Fortification of Dayak Onion Extract (*Eleutherine palmifolia* (L.) Merr.) to Jelly Drink as a Functional Food

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ABSTRACT

Indonesia is a nation characterized by a diverse array of plant species that possess notable health benefits. Among these botanical resources is the Dayak onion, scientifically known as *Eleutherine palmifolia* (L.) Merr. The Dayak Tribe – an indigenous people of Borneo`s island has historically utilized the Dayak-onion, which possesses a distinctly bitter and acidic flavor, across several generations. The consumption of jelly drinks is favored by individuals from many socio-cultural backgrounds and throughout different age groups. The incorporation of Dayak-onion bulb extract into a jelly drink is anticipated to enhance its organoleptic attributes and functional characteristics. The objective of this study was to investigate the impact of different concentrations (0%, 0.1%, 0.2%, and 0.3% w/v) of Dayak onion bulb extract on the physicochemical and organoleptic properties of a jelly drink. The extraction process involved the utilization of the maceration method, employing a 96% food-grade ethanol solvent. Subsequently, the resulting extract was subjected to freeze drying and subsequently incorporated into a jelly drink. The physicochemical study revealed a statistically significant difference in the color, pH level, antioxidant activity, total phenolic content, and flavonoid content (P-value < 0.05) of the jelly drink. However, no significant change was seen in the syneresis level, gel strength, and hardness (P-value > 0.05). All jelly beverages have met the criteria outlined in the National Standard of Indonesia (SNI) 01-3552-1994 for total plate count and coliform microbiological contamination, indicating that they are deemed safe for consumption. According to the results of the hedonic-organoleptic and efficacy index tests, it was determined that the jelly drink containing 0.1% Dayak onion bulb extract exhibited superior qualities and was the most favored among the jelly drinks evaluated.

Keywords: Antioxidant, *dayak onion, functional food, jelly drink.*

1. INTRODUCTION

According to the Health Research and Development Agency's Research on Medicinal Plants and Herbs of Indonesia (RISTOJA), a total of 2,848 species of medicinal plants have been documented as being utilized by various ethnic groups across Indonesia. Among these species is the Dayak onion (*Eleutherine palmifolia* (L.) Merr.), which is indigenous to Kalimantan Island, Indonesia. The Dayak tribe has a longstanding tradition of utilizing Dayak onion bulbs as a medicinal remedy, which has been supported by empirical evidence demonstrating its effectiveness in treating various ailments such as high cholesterol, hypertension, and high triglyceride levels [1]. Several studies have demonstrated the antidiabetic activity of dayak onions [2] [3] as well as their antihypertensive properties, anti-ulcer effects [4], anti-inflammatory effects [4], antibacterial and antifungal activity [5], anticancer potential [6], and HIV antiviral activity [7]. Based on those findings, it has been observed that Dayak onion bulbs possess phytochemical constituents, including alkaloids, tannins, glycosides, flavonoids, and phenolics, which exhibit antioxidant properties. The significance of antioxidants in promoting human health lies in their ability to mitigate the likelihood of chronic ailments, such as diabetes, cancer, and cardiovascular illnesses, by counteracting the detrimental effects of free radicals that induce oxidative

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stress and cellular harm [8]. According to a preceding study, the IC_{50} value for the antioxidant activity of the ethanol extract derived from Dayak onion bulbs was found to be 112 ppm [2]. Additionally, the total phenolic content was determined to be 217.71 $\pm$ 3.37 mg GAE/g, while the total flavonoid content was measured to be 65.35 $\pm$ 0.55 mg QE/g. The customary method of consumption for Dayak onion bulbs typically involves boiling them in water. The cooking water of Dayak onions has a bitter and mildly astringent flavor profile, rendering it less palatable and appealing for ingestion, despite the numerous advantages associated with Dayak onions, particularly its antioxidant properties. Furthermore, the elevated temperature experienced during the boiling process may potentially compromise the integrity of secondary metabolite chemicals found in Dayak onions. Jelly, in its edible form, is a highly favored delicacy among individuals from diverse backgrounds and age groups due to its unique texture. In addition to its practicality, the jelly drink has gained popularity as a snack for hunger delay in modern culture. Nevertheless, the current jelly drink products available in the market solely consist of sugar and artificial flavors, lacking any further advantages or nutritional value. The objective of Dayak onion jelly drink products is to enhance the organoleptic characteristics of Dayak onions, hence facilitating their wider acceptance among the general population. The incorporation of Dayak onion into jelly beverages is anticipated to enhance not only the physical attributes, such as the yellowish red hue, but also the functional benefits, specifically the antioxidant activity inherent in Dayak onion, and organoleptic parameters such as easy to consume, flavor and texture.

