

REVIEW ARTICLE

MANUFACTURING PROCESS AND CHARACTERIZATION OF ISOTONIC BEVERAGES MADE FROM COCONUT WATER WITH THE ADDITION OF BLUEBERRY

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ABSTRACT

Coconut water is part of the coconut fruit that contains various nutrients such as minerals, vitamins, antioxidants, amino acids and enzymes that are beneficial to the body. Coconut water can be developed as an isotonic drink because the nutrients in coconut water have a good electrolyte balance like human body fluids. Coconut water, especially in young coconuts, contains quite good nutrients so that it can be categorized as a highly nutritious, hygienic and natural drink and there have been many studies that prove it can cure various diseases. Currently there are coconut water products that are used as isotonic drinks on the market, but not many variations are added. So, in this study, the addition of variants was carried out to improve the taste and additional benefits into the isotonic drink. The addition of variants carried out is by adding blueberry fruit extract. This study aims to determine the most optimum formulation of the ratio of young coconut water and blueberry extract and what tests are carried out to determine the optimum formulation. Where in this study conducted by making several variations of the addition of young coconut water and blueberry extract, namely 95% coconut water and 5% blueberry fruit extract (F1), 90% coconut water and 10% blueberry extract (F2), 85% coconut water and 15% blueberry extract (F3) and 80% coconut water 20% blueberry extract (F4). Then to find out the most optimum formulation, pH, viscosity and organoleptic testing were carried out. Then the results showed that formula F3 has a pH of 3.77 which indicates that this isotonic drink is in accordance with the provisions of the National Standards Agency, has a viscosity of 1.4 cP which is in accordance with the viscosity of isotonic drinks on the market and has the highest average general acceptance of 4.64 obtained from organoleptic testing with a hedonic test conducted to determine the highest favorability value tested by 10 respondents, so that the formula becomes the most optimal formula in making isotonic drinks from young coconut water and blueberry extract.

KEYWORDS

Young coconut water, blueberry fruit extract, optimal formula.

1. INTRODUCTION

Indonesia is one of the many countries with a tropical climate and is often referred to as one of the world's vegetation areas, this is because Indonesia is a suitable place for the development and growth of various types of plants. One of the plants that can grow well in tropical climates such as Indonesia is coconut (*Cocos Nucifera*) (Pakaya et al., 2021). Coconut is a plant known as the tree of life, because all parts of the coconut can be used in food processing, from the tree, leaves, fruit, to the water. Coconut water is a liquid that naturally occurs in coconuts, where on average there is 230-300 mL of coconut water with an average specific gravity of 1.02 and a slightly acidic pH of 5.6. Coconut water contains nutrients that are quite complete for human health. Some of the elements contained in it are carbon and nitrogen, where the carbon element in coconut water is in the form of simple carbohydrates such as glucose, sucrose, fructose, sorbitol, inositol, etc., as well as the nitrogen element in the form of proteins composed of amino acids, such as aline, arginine, alanine, cystine and serine. Apart from that, coconut water also contains micro elements in the form of minerals, which the body needs, such as potassium (K), calcium (Ca), magnesium (Mg), ferrum (Fe), cuprum (Cu), phosphorus (P), and sulfur (S) (Wahyuni, 2018).

According to the National Standards Agency, Isotonic drinks are a carbonated or non-carbonated soft drink product that can function to improve fitness, which contains sugar, citric acid and minerals (National Standards Agency, 1998). Isotonic drinks are also known as sports drinks, namely drinks that function to retain fluids and provide carbohydrate energy when doing activities. Isotonic drinks are drinks that can improve fitness because they contain minerals that function as replacements for lost electrolytes and have good rehydration capabilities. Many experiments have been carried out to process coconut water as an isotonic drink with various addition variants. Several variants of addition were made, such as the addition of lemon extract (Citrus Lemon) where lemon was added to meet the pH standards of isotonic drinks, purple sweet potato to determine antioxidant activity and determine levels (Pakaya et al., 2021; Henrique, 2021).

