phenolic and flavonoid content (Budhiniar & Janeva, 2016). Butterfly pea flowers (*Clitoria ternatea L*.) are very potent antioxidants with an IC50 value of 70.93 ppm. The antioxidants in butterfly pea flowers include phenols and flavonoids (flavonols and flavones) and contain vitamin C 4.74 ppm (Apriani & Pratiwi, 2021).

In general, *infused* water entails fresh fruit soaked in water. The term "*infused*" refers to the process of inserting the fruit into the water. *Infused* water is free from artificial additives such as sugar and colouring, making it a natural drink. The body can reap benefits from consuming infused water as it is rich in antioxidant bioactive compounds and vitamin C (Harifah *et al.,* 2016).

The drying process employed to preserve the bioactive compounds has a temperature range of 30-60 °C. Any drying temperatures beyond 60 °C might harm antioxidants and vitamin C present in dried flowers, making it a disadvantage of edible flower infused dipping products. The drawback of these products is that two heating processes are needed, drying and steeping. Product exposure to temperatures exceeding 60 °C might quickly diminish the product's antioxidant and vitamin C content. The weakness can be addressed by implementing temperatures below 60 °C during the steeping and drying process. Furthermore, products infused with edible flowers offer the convenience of being prepared in a format akin to tea bags.

The drying process must be performed to attain the moisture content of dry tea in compliance with the SNI, which is ≤ 8%, as *edible flower infused* dipping products resemble dry tea bags (Badan Standarisasi Nasional, 2013). The bioactive compound content in the material may be influenced by the temperature and duration of the drying and steeping of the edible flower. The antioxidant activity and vitamin C levels of edible flowers are impacted by their drying and steeping time, potentially resulting in a decrease in the concentration of flavonoids and phenolic compounds. Furthermore, the antioxidant and vitamin C activity is affected by the temperature used during drying and steeping; higher temperatures result in lower antioxidant and vitamin C activity levels (Kushargina *et al.,* 2022).

In this study, we developed dry *infused* dips made from the basic ingredients of chrysanthemums, butterfly pea flowers, and jasmine flowers, which are typically consumed directly. The dips were first formulated as wet products and then redeveloped into dry products. Infused dips have been invented to provide practicality, particularly in terms of product longevity, whilst also offering added value as a health drink that can help combat free radicals due to its antioxidant content and vitamin C. Therefore, this investigation analyses the impact of temperature and brewing duration on the functional properties associated with antioxidant and vitamin C levels in the *edible flower infused* dip product following the heating, dehydration, and brewing stages.

MATERIALS AND METHODS

The study focuses on chrysanthemums, jasmine flowers, and butterfly pea flowers, which were obtained from a single flower seller at Kalisari Flower Market in Semarang City to ensure uniformity in size and freshness. Samples of each flower type, in a ratio of 1:1:1, were placed in small bags with a net weight of 9 grams per bag.

Materials

Ethanol (Merck), distilled water, ascorbic acid (Merck), 2,2-diphenyl-1-picrylhydrazyl (DPPH) (Aldrich), purple chrysanthemum flowers, jasmine flowers, and butterfly pea flowers.

Tools

Knife, cutting board, basin, digital scale (Sojikyo), plastic wrap, spoon, label, *vacuum dryer*, tea bags, sonicator, spectrophotometer (*Thermo Scientific Genesys* 10 S UV), centrifuge (Hettich 0085770), spinball, measuring cup (Pyrex), volumetric flask (Pyrex), yellow tip, micropipette (DragonLab).

Research Design

The research design is descriptive and quantitative using experimental methods and a completely randomized design (CRD) design with two factors. Factor 1 is the variation in the use of brewing temperature and factor 2 is the variation in brewing time, each treatment with three repetitions. The research design uses different brewing temperatures and times. The temperature and time used are low temperature to maintain the content of bioactive compounds in it.

Research Stages

Drying of *Edible Flower Infused* Dip Samples, Moisture Content Test, Antioxidant Activity Test, Vitamin C Test.