2. MATERIALS AND METHODS

2.1. Sample Preparation

The mechanical maceration method was employed for the extraction of Dayak onions. The Dayak onion bulbs were sliced thinly using a slicer and afterward subjected to drying using a cabinet dryer at a temperature of 40ºC for 36 h. The dehydrated segments of Dayak onion were subsequently pulverized to achieve a smooth consistency and filtered through a 60-mesh screen. The extraction of Dayak onion flour was conducted using the methodology described previously [9], with certain modifications. The extraction process was conducted using the maceration method, employing a 96% food-grade ethanol solvent at 25◦C for 3 h. Additionally, the extraction was subjected to two rounds of maceration utilizing a shaker incubator. The ratio of Dayak onion flour to solvent was 1:10 ($g.mL^{-1}$). The maceration results were subsequently subjected to filtration using filter paper. The filtrate that had been subjected to filtration was subjected to evaporation using ethanol as the solvent. This process was carried out using a rotary evaporator at a temperature of 45◦C.

2.2. Extraction of Phytochemical Compounds

The thick extract of Dayak onion was dried by freeze-dry method with modifications [10]. The viscous extract was subjected to cryopreservation at a temperature of -80°C for a minimum duration of 6 h. The frozen, highly viscous extract was subsequently subjected to freeze-drying at a temperature of -55◦C for a duration of 48 h. Subsequently, the desiccated extract was pulverized using a mill and pestle until it had a finely powdered consistency. The desiccated extract is afterward placed in an aluminum foil standing pouch and kept in a freezer at a temperature of around -18°C.

2.3. Jelly Drink Preparation

The process of producing jelly drinks involves the dissolution of carrageenan in water, which is subsequently heated to a temperature of 80◦C. During this heating process, sugar is added to the mixture while continuously stirring. The temperature was subsequently reduced to 50◦C, followed by the addition of citric acid at a concentration of 0.3% and various quantities (0%, 0.1%, 0.2%, 0.3%) of Dayak onion extract. The mixture was then stirred gently. Subsequently, the combination is subjected to a cooling process until it solidifies and assumes the form of a gelatinous beverage.

2.4. Determination of Phytochemical Compound

The alkaloid test involves the utilization of 10 mg of dried Dayak onion extract for analysis. In one test tube, 3 drops of Dragen Dorff's reagent were added, while in the other test tube, 5 mL of hydrochloric acid (HCl) and 3 drops of Mayer's reagent were added. According to the preceding report, positive outcomes can be identified by the presence of an orange-brown precipitate when Dragen Dorff's reagent is utilized, as well as a yellow precipitate when Mayer's reagent is employed (11). The present study involves the utilization of the Folin-Ciocalteu reagent for qualitative analysis of phenolic compounds. In this experiment, a quantity of 10 mg of dehydrated Dayak onion extract was supplemented with 3 drops of Folin-Ciocalteu reagent. The occurrence of favorable outcomes is indicated by a discernible alteration in color, namely shifting towards a blue/green hue. Qualitative testing of flavonoid compounds was conducted by combining 2 mL of desiccated samples with 0.1 mg of powdered substance and 1 mL of strong hydrochloric acid (HCl). Hanani et al. [12] observed that positive outcomes can be identified by the alteration of the solution's hue to red. The qualitative analysis of tannin components was conducted by combining 10 mg of desiccated extract samples with a 10% solution of $FeCl_3$. Positive outcomes are distinguished by a discernible alteration in hue, typically shifting towards

shades of blue or dark green [12]. The experimentation involved the combination of 1 mL of desiccated samples with 0.5 mL of chloroform, 0.5 mL of glacial acetic acid, and 2 mL of concentrated H_2SO_4 for testing steroid and triterpenoid chemicals. According to previous study [13], the beneficial effects of steroids are indicated by the presence of greenish-blue outcomes, but the advantageous effects of triterpenoids are distinguished by the development of brownish/violet rings. The evaluation of glycoside chemicals involves the combination of 1 mL of a desiccated sample with 5 mL of anhydrous acetic acid and 10 droplets of concentrated sulfuric acid. Positive outcomes are distinguished by a discernible alteration in the hue of the solution, manifesting as a shift toward the blue or green spectrum. The saponin components were subjected to testing through the process of combining 0.5 g of the extract with 5 mL of heated water for 10 sec, followed by a resting period of 10 min. According to a previous report, positive outcomes are distinguished by a consistent foam formation that persists for at least 10 min of stillness and remains unaffected even with the introduction of a single drop of hydrochloric acid with a concentration of 2N [14].