Purple sweet potato anthocyanins, starfruit as nutritional value enhancers, namely flavonoids and triterpenoids, Aloe Vera which is composed mostly of water, so it can prevent and overcome dehydration and can restore stamina body, soursop juice, the addition of flavor which has a distinctive sharp taste and honey as a flavor enhancer, contains rich minerals, and is antimicrobial is expected to inhibits the growth of

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microorganisms (Ihsan, 2018; Rusanti et al., 2019; Lempoy et al., 2020; Az-zahra et al., 2019). Currently there are also coconut water products that are used as isotonic drinks on the market, but not many additional variations have been made. So, in this research additional variants were carried out to improve the taste and additional benefits of the isotonic drink. The additional variant that was made was by adding blueberry fruit extract.

Blueberries have a nutritional and physiological composition that is good for body health. Now blueberries can be found in various countries, including Indonesia. As the name suggests, blueberries are blue, and round in shape and small in size. The purple pigment or anthocyanin in blueberries is useful as an antioxidant because it can absorb toxins, improve blood flow and is a natural anti-inflammatory. The high anthocyanin content in blueberries has high stability compared to anthocyanins from other sources (Nurbaeti et al., 2017). Therefore, this plant is an option as an addition to isotonic drinks because it is healthier in terms of its composition and as an alternative to natural dyes.

It is hoped that this isotonic drink product from coconut water with the addition of blueberry extract will be one of the innovations in isotonic drink products that will be well received by the public. This isotonic drink made from young coconut water and blueberry extract has the benefit of replacing body ions lost in the body due to physical activity and the addition of blueberries increases the benefits because blueberry extract is rich in antioxidants. Based on the description above, research was carried out regarding the manufacture of isotonic drinks using young coconut water and blueberry extract to increase the economic value and add value to the isotonic drink product.

2. LITERATURE REVIEW

Coconut is a plantation or industrial plant in the form of a straight stem tree from the Palmae family. Coconut (*Cocos nucifera* L) is the sole member of the *Cocos* genus of the Arenan or Arecace tribe. Basically, coconut plants are classified as one of the most useful types of annual plants because everything from the leaves, fruit flesh, stems to roots can be used by the community (Winarno, 2015). Coconut fruit is a part of the coconut tree that is widely used by humans, where the components of the coconut fruit consist of the outer shell (epicarp), husk (mesocarp), shell (endocarp) and inner part (endosperm) which consists of two parts, namely the flesh (white kernel) and a clear liquid called coconut water. Coconut water reaches its maximum volume at the age of 6-8 months, after that the volume of coconut water will decrease and be replaced with kernels or fruit flesh which becomes thicker and harder (Prasetyo et al., 2020).

Coconut water contains nutrients that are rich in nutrients such as sugar, protein, fat and is relatively complete, so it is very good for the growth of bacteria that produce food products, so this has good potential for coconut to be made into fermented drinks. According to Simanhuruk, coconut water can be processed into nata de coco, vinegar, jelly, alcohol, soy sauce, and soft drinks such as isotonic, and so on (Simanhuruk, 2013). Coconut water contains a number of nutrients, such as 0.2% protein, 0.15% fat, 7.27% carbohydrates, sugar, vitamins, electrolytes and growth hormones.

The water in coconuts is clear and tastes sweet, but the older the coconut, the color of the water will change to cloudy and the taste is bland. This is because the sugar content such as glucose, fructose and sucrose has been greatly reduced for the formation of fruit flesh. This process causes the fruit flesh to become thicker and is followed by a reduction in the volume of coconut water. Old coconuts have coconut water with a pH ranging from 4-5, which indicates that coconut water is acidic (Putri et al., 2023). Meanwhile, young coconut water has a pH of 5.5 (Mokoginta, 2017).