Methods

Drying of *Edible Flower Infused* Samples with *Vacuum Dryer*, Moisture Content Test with *Moisture Analyzer*, Antioxidant Activity Test with DPPH method, Vitamin C Test with UV Spectrophotometric method.

Analysis Procedure

Moisture Content Test

The Ohaus MB45 *Moisture Analyzer* was used to conduct the moisture content test. Three grams of the sample were placed on the *moisture analyzer* pan, which had been cleaned and tared to zero, and then the measurement was automatically carried out for approximately 15 minutes. The tool displayed the results of the moisture content measurement in units of % MC (Moisture Content) on the screen (Tubagus *et al.,* 2021).

Antioxidant Activity Test

a. Sample Preparation

Sample solutions were created by brewing 9 g of moist sample and 9 g of dried sample in 100 ml of water per treatment. One millilitre of filtered *infusion* was extracted, to which 9 ml of ethanol was added, homogenized and macerated for 1 hour. Filtrate and methanol were sonicated for 280 seconds and centrifuged at 4,000 rpm at room temperature for 15 minutes to form the supernatant.

b. Determination of Antioxidant Activity

Take 3 ml of the infused dip filtrate and transfer it to a clean cuvette. Then, add 1 ml of the 50 ppm stock solution of 2,2-diphenyl-1-picrylhydrazyl (DPPH) and homogenize the mixture. Measure the initial OD (Optical Density or Absorbance Value) of the mixture at a wavelength of 516 nm. Incubate the mixture for 30 minutes at 37 °C and measure the absorbance using a spectrophotometer at 516 nm wavelength (Nuramanah *et al.,* 2013) (Puspita *et al.,* 2020). Prepare a blank by substituting the sample with 4 ml of ethanol. Calculate the percentage of DPPH decay using the formula:

$$\%\text{Inhibition} = 1 - \frac{At30}{At0} \times 100\%$$

Notes: At30 is the absorbance of the sample at the 30 minutes, At0 is the absorbance of the control. The IC50 value is calculated when the % inhibition is 50% (Apriyantono *et al.,* 1989).

Vitamin C Test

Sample testing is based on the method of determining vitamin C content by spectrophotometry. Sample solutions were made by brewing each treatment as much as 9 g of wet sample and 9 g of dry sample in 100 ml of water. The samples were filtered and centrifuged at 40,000 rpm for 15 minutes to facilitate the reading of the filtrate. Inserted a blank solution in the form of distilled water and a sample of 4 ml in a cuvette and then measured the absorbance of the sample with a spectrophotometer at a wavelength of 265 nm. The absorbance of the blank and sample was recorded on the spectrophotometer monitor.

RESULTS AND DISCUSSION

Infused edible flower dips were processed through the drying stage using a *vacuum dryer* at 50 °C for 4 hours. The drying temperature and time are in line with research (Ayu Martini *et al.,* 2020) to dry bay flowers and research (Yulianti *et al.,* 2019) to dry chrysanthemums and jasmine flowers. The drying temperature and time in the two studies above produced dried flowers with the same moisture content of ≤ 8%. The drying process is carried out to obtain dried flowers with a moisture content of ≤ 8% so that they meet the terms and conditions of dried tea samples based on the Indonesian National Standard (Badan Standarisasi Nasional, 2013). The technique of reducing moisture content is carried out to inhibit the growth of microorganisms and reduce the activity of enzymes that cause flower damage and can extend shelf life and preservation (Lagawa *et al.,* 2019).