2.5. Determination of Phenolic Compounds

The method for conducting total phenolic testing is described in the previous study [15]. The sample was dissolved using a solution of 96% ethanol. A volume of 0.1 mL of the dissolved sample was afterward combined with 0.5 mL of a 10% Folin-Ciocalteu solution and 0.5 ml of a 7.5% $NaHCO_3$ solution. The void in this experiment is prepared using the same methodology as the reference sample, with the exception that 0.1 mL of the sample is substituted with an equal volume of 96% ethanol. The samples and blanks are thereafter vortexed for 30 sec and then left undisturbed for 15 min at a temperature of 45°C. The absorbance of the sample is subsequently measured at a wavelength of 765 nm. To determine the total phenolic equivalent value of gallic acid, the concentration derived from the calculation of the absorbance regression standard curve of gallic acid is compared with the concentration of the sample solution and subjected to a reaction.

$$\text{TPC}=\frac{C\ Gallic\ acid(\frac{mg}{ml})}{C\ sample\ (\frac{g}{ml})}= \text{..... (mg GAE/g sample)}$$

2.6. Determination of Total Flavonoid

The method for conducting total phenolic testing is described in the previous study [15]. The sample was dissolved using a solution of 96% ethanol. A volume of 0.1 ml of the dissolved sample was afterward combined with 0.5 mL of a 10% Folin-Ciocalteu solution and 0.5 ml of a 7.5% $NaHCO_3$ solution. The void in this experiment is prepared using the same methodology as the reference sample, with the exception that 0.1 mL of the sample is substituted with an equal volume of 96% ethanol. The samples and blanks are thereafter vortexed for 30 sec and then left undisturbed for 15 min at a temperature of 45◦C. The absorbance of the sample is subsequently measured at a wavelength of 765 nm. To determine the total phenolic equivalent value of gallic acid, the concentration derived from the calculation of the absorbance regression standard curve of gallic acid is compared with the concentration of the sample solution and subjected to a reaction.

$$\text{TFC}=\frac{C\ Quercetim(\frac{mg}{ml})}{C\ sample\ (\frac{g}{ml})}= \text{..... (mg QE/}g\text{ sample)}$$

2.7. Organoleptic Analysis

Organoleptic testing was carried out by giving jelly drink Dayak onion at 15◦C to be tasted and assessed by 45 untrained panelists. Organoleptic tests are performed to determine whether the sample is organoleptically acceptable or not. The organoleptic test conducted is the hedonic organoleptic test (preference level). The attributes tested were among others color, aroma, stir texture, mouthfeel texture, ease of sucking, taste, aftertaste, and overall. The scale used in this study hedonic test is 1-6 with a scale of 1 (very dislike), 2 (dislike), 3 (somewhat dislike), 4 (somewhat like), 5 (like), and 6 (very like).

3. RESULT & DISCUSSION

3.1. Chemical Characteristics of Dayak Onion Bulb

A quantity of 3 kg of Dayak onion simplicia powder was subjected to extraction using a food-grade ethanol solvent with a concentration of 96%. The extraction process was carried out using the mechanical maceration method, employing a shaker incubator for a duration of 3 h. The resulting mixture was subjected to two cycles of re-maceration. The final yield of the extraction process amounted to 309.32 g of a concentrated extract. In order to determine the yield, the mass of the concentrated extract was afterward compared to the mass of the Dayak onion simplicia, resulting in a Dayak onion extract yield of 10.31%.