Young coconut water is a natural drink, healthy, nutritious and tends to have no side effects, provided by nature and found in many tropical countries. Apart from being safe to consume, coconut water also has a sweet and refreshing taste, this is because coconut water contains a total of 3-6% sugar. where the types of sugar contained are sucrose, glucose, fructose and sorbitol. These sugars are what make young coconut water sweeter than older coconut water. Young coconut water also has a number of macro and microminerals, and contains vitamins and protein, although in small amounts. Even though the protein content of young coconut water is only 0.1%, the amino acids contained in it include Arginine (12.75%), Alanine (2.41%), Cysteine (1.17%), and Serine (0.91%). % are four types of amino acids which are higher than those contained in cow's milk protein.

The nutritional value of young coconut water, especially the mineral composition, is highest when the fruit is 8 months old and the mineral potassium is the highest. Therefore, various studies show that the use of

coconut water can cure several diseases. Such as neutralizing toxins in the body, curing dengue fever, cleaning the digestive tract, preventing kidney stones, and improving blood circulation, can reduce blood pressure in hypertension sufferers, can help reduce pain due to menstrual cramps and others (Putri, 2019; Roza et al., 2020; Melva et al., 2021).

Apart from that, young coconut water also has a therapeutic effect and contains various nutrients such as minerals, vitamins, antioxidants, amino acids, enzymes that are beneficial for the body (Prabhakar et al., 2018). Young coconut water also has isotonic properties, so ideally young coconut water can be used to replace body fluids lost during physical activity. The electrolytes contained in young coconut water can replace the body's electrolytes lost through sweat because it has an electrolyte balance like fluids in the human body. The concentration of electrolytes in young coconut water can cause the same osmotic pressure as body fluids but will not affect hemostasis. As a natural isotonic drink, young coconut water is very good to drink for rehydration when the body loses a lot of fluids during physical activities such as sports (Hasibuan and Simanullang, 2019).

Blueberry is a fruit plant originating from North America. This plant is native to the United States and Southern Canada, growing wild in hilly areas and forests. The three prominent varieties grown are highbush (*V. corymbosum*, *V. ashei*), lowbush (*V. angustifolium*) and evergreen (*V. darrowii*). Currently, blueberries can be found in any country, including Indonesia. As the name suggests, blueberries are blue, and round in shape and small in size. Berries are known as a storehouse of nutrients with lots of fiber, tannins, anthocyanins, proanthocyanidins, vitamins, omega-3 fatty acids, carotenoids, minerals and more. Blueberries have a purple pigment called anthocyanin. These anthocyanin flavonoids account for up to 60% of the total polyphenols in ripe blueberries. Therefore, anthocyanins make the greatest contribution to blueberries' health benefits.

Anthocyanins have various benefits, one of which is as a natural free radical destroying and antidote compound or better known as a natural antioxidant compound in humans. In the food sector, anthocyanins are used as additives or food additives (BTP) which are added to food and beverages. As BTP, anthocyanin acts as a natural food and beverage coloring such as the anthocyanin color in blueberries (Priska et al., 2018). Blueberries are very beneficial for the body because this fruit is known to contain various important nutrients, such as vitamins, antioxidants, minerals, fiber and complex carbohydrates. The various important nutrients contained in blueberries make this fruit good for preventing various diseases and maintaining body health, such as maintaining heart health, maintaining mental and brain health, preventing premature aging, reducing the risk of cancer, controlling blood sugar, reducing inflammation.

Isotonic drinks according to (SNI 01-4452-1998) are a carbonated or non-carbonated soft drink product that is consumed to improve body fitness, containing sugar, citric acid and minerals. Isotonic drinks are able to replace body fluids quickly because they contain the electrolytes needed by the body and have an osmolarity that matches the body's osmotic pressure. (Ariviani et al., 2017). Isotonic drinks not only function as thirst quenchers and increase fitness for the human body but can also function as a replacement for lost body fluids and as an energy supplier after physical activity such as work and exercise. This is because isotonic drinks can encourage voluntary fluid consumption, stimulate rapid fluid absorption, provide carbohydrates to improve performance, increase physiological responses, and for rapid rehydration (Navianto, 2019).