A B

Figure 1. Fresh Flowers (A) dan Dried flower (B) dried at 50℃ for 4 hours

Tabel 1. Kadar Air (%) Control dan Sample

No	Flower Name	Weight (g)		Moisture Content (%)
		Before	After	
		Wet Flowers (Control)		
1.	Chrysanthemum	3.001	0.354	88.12 ± 0.08
2.	Butterfly pea	3.002	0.386	87.07 ± 0.03
3.	Jasmine	3.001	0.387	87.12 ± 0.03
		Dried Flowers (Sample)		
1.	Chrysanthemum	26.85	3.16	7.40 ± 0.10
2.	Butterfly pea	15.2	1.89	7.25 ± 0.02
3.	Jasmine	60.12	7.99	6.30 ± 0.05

The moisture content of fresh chrysanthemum, jasmine, and butterfly pea flowers was 88.12±0.08%, 87.07±0.03%, and 87.12±0.03%, respectively. The drying process with a vacuum dryer produces a moisture content of dried chrysanthemum flowers as much as 7.40 ± 0.10%. This result is smaller than the research of (Yulianti *et al.,* 2019) with a chrysanthemum flower moisture content of 8.07%. The moisture content of dried jasmine flowers produced was 6.30 ± 0.05%. The water content of butterfly pea flowers is 7.25±0.02%. This value is smaller than the research of (Ayu Martini *et al.,* 2020) with a water content of 10.18%. The decrease in water content is in line with Kencana, (2016) research which states that the longer the drying time, the heat received by the flowers will be longer so that the amount of water evaporated in the sample is greater, and the water content drops to low. The higher the temperature and the longer the drying time, the smaller the moisture content of the flowers. The higher the drying temperature, the greater the heat energy carried by the air so the greater the amount of liquid mass evaporated from the surface of the dried flowers (Kencana, 2016).

The analysis of variance results indicates that there was no significant difference at a 95% confidence level ($P<0.05$) in the effect of brewing temperature and time on the antioxidant inhibition power of infused edible flower dip Tables 2 and 3. No difference was observed between brewing temperature and the percentage of antioxidant inhibition or activity and between brewing time and % antioxidant inhibition or activity.

Chrysanthemum flowers (*Chrysanthemum indicum L*.) contain various bioactive compounds, such as flavonoids, saponins, steroids, tannins, terpenoids, and alkaloids. According to Yulianti *et al.,* (2019), chrysanthemum flowers dried at 50 °C showed antioxidant activity in the DPPH method with an IC50 value of 137.99 ppm. Similarly, purple chrysanthemum flowers exhibited moderate antioxidant activity when tested using the DPPH method. Furthermore, when dissolved in 100 °C water, purple chrysanthemum flower tea demonstrated high antioxidant activity.

Jasmine (*Jasminum sambac L*.) is one of the plants that potentially has antioxidant activity. The parts of the jasmine plant that have the potential to have antioxidant activity are the flowers and leaves. Jasmine flowers extracted using ethanol have an IC50 value of 94.13 ± 10.54 µg/ml (Budhiniar & Janeva, 2016; Khidzir *et al.,* 2015).

Telang flowers (*Clitoria ternatea L*.) are source of anthocyanins and flavonoids. According to de Morais *et al.* (2020), telang flowers contain phenolic acids, flavanols, anthocyanins, flavonols, and flavanones. (Iamsaard *et al.,* 2014) report that telang flower extract has an IC50 value of 84.15 ± 1.50 µg/ml.

The antioxidant inhibition power test was conducted on fresh and dried flower samples. Results showed a brewing temperature of 50 °C for 3 minutes gave the strongest antioxidant inhibition power value of 34.61±0.91% for the dried flowers. For the fresh flower control, the best antioxidant inhibition power value of 94.14±0.20% was observed at a brewing temperature of 70 °C for 5 minutes. The study findings indicated that the antioxidant inhibition capacity of the fresh flower sample, used as control, was superior to that of the dried ones. The fresh flower control demonstrated an antioxidant activity range (expressed in % antioxidant

inhibition) of 67.70-94.14 %, while the dried flower samples exhibited activity levels of 23.81-34.61%.

Antioxidant Inhibition Power of Edible Flower Infused Dip

The average antioxidant inhibition power (%) of infused edible flower dips at different brewing temperatures and times can be seen in Table 2.