The extraction process was conducted using the maceration method, employing a 96% food-grade ethanol solvent. The extraction was facilitated by a shaker incubator, operating at ambient temperature. The maceration method of extraction is a convenient and appropriate technique for extracting phytochemical components that are susceptible to degradation under

elevated temperatures [16]. Previous report posits that the utilization of continuously operating stirring machines has the potential to reduce maceration time by a significant margin, ranging from 6 to 24 h [17]. The process of re-maceration is employed to enhance the extraction yield. The solvent utilized in this study was 96% food-grade ethanol, chosen due to its availability in a food-grade formulation. Moreover, ethanol serves as a versatile solvent for the extraction of phytochemical compounds with varying degrees of polarity, including polar, semipolar, and nonpolar molecules [18]. Consequently, it is anticipated that the extraction of all phytochemical compounds may be achieved using ethanol. The selection of 96% ethanol above 70% ethanol was based on its ability to generate more antioxidant activity and total phenol content, as demonstrated by [19]. The ethanol solvent is evaporated using a rotary evaporator at a temperature of 45°C until a concentrated extract is achieved. The rotary evaporator functions by reducing the pressure of the solution mixture, hence decreasing its boiling point, and facilitating faster evaporation. Additionally, it employs heating and rotation to enhance the effective surface area available for heating the solution mixture. The utilization of a rotary evaporator facilitates the preservation of antioxidant component extracts due to its ability to operate at moderate temperatures, as noted by [20].

3.2. Phytochemical Analysis of Dried Dayak Onion Bulb.

A total of 300 g of concentrated extract was subjected to freeze drying, resulting in the production of 227.85 g of powdered Dayak onion extract. The yield of dry extract obtained from the freeze-dried Dayak onions was determined to be 75.95%. The chemical analysis result can be seen in Table 1.

Table 1. Chemical characteristic of concentrated and dried extract of Dayak Onion bulb

Parameters	Concentrated Extract	Dried Extract
IC_{50} (ppm)	133,781^{b}±4,265	72,308^{a}±4,060
AEAC (mg AAE/g)	107,667^{a}±4,279	139,476^{b}±0,719
Total phenol (mg GAE/g)	61,292^{a}±0,450	80,431^{b}±0,658
Total Flavonoid (mg QE/g)	15,787^{a}±1,604	19,587^{b}±1,331

The qualitative analysis of phytochemical substances involves the addition of extracts to reagents based on specific testing protocols. The phytochemical analysis revealed the presence of alkaloids, phenolics, flavonoids, tannins, triterpenoids, and glycosides in the extract of Dayak onion. However, saponins were not detected in the extract. Phytochemical analysis results can be seen in Table 2.

The concentrated extract is subsequently subjected to freeze drying, a technique that involves the removal of moisture by low temperature and pressure. In order to assess the impact of the freeze-drying method on the chemical properties of the Dayak onion thick extract, a series of experiments were done to evaluate the antioxidant, phenolic, and flavonoid activities. The objective was to ascertain whether the antioxidant components present in the extract undergo any detrimental changes as a result of the freeze-drying procedure. The test results indicate notable variations in IC_{50}, AEAC (Antioxidant capacity equivalent to ascorbic acid), total phenolic, and total flavonoid characteristics between the concentrated extract and dehydrated extract of Dayak onion.

Table 2. Phytochemical characteristic of concentrated and dried extract of Dayak Onion bulb.

Phytochemical Compound	Result
Alkaloid	+
Phenolic	+
Flavonoid	+
Tanin	+
Steroid & Triterpenoid	+
Glycoside	+
Saponin	-

The IC_{50} value, which represents the concentration of a sample required to neutralize 50% of DPPH (2,2-diphenyl-1-picrylhydrazyl) free radicals, is lower for the dry extract compared to the condensed extract. This indicates that the dry extract possesses a higher antioxidant activity than the condensed extract, as it requires a lower concentration of ingredients to counteract 50% of DPPH free radicals. This observation aligns with the findings from the tests conducted on the equivalent antioxidant capacity of ascorbic acid, total phenolic content, and total flavonoid content. Specifically, the dry extract exhibited a greater value compared to the condensed extract. This suggests that the freeze-drying method effectively preserves antioxidant compounds due to its utilization of low temperatures. Additionally, the evaporation of ethanol during the drying process leads to a higher concentration of antioxidant compounds, specifically phenolic compounds, and flavonoids. Furthermore, [10] conducted a study on freeze-drying olive leaf thick extract, wherein they found that the freeze-drying procedure not only concentrates the extract but also safeguards its antioxidant components. According to the findings of the study, there was no statistically significant alteration seen in the overall flavonoid, phenolic, and antioxidant FRAP (Ferric Reducing Antioxidant Power) content of olive leaf dry extract that underwent freeze drying at a temperature of 4°C in a refrigerator over two months. The dry extract of Dayak onion exhibits the

presence of various beneficial chemicals, including alkaloids, phenolics, flavonoids, tannins, steroids, and glycosides, while lacking saponin compounds. These results are like the research from Yuswi that indicated that the extraction of Dayak Onion Bulb by ethanol 96% produces total phenol, and antioxidant activity IC_{50} 240.63 mg GAE/g and 52.38 ppm, respectively [21].