Losing body fluids will reduce metabolism and can cause organ function disorders, so this condition needs to be treated immediately. Loss of body fluids can cause a reduction in electrolytes because they are also excreted by the body. Electrolytes are minerals needed in small quantities/micronutrients that dissociate in fluids and play an important role in increasing human energy production. In the human body, electrolytes are found in sweat, plasma and intracellularly. Humans usually get electrolytes from food and drink, this is because the human body cannot produce electrolytes on its own. The best way to overcome fluid loss is to drink drinks, such as water. However, the problem is the rehydration capacity of water (Prasetyo et al., 2020).

Rehydration is the ability to restore body fluids to normal. Water, isotonic drinks and cola drinks apparently have different hydration. After 2 hours of recovery period, there was a difference in rehydration between people who were given water, isotonic drinks and diet cola. People who were given isotonic drinks had the highest rehydration speed (73%), followed by water (65%) and diet cola (54%). This shows that water or diet cola are not good enough to replace body fluids compared to isotonic drinks. A high rehydration index indicates that young coconut water is more effective

and can quickly improve dehydration. Another advantage is that it has a tastier taste and is easily tolerated by the stomach so young coconut water can be drunk in sufficient quantities. A higher rehydration index means that young coconut water is more effective and quickly improves dehydration. Another advantage is that it has a tastier taste and is easily tolerated by the stomach so that young coconut water can be drunk in large quantities.

This isotonic drink itself has two main purposes, namely replacing body fluids and electrolytes lost through sweat during activities and also replacing carbohydrates used from liver and muscle reserves during activities. However, even though it can restore lost body fluids, isotonic drinks consumed must meet quality requirements based on the Indonesian National Standard (SNI) 01-4452-1998. Isotonic drink formulations must provide several benefits, such as being liked by consumers, fast absorption of fluids, increasing fitness and speeding up rehydration. Rehydration is meant to be related to the recovery of body fluids after physical activity.

3. RESEARCH METHOD

In this research, the preparation of isotonic drinks was carried out in several stages, namely preparing blueberries, preparing young coconut water and making isotonic drinks. In preparing blueberries, the blueberries are sorted to separate those that are suitable for processing and those that are not. Blueberries that are suitable for processing are ripe, smooth-skinned and bright blue in color. Blueberries that are not suitable for processing are blueberries that are soft, wilted and moldy. After sorting, the blueberries are cleaned using running water to free them from dirt that is still attached to the fruit. Then the blueberries are dried until there is no remaining water attached. Blueberries that are clean and dry are mashed using a blender until blueberry juice is produced which is a deep purple color. The resulting blueberry juice is then filtered using a nylon filter to extract the extract.

After producing the blueberry extract, store the blueberry extract in a closed container to maintain the quality of the blueberry extract. In the process of preparing young coconut water, it is done by separating the

coconut water from the fruit, then storing it in a container and checking the pH first. Coconut water that has an appropriate pH is then filtered using a nylon filter to obtain clean young coconut water free from fine impurities contained in the young coconut water. Then the final stage, namely making isotonic drinks, is done by adding several different mixing variations, namely as follows:

F1= 95% coconut water : 5% blueberry extract

F2= 90% coconut water : 10% blueberry extract

F3= 85% young coconut water : 15% blueberry extract

F4= 80% young coconut water : 20% blueberry extract

After preparing several variations of these additions, citric acid was added to each treatment as much as 0.3%, sugar as much as 5% and sodium benzoate as much as 0.1%. After making the isotonic drink, several tests were carried out to find out the most optimum formulation for the isotonic drink that had been made, namely testing the degree of acidity (pH), viscosity and organoleptic testing including taste, aroma, color. The organoleptic test carried out in this research was the hedonic test or liking test which was assessed by 10 respondents with an age range of 20-25 years. In this test, respondents are asked to express their personal responses which can be in the form of likes or dislikes. Next, the general acceptance of the panelists was assessed using the proportion of each observation, namely color (30%), aroma (30%) and taste (40%). The hedonic scale used is using 7 numerical scales, very like (7), like (6), somewhat like (5), neutral (4), somewhat dislike (3), dislike (2) and strongly dislike (1). And the parameters assessed include color, aroma and taste.