Table 2. Antioxidant Inhibition Result (%)

Inhibisi Antioksidan (%)					
Temperature	**Time**	**Code**	**Control**	**Code**	**Sample**
30 °C	1 Minute	K001	75.98 ± 0.41	S1W1	23.81 ± 0.62
	3 Minutes	K002	67.70 ± 0.10	S1W2	34.24 ± 0.90
	5 Minutes	K003	74.51 ± 0.37	S1W3	34.48 ± 0.90
50 °C	1 Minute	K004	84.96 ± 0.21	S2W1	31.87 ± 0.83
	3 Minutes	K005	82.49 ± 0.33	S2W2	34.61 ± 0.91
	5 Minutes	K006	84.87 ± 0.20	S2W3	32.84 ± 0.86
70 °C	1 Minute	K007	90.89 ± 0.10	S3W1	34.13 ± 0.89
	3 Minutes	K008	91.00 ± 0.34	S3W2	31.79 ± 0.83
	5 Minutes	K009	94.14 ± 0.20	S3W3	31.61 ± 0.83

Temperature 30 °C

The dry samples exhibited the highest antioxidant inhibition power when brewed at 30 °C for 5 minutes, with a resulting value of 34.48±0.90%. In comparison, the control had a value of 74.51±0.37%. This value was the highest when compared to brewing times of 1 and 3 minutes. Brewing at 30 °C for 1 minute resulted in a control of 75.98±0.41% and a sample of 23.81±0.62%. Brewing the samples at a temperature of 30 °C for 3 minutes yielded control results of 67.70±0.10% and samples of 34.24±0.90%. After brewing the fresh samples at 30 °C for 1, 3, and 5 minutes, the antioxidant activity decreased by 0.50-0.69%. Using a brewing temperature of 30 °C is less efficient in extracting antioxidant compounds. Technical abbreviations should be explained when first used. The dried flower samples were not optimally extracted, resulting in low levels of antioxidant inhibition. The limited steeping time used resulted in a low antioxidant activity in the edible flower infuses sample, as the compounds present not fully dissolved (Rondang Tambun *et al.,* 2017).

Temperature 50 °C

The highest antioxidant inhibition power of the dried sample obtained when brewed for 3 minutes at 50 °C, namely 34.61±0.91%, compared to brewing times of 1 minute and 5 minutes. The antioxidant inhibition power of the dried sample brewed for 1 minute at 50 °C was 31.87±0.83%, with a control of 84.96±0.21%. The result was 32.84±0.86% with a control of 84.87±0.20% for the dried sample brewed for 5 minutes at 50 °C. Tea brewed for insufficient time is less effective as the solubility of tea compounds has not reached optimal conditions (Nindyasari & Prangdimurti, 2012). Nevertheless, the outcomes of this study varied from those of Nindyasari & Prangdimurti (2012), as the optimal brewing time was found to be 3 minutes at 50 °C. Thus, it concluded that the brewing temperature of 50 °C for 3 minutes is sufficient to extract the compound content of the i*nfused edible flower* dip, which possesses antioxidant properties, as determined by this study.

Temperature 70 °C

The antioxidant inhibition power of the dry sample with a brewing temperature of 70 °C for 1 minute gave the highest result of 34.13±0.89%. The antioxidant inhibitory power at brewing time of 3 minutes and 5 minutes was lower at 31.79±0.83% and 31.61±0.83%. The antioxidant inhibition power of the control with 70 °C brewing temperature for 1 minute, 3 minutes, and 5 minutes were 90.89±0.10%, 91.00±0.34%, and 94.14±0.20%, respectively.