3.3. Dayak Onion Bulb Jelly Drink

3.3.1 Antioxidant Activity, Phenolic Compound & Total Flavonoid

The inclusion of Dayak onion tuber concentration resulted in a significant increase in various parameters, including antioxidant activity %, equivalent antioxidant capacity of ascorbic acid, total phenolic content, total flavonoid content, and pH. The higher the number of extracts incorporated into the jelly drink, the greater the concentration of antioxidant chemicals found in the jelly drink. The present study has revealed that Dayak onion extract is rich in antioxidant components such as alkaloids, phenolics, flavonoids, tannins, and glycosides, as determined using phytochemical testing. Furthermore, Dayak onions possess additional antioxidant compounds belonging to the class of naphthoquinone derivatives. These compounds, namely eleutherine, isoeleutherine, eleutherinoside A, eleuthoside B, and eleutherol, are unique to Dayak onions [22]. Additionally, Dayak onion extract has been found to contain vitamin C at a concentration of 31.68 mg per 100 g [23].

3.3.2 Texture & Appearance

As the content of Dayak onion extract increases, there is an observed rise in the pH of the jelly drink, resulting in an alkaline environment. This finding suggests that the utilization of Dayak onion extract has the potential to increase the pH level of jelly drinks. The inclusion of Dayak onion bulb extract resulted in a reduction in the L* and °hue values while leading to an increase in the a* and b* values. As the concentration of Dayak onion extract increases, the color parameters L* become darker, A* become redder, and B* become more yellow. According to the preceding report [24], the inclusion of extracts at concentrations of 0.1%, 0.2%, and 0.3% in a jelly drink result in a hue degree parameter value that can be described as yellow-red. From a visual standpoint, the incorporation of Dayak onion extracts into jelly drink results in a color ranging from yellow to brownish yellow, as opposed to the typical red hue. The presence of anthocyanin chemicals, which belong to the flavonoid group of substances, in Dayak onions may account for this phenomenon [25]. The sensitivity of anthocyanin chemicals found in Dayak onion extract is influenced by changes in pH levels. The pH range of the jelly drink examined in this study was found to be between 3.35 and 3.42. According to a previous study [26], certain varieties of anthocyanins exhibit a yellow coloration under acidic conditions, while others demonstrate an inverse response. The inclusion of Dayak onion bulb concentrations at 0.1%, 0.2%, and 0.3% did not yield any statistically significant impact on the syneresis, strength, and hardness of the gel. This phenomenon could be attributed to the absence of variation in the concentrations of carrageenan, citric acid, and sugar across all formulations of jelly drinks. The content of carrageenan is a significant determinant of gel hardness, gel strength, and syneresis in jelly drinks. An increase in carrageenan concentration leads to higher levels of gel hardness and strength, while simultaneously reducing syneresis. The progressive augmentation of carrageenan concentration results in the development of a more robust gel double helix configuration. This phenomenon results in an increased affinity for water molecules to form stronger bonds [27]. The texture strength, gel hardness, and gel syneresis are also influenced by the concentration of sugar. The addition of sugar to water results in an increase in viscosity due to its ability to attract and bind with unbound water molecules. An increase in the amount of bound water leads to an elevation in strength hardness and a reduction in syneresis (Table 3).

Table 3. Syneresis Result of Dayak Onion Bulb Jelly Drink

Dayak Onion Bulb Concentration (%)	Syneresis (%)		
	24 h	48 h	72 h
0	1,544^{a} ± 0,006	3,725^{a} ± 0,192	5,227^{a} ± 0,204
0.1	1,559^{a} ± 0,021	3,666^{a} ± 0,191	5,258^{a} ± 0,057
0.2	1,563^{a} ± 0,027	3,622^{a} ± 0,136	5,379^{a} ± 0,186
0.3	1,575^{a} ± 0,034	3,659^{a} ± 0,039	5,556^{a} ± 0,268

The concentration of citric acid also has an impact on gel strength, gel hardness, and syneresis due to its role as an acidity regulator. This is significant since carrageenan exhibits optimal pH gelling within the range of 3-4. According to preceding research [28], carrageenan gels exhibit stability primarily at low pH levels, specifically within the range below 4. An increase in gel stability is directly proportional to gel strength and hardness, while concurrently leading to a decrease in syneresis. A complete physic-chemical analysis can be seen in Table 4.