4. FINDINGS AND DISCUSSION

In the process of making an isotonic drink from young coconut water and blueberry extract, then adding additional substances such as citric acid, sucrose and sodium benzoate, 4 different addition formulas are produced, namely F1, F2, F3, F4 in the form of purple solutions with different concentrations. As can be seen in the following image:



Figure 1: Variations in adding isotonic drinks with coconut water and blueberry extract after adding citric acid, sucrose and sodium benzoate

The next stage in this research is to determine the optimum formulation of the isotonic drink to be made, namely by carrying out characterization tests such as organoleptic tests which include color, aroma and taste using hedonic tests, then measuring pH, measuring viscosity, measuring sodium and potassium levels and measuring sucrose. Next, the general acceptance of the panelists was assessed with the proportion of each observation,

namely color (30%), aroma (30%) and taste (40%) and also looked at the results of pH, viscosity, sodium and potassium levels and sucrose measurements to be able to determine Which additional variant formulation is the most optimal.

The first test carried out is measuring the pH or degree of acidity. The results can be seen in the following table:

Table 1: Results of pH measurements before and after adding citric acid

Isotonic drink formula	pH value	
	pH before adding citric acid	pH after adding citric acid
F1	4,82	3,96
F2	4,61	3,82
F3	4,38	3,77
F4	4,25	3,66

The table above shows that in the isotonic drink treatment, 95% young coconut water with 5% blueberry extract at the final pH had the highest pH value compared to other treatments, namely 3.96. Each formulation has a pH range of between 3.66-3.96. This result is in accordance with the standards set by SNI for isotonic drinks, namely a maximum of 4 (BSN, 1998). So the results of research on the pH of isotonic drinks from young coconut water with blueberry extract meet the quality requirements in the SNI standards for isotonic drinks. The table also shows that the greater the proportion of blueberry extract added tends to lower the pH value of

isotonic drinks. This can be seen in the pH value before adding citric acid, where the more blueberry extract that is added, the lower the resulting pH will be. This is because blueberries themselves already have a sour taste and the addition of citric acid also plays a role in lowering the pH to make it more acidic. The addition of citric acid makes the pH lower because citric acid acts as an acidifying agent and citric acid can also function as an acidulant (an acidic chemical compound added to food processing for various purposes) and as a preservative. The element that causes the sour taste is the H⁺ ion or hydrogenium ion H₃O⁺. The more acid added to a

solution, the greater the proportion of H⁺ ions released, thereby lowering the pH.

The next test is viscosity testing, the results of which can be seen in the following table:

Table 2: Results of viscosity testing of isotonic drinks	
Isotonic drink formula	Viscosity Value (Cp)
F1	1,4
F2	1,38
F3	1,4
F4	1,41

Based on the table above, the comparison of young coconut water and added blueberry extract has no effect on the viscosity of isotonic drinks. This is proven by the results in table 4.2 which shows that each additional variation treatment has a viscosity range ranging from 1.38-1.41 where the results of each treatment do not differ significantly from each other. Even when seen directly, this isotonic drink has liquid properties, this is due to the filtering process during the preparation of young coconut water and blueberries, so that there is no residue that causes the isotonic drink

Table 4: Organoleptic Test Results			
Sample	Organoleptic Test		
	Color (30%)	Aroma (30%)	Taste (40%)
F1	5,3	3,6	4,8
F2	4	3,9	5,6
F3	3,4	4,2	5,9
F4	2,2	4,6	5,2

Based on the table above, respondents gave the highest rating for the color in the F1 formula with a rating of 5.3 which means like it, the highest rating for the aroma in the F4 formula with a rating of 4.6 which means quite like it and the highest rating for the taste of the formula F3 with a rating of 5.9 which means like it. In the color assessment, respondents gave the reason that the F1 formula has a color that is not too intense so that as an isotonic drink the color is more pleasing to look at. From these results, the ratio of coconut water and blueberry extract added influences the hedonic assessment of the color of isotonic drinks. The higher the percentage of blueberry extract causes a decrease in the hedonic value of isotonic drinks. This is because blueberry extract contains anthocyanin pigments which contribute to providing color. So the more blueberry extract you add, the more intense the color of the isotonic drink will be. This dark color is what respondents don't like.