(Huri, 2016) stated that the higher the temperature and the longer the brewing time will increase the antioxidant activity in tea. However, the results of this study differ from the research of (Huri, 2016), namely the higher the temperature and the longer the brewing time, the lower the antioxidant activity. Antioxidant activity increases as the total bioactive component of flavonoids increases. Flavonoids are bioactive compounds that act as antioxidants (D *et al.,* 2014) and are supported by the research of Ibrahim et al., (2015) which states that the high total flavonoids and total phenols in infused dipped edible flowers show high antioxidant activity. High levels of phenols will increase antioxidant activity in dip infused edible flower (Septianingrum *et al.,* 2016). Antioxidant activity in tea extract is influenced by total phenol and flavonoid levels. Antioxidant activity will increase with increasing levels of total phenols and flavonoids (Handayani *et al.,* 2016).

Data on the percentage inhibition value at 70 °C compared to 50 °C during the brewing time of 1, 3, and 5 minutes showed reduced antioxidant activity at the higher temperature. Nevertheless, the variation in activity level was not statistically significant, decreasing only by 0.58-0.66%.

Vitamin C Content of Infused *Edible Flower* Dip

The average vitamin C content of infused edible flower dips in temperature and steeping time treatments can be seen in Table 3.

Table 3. Vitamin C Content Result (%)

Vitamin C (%)					
Temperature	**Time**	**Code**	**Control**	**Code**	**Sample**
30 °C	1 Minute	K001	0.28 ± 0.03	S1W1	0.23 ± 0.03
	3 Minutes	K002	0.44 ± 0.04	S1W2	0.29 ± 0.01
	5 Minutes	K003	0.41 ± 0.02	S1W3	0.28 ± 0.02
50 °C	1 Minute	K004	0.49 ± 0.04	S2W1	0.21 ± 0.02
	3 Minutes	K005	0.38 ± 0.01	S2W2	0.27 ± 0.04
	5 Minutes	K006	0.46 ± 0.02	S2W3	0.27 ± 0.00
70 °C	1 Minute	K007	0.36 ± 0.02	S3W1	0.26 ± 0.02
	3 Minutes	K008	0.46 ± 0.01	S3W2	0.28 ± 0.00
	5 Minutes	K009	0.53 ± 0.02	S3W3	0.29 ± 0.01

The analysis of variance demonstrated no significant difference in the effect of temperature and brewing time on the vitamin C levels of the dip infused edible flower with a 95% confidence level ($P<0.05$). Specifically, the results indicated that there was no difference between brewing temperature and vitamin C content, as well as between brewing time and vitamin C content. According to food composition figures from the Ministry of Health in Indonesia in 2018, 100 g of dried jasmine flowers contain 85 mg of vitamin C. The Telang flower (*Clitoria ternatea L.*), on the other hand, has a vitamin C content of 4.74 ppm (Dianatasya, 2020). A study by (Iamsaard *et al.,* 2014) found that vitamin C has an IC50 value of 5.34±0.09 µg/ml.

The results of the vitamin C test with fresh flower samples as control and dried flowers as dry samples gave the best vitamin C levels at a brewing temperature of 30 °C for 3 minutes and 70 °C for 5 minutes with a value of 0.29±0.01% and 0.29±0.01%. The fresh flower control gave the best vitamin C content at a brewing temperature of 70 °C for 5 minutes with a value of 0.53±0.02%. The results show that the vitamin C content of the fresh flower sample as a control is higher than the dried flower sample. This may occur because the dried flowers have undergone 2 heating processes, namely drying and brewing, thus affecting the vitamin C content in the sample. The structure of vitamin C can be damaged by heat exposure for a relatively long time (Rosida & RA, 2013). Vitamin C levels in the fresh flower control had values

between 0.28-0.53% and vitamin C levels in the dried flower sample had values between 0.21-0.29%.

Temperature 30 °C

The analysis undertaken on samples of brewing tea at 30 °C for 3 minutes revealed a Vitamin C content of 0.29±0.01%. Comparing this result to brewing time of 1 minute and 5 minutes shows the highest level at 3 minutes brewing time. Nevertheless, statistical analysis indicates no significant variance in Vitamin C content at 30 °C under different brewing times. All treatments (1, 3, and 5 minutes brewing) showed lower Vitamin C values compared to the Vitamin C control. Dried flower test samples exemplified relatively low content of Vitamin C.