Table 4. Physicochemical characteristic of Dayak Onion bulb

Parameters	Dayak Onion Extract Concentration			
	0	0.1	0.2	0.3
% inhibition (0.1 g/mL)	5,835^{a} ± 0,324	46,894^{b} ± 1,055	60,832^{c} ± 1,718	74,608^{d} ± 0,799
AEAC (mg AAE/g jelly)	0,0068^{a} ± 0,0033	0,1106^{b} ± 0,0034	0,1620^{c} ± 0,0057	0,2815^{d} ± 0,0054
Total Phenolic (mg GAE/g jelly)	0,0076^{a} ± 0,0004	0,0589^{b} ± 0,0011	0,1127^{c} ± 0,0022	0,1419^{d} ± 0,0047
Total Flavonoid (mg QE/g jelly)	0,0007^{a} ± 0,0002	0,0137^{b} ± 0,0006	0,0262^{c} ± 0,0008	0,0382^{d} ± 0,0006
pH	3,35^{a} ± 0,020	3,38^{ab} ± 0,009	3,39^{bc} ± 0,011	3,42c ± 0,003
L*	88,0^{d} ± 0,40	75,13^{c} ± 0,93	69,20^{b} ± 0,20	56,30^{a} ± 0,56
a*	1,20^{a} ± 0,10	4,10^{b} ± 0,10	9,63^{c} ± 0,15	18,17^{d} ± 0,25
b*	0,15^{a} ± 0,05	44,37^{b} ± 0,95	57,20^{c} ± 0,36	61,03^{d} ± 0,15
°Hue	172,9^{od} ± 2,18	84,72^{oc}± 0,19	80,44^{ob} ± 0,11	73,42^{ao} ± 0,23
Objective Color	Green	Yellow reddish	Yellow reddish	Yellow reddish
Gel Harness (g)	16,113^{a} ± 0,509	15,447^{a} ± 0,693	16,890^{a} ± 1,168	15,557^{a} ± 1,261
Gel Strength (g/cm^{2})	12,115^{a} ± 0,383	11,614^{a} ± 0,521	12,699^{a} ± 0,879	11,697^{a} ± 0,948

3.3.3 Microbial Contamination

The results of the Coliform Jelly Drink test indicated negative outcomes, as evidenced by the absence of bubble formation in all Durham tubes, regardless of the volume (0.1 mL, 1 mL, and 10 mL) used. These results were obtained using the most likely number (MLN) method, as specified in the Indonesia Standard (SNI) microbial contamination test method [29]. According to this method, a positive combination of 0-0-0 in the 1:10, 1:100, and 1:1000 dilutions can be interpreted as having a microbial count of less than 3 MPN.g^{-1}, which meets the established standards. The test findings indicate that the total number of bacterial colonies on the Jelly Drink plates was zero since no colonies were observed in dilutions ranging from 10^{-2} to 10^{-4}, which complies with the established requirements. Detailed results of microbial contamination can be found in Table 5.

Table 5. Microbial Contamination of Dayak Onion Bulb Jelly Drink

Dayak Onion Bulb Concentration (%)	Microbial Test	
	Coliform (colony/g)	TPC
0	<3	-
0.1	<3	-
0.2	<3	-
0.3	<3	-

3.3.4 Organoleptic

A series of hedonic organoleptic tests were administered to a sample of 45 individuals who lacked formal training in sensory evaluation. The inclusion of Dayak onion tuber concentrations at 0.1%, 0.2%, and 0.3% did not provide any statistically significant impact on the characteristics of color, scent, stir texture, mouthfeel texture, and ease of suction. However, it did exhibit a significant influence on the attributes of taste, aftertaste, and overall perception. The panelists are inclined to appreciate all varieties of color, despite the colors exhibiting notable differences according to the color readings obtained by the color reader. The lack of differentiation in scent preference may be attributed to the inclusion of untrained panelists in this study, whose olfactory senses have not undergone formal training, resulting in less sensitivity to subtle variations in aroma caused by minimal intervals of extract addition. The absence of variation in preference for the qualities of stir texture, mouthfeel texture, and ease of suction can be attributed to the uniform hardness and strength of gel jelly drinks. The preference for a jelly drink with a 0.1% extract concentration is likely due to its ability to provide a discernible taste without being overly pronounced. Conversely, the addition of a 0.3% extract concentration to the jelly drink results in an excessively bitter taste, hence rendering it unfavorable among the panelists. The bitter taste of Dayak onions is attributed to the presence of phytochemical components, including polyphenolic compounds such as tannins and flavonoids, as well as alkaloids and triterpenoids [20] [30].