In the aroma assessment, respondents liked the dominant aroma of blueberries or had an aroma like fresh berries found in the F4 formula. The added coconut water and blueberry extract have an effect on the hedonic assessment of the aroma of isotonic drinks. The lower the percentage of blueberry extract and the higher the percentage of young coconut water

Table 5: Determination of optimum formulation					
Sample	Organoleptic Test			pH	Viscosity (Cp)
	Color (30%)	Aroma (30%)	Taste (40%)		
F1	5,3	3,6	4,8	3,96	1,4
F2	4	3,9	5,6	3,82	1,38
F3	3,4	4,2	5,9	3,77	1,4
F4	2,2	4,6	5,2	3,66	1,41

From the table above it can be seen that the optimum formulation of an isotonic drink from young coconut water and blueberry extract is the variant with the addition of 85% young coconut water and 15% blueberry extract, this is because this formula has the largest average general acceptance, namely 4.64, and appropriate viscosity and pH (BSN, 1998).

5. CONCLUSION

In this research, it can be concluded that the most optimal formulation for making isotonic drinks from young coconut water with the addition of blueberry extract is the F3 formula, namely the addition of 85% young coconut water and 15% blueberry extract and tests were carried out to determine the optimum formulation in the research. This is a pH, viscosity and organoleptic test carried out using a hedonic test on 10 respondents to assess the color, aroma and taste so that the best formulation is produced in the F3 formulation as seen from the results of the pH test which produces a pH in the range of 3.66-3.96 which indicates that The pH

to become thick. As a comparison, viscosity testing was also carried out on several brands of isotonic drinks on the market with results as in the following table:

Table 3: Viscosity test results for several isotonic drinks on the market	
Isotonic drink formula	Viscosity Value (Cp)
Brand 1	2,47
Brand 2	1,42
Brand 3	1,39
Brand 4	2,39

From the table above, it appears that isotonic drinks on the market have a viscosity in the range of 1.39-2.47 cP. So the viscosity produced from isotonic drinks from young coconut water and blueberry fruit extract which have a viscosity between this range has entered the viscosity criteria like isotonic drinks on the market. Then the final test is an organoleptic test, namely a hedonic test to measure the respondent's objective attitude towards the product. This isotonic drink is made using 4 treatments. For each treatment, this isotonic drink has different characteristics, namely in terms of color, smell and taste. The assessment results can be seen in the following table:

causes a decrease in the hedonic value of the aroma. This is because the less blueberry extract you add, the stronger the smell of coconut water will be, whereas the more blueberry extract you add, the less aromatic the coconut water will be.

And in the taste assessment, each formula has quite a large value. This is because the panelists felt that the taste was quite good, but the F3 formula had a more appropriate sweet and sour taste so it was more popular. So, the ratio of added coconut water and blueberry extract influences the hedonic assessment of the taste of isotonic drinks. There was a decrease in the hedonic value of taste as the percentage of young coconut water increased. This is because coconut water itself already has a sweet taste and blueberries have a sweet, slightly sour taste, but because of the addition of sugar and citric acid, the taste of the isotonic drink changes. Where sugar and citric acid also act as sweet and sour taste enhancers, so the more blueberry extract you add, the sweeter and sour the taste will be. After carrying out all the tests, the optimum formulation of the drink produced can be determined by assessing the general acceptance of the panelists and looking at the results of other characterization tests which can be seen from the following table:

of this isotonic drink is in accordance with and the viscosity results are in the range of 1.38-1.41, which is in accordance with the viscosity of isotonic drinks on the market and this formula has the largest average general acceptance, namely 4.64.

LIMITATION AND FURTHER RESEARCH

Based on the research that has been carried out, it is hoped that further research can be carried out by adding additional tests such as testing the total mineral and sugar content to ensure the amount of minerals and sugar contained in isotonic drinks is in accordance with the requirements in.

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