Vitamin C of the control with a brewing temperature of 30 °C for 1 minute was 0.28±0.03%. The lowest value of vitamin C content in dried flower samples with 30 °C brewing for 1 minute was 0.23±0.03%. The low level of vitamin C at a brewing temperature of 30 °C for 1 minute is in line with research (Wassalwa, 2016) which states that the temperature and brewing time greatly affect the process of dissolving vitamin C contained in dried flower samples to dissolve in water. The brewing temperature of 30 °C for 5 minutes obtained a control result of 0.41±0.02% and a sample of 0.28±0.02%.

Temperature 50 °C

Brewing using 50 °C for 3 minutes and 5 minutes gave vitamin C content of 0.27±0.04% and 0.27±0.00%, respectively. Vitamin C content obtained from brewing at 50 °C for 1 minute is the lowest value of 0.21±0.02%. The lowest vitamin C value can occur because the increase in brewing temperature can damage the structure of vitamin C and the relatively short brewing time causes vitamin C not to dissolve optimally. This is in line with the research of Rosida & RA, (2013) that vitamin C is easily oxidized with oxygen and the oxidation process can be accelerated by high temperatures, but hot conditions for a relatively long time can damage the structure of vitamin C. Vitamin C content do not have a significant difference, the control with a temperature of 50 °C for 1 minute, 3 minute, and 5 minute is 0.49±0.04%, 0.38±0.01%, and 0.46±0.02%, respectively.

Temperature 70 °C

The vitamin C content produced by brewing at a temperature of 70 °C for 5 minutes was the highest, measuring at 0.29±0.01%, compared to brewing for 1 minute and 3 minutes. Vitamin C content at 1 minute were lower at 0.26±0.02% compared to the control of 0.36±0.02%. Results for a brewing time of 3 minutes did not significantly differ from that of the 1-minute brewing time, measuring at 0.28±0.02% and 0.26±0.02%. The content of dry samples were lower than those of the control. The control was held at a temperature of 70 °C for 1, 3, and 5 minute, and the percentages were 0.36±0.02%, 0.46±0.01%, and 0.53±0.02% respectively. As Rosida & RA, (2013) stated, vitamin C is highly susceptible to damage from prolonged exposure to high temperatures. When compared to the initial vitamin C value (control) for each brewing time, a decrease of 27%, 39%, and 54% occurred for brewing times of 1, 3, and 5 minute, respectively. This suggests that vitamin C damage occurs over a relatively long period, as found in (Rosida & RA (2013) research.

Vitamin C Test Results and Antioxidant Inhibition Power

Based on the data obtained, the treatment at 50 °C with a brewing time of 3 minutes is the most optimal time and temperature to gain the benefits of antioxidant power from a mixture of dried flowers of jasmine, butterfly pea, and chrysanthemum (1:1:1 ratio) with an antioxidant content of 34.61%. The brewing temperature treatment of 30 °C for 3 minutes and the brewing temperature of 70 °C for 5 minutes obtained the same vitamin C content of 0.29%. Meanwhile, when using fresh flower samples, the best treatment to gain optimum antioxidant power is 70 °C for 5 minutes, and optimum vitamin C at 70 °C for 5 minutes.

CONCLUSION

According to the conducted research, it can be inferred that the vitamin C content and antioxidant activity of dip Infused Edible Flower is not impacted by temperature or brewing time. The dry sample demonstrated optimum antioxidant activity at 50 °C for 3 minutes, yielding a result of 34.61%. The wet flower control exhibited maximum antioxidant activity at 70 °C for 5 minutes, resulting in 94.14%. The optimal vitamin C content in dry samples were obtained at a brewing temperature of 30 °C for 3 minutes and at a brewing temperature of 70 °C for 5 minutes, resulting in 0.29% concentration. Similarly, the optimal vitamin C content in the wet flower control was found at a brewing temperature of 70 °C for 5 minutes, yielding a concentration of 0.53%.

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