Table 6. Organoleptic Characteristic of Dayak Onion Bulb

Parameters	Dayak Onion Extract Concentration			
	0	0.1	0.2	0.3
Color	4,02^{a} ± 1,500	4,67^{a} ± 1,044	4,76^{a} ± 1,090	4,38^{a} ± 1,193
Aroma	3,58^{a} ± 1,545	4,27^{a} ± 1,268	4,22^{a} ± 1,277	3,87^{a} ± 1,486
Texture (spoon)	4,22^{a} ± 1,288	4,8^{a} ± 0,919	4,84^{a} ± 0,903	4,47^{a} ± 1,290
Mouthfeel texture	5,02^{a} ± 1,118	5,18^{a} ± 0,860	5,04^{a} ± 0,928	4,73^{a} ± 1,214
Easy consume	4,89^{a} ± 1,172	5,09^{a} ± 0,952	5,04^{a} ± 0,976	4,64^{a} ± 1,131
Taste	4,89^{a} ± 1,229	5,11^{a} ± 0,935	4,51^{b} ± 0,991	3,91^{c} ± 1,362
Aftertaste	5,11^{a} ± 1,092	4,76^{ab} ± 1,209	4,29^{bc}± 1,290	3,89^{c} ± 1,641
Overall	4,91^{ab} ±1,125	5,09^{a} ± 0,900	4,53^{b} ± 1,079	3,911^{c} ±1,328
Average	4,580	4,865	4,654	4,225

The attribute of aftertaste is highly valued in jelly drink control, as the incorporation of Dayak onion extract

effectively eliminates any lingering taste. Conversely, jelly drinks containing 0.3% extract may not be favored due to the presence of a noticeably bitter aftertaste. In general, the jelly drink with a 0.1% extract concentration was found to be the most favored, while the jelly drink with a 0.3% extract concentration was the least preferred, as indicated by the average value. According to the mean scores obtained from hedonic organoleptic tests, the jelly drink that was most favored by participants was the one containing Dayak onion extract at a concentration of 0.1%, with an average score of 4.865 (indicating a preference for the product). Conversely, the jelly drink that received the least preference was the one containing Dayak onion extract at a concentration of 0.3%, with an average score of 4.225 (indicating a relatively lower level of preference). According to the findings derived from the Effectiveness Index assessment, the most efficacious intervention is the jelly drink supplemented with 0.1% extract, as evidenced by its overall score of 0.725. The jelly drink that received the lowest ranking is the one without the addition of extracts, with a total score of 0.377 (Table 6).

4. CONCLUSION

The color, pH, antioxidant activity, total phenolic content, and flavonoid content of Dayak onion jelly drink gel (*Eleutherine palmifolia* (L.) Merr.) are significantly influenced by variations in the concentration of Dayak onion extract added to the jelly drink formulation. However, no significant effect is observed on the syneresis, hardness, and strength of the gel. The total coliform value and plate number of a jelly drink with varying concentrations of dayak onion extract meet the requirements set by the SNI Jelly Agar standard. The hedonic organoleptic test attributes of taste, aftertaste, and overall are significantly influenced by variations in the concentration of Dayak onion extract added to the formulation of the jelly drink. However, there is no significant impact on the attributes of color, aroma, texture of stir, mouthfeel texture, and ease of suction of the Dayak onion jelly drink (*Eleutherine palmifolia* (L.) Merr). Based on the findings of physicochemical and organoleptic assessments, it is recommended to incorporate a concentration of 0.1% Dayak onion extract into the formulation of the Dayak onion jelly drink (*Eleutherine palmifolia* (L.) Merr).

AUTHORS' CONTRIBUTIONS

YPM: Writing, review & editing – original draft. BY: Writing & data acquisition. ADRD: review & data interpretation. SCK: review & editing. All authors read and approved the final manuscript.

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