

Physicochemical and sensory characteristics of instant red ginger from various volumes of added water

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World Journal of Advanced Research and Reviews, 2024, 21(02), 1499–1507

Publication history: Received on 07 January 2024; revised on 19 February 2024; accepted on 21 February 2024

Article DOI: <https://doi.org/10.30574/wjarr.2024.21.2.0549>

Abstract

The aim of this research is to obtain the right volume of water in ginger juice extract that has the best effect on the physicochemical and sensory properties of instant ginger. The research was carried out from March to May. The location of this research was carried out at the Agroindustry Laboratory, Faculty of Agriculture and Chemistry Laboratory, Faculty of Mathematics and Natural Sciences, Tadulako University, Palu. Research parameters include yield, water content, pH test, antioxidant activity and sensory tests with ginger juice extract and water treatment formulations, namely, (100g:100mL), (100g:150mL), (100g:200mL), (100g:250mL), (100g:300mL). The research results showed that the ratio of ginger juice extract and water at an added volume of 300 mL of water provide the best physicochemical and sensory characteristics of instant ginger drink. Yield, antioxidant activity, aroma, taste, preferences have a tendency increases with increasing water volume, while water content, pH and IC₅₀ decrease.

Keywords: Red Ginger; Water; Ginger Juice Extract; Instant Ginger Drink

1. Introduction

Ginger (*Zingiber officinale*) is a spice that has long been used as a medicinal plant. In Indonesia there are three types of ginger clones (cultivars), namely small ginger, red ginger and large ginger [27]. The uses of ginger include spices, food/drink mixtures, medicines and cosmetics [1]. Compounds in ginger which are antioxidants include gingerol, shogaol and zingerone which have higher antioxidant activity than vitamin E and act as anti-inflammatory, analgesic, anticarcinogenic and cardiotoxic [30]. The phenol component in ginger oleoresin, apart from providing ginger's distinctive spicy taste, also acts as a natural antioxidant. Phenolic components such as 6-gingerol and 6-shogaol are known to have sufficient antioxidant activity. The natural antioxidant compounds in ginger are quite high and very efficient in inhibiting superoxide and hydroxyl free radicals produced by cancer cells and are anticarcinogenic, non-toxic and non-mutagenic at high concentrations [6].

One type of ginger that has been researched and is known to have good physiological properties for the body is red ginger (*Zingiber officinale* var. *Rubrum*). Another alternative to optimize the use of ginger rhizomes is to process them into ginger juice drinks in glass packaging. In this way, consuming ginger juice is more practical for modern society and more hygienic [16]. Ginger juice drink is a drink made from ginger extract. Extraction is carried out by adding a certain amount of water to obtain ginger juice which has a distinctive color, aroma and taste. After the extraction process takes place, usually there will be sediment in the ginger juice drink which comes from ginger components that are not water soluble. Was reported earlier [14], the ratio of ingredients and water in the extraction process can be determine the total chemical compounds that dissolve and influence the appearance of taste.

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2. Research Methods

The research was carried out from March to May. The location of this research was carried out at the Agroindustry Laboratory, Faculty of Agriculture and Chemistry Laboratory, Faculty of Mathematics and Natural Sciences, Tadulako University, Palu.

The ingredients used in this research were red ginger rhizomes, granulated sugar and water. The red ginger rhizomes used in this research came from the Impres Manonda market, West Palu District, Palu City. As auxiliary materials, chemicals are used for pH analysis of solutions and antioxidant analysis such as methanol, DPPH solution, HCl and distilled water (H₂O).

The tools used in this research include ovens, cups, knives, pans, spatulas, sieves, measuring cups, glasses, containers, cutting boards, pipettes, measuring flasks, spoons, digital scales (analytical scales esj210-4b), stoves (rinnai), blender (miyako) and tools for pH parameter analysis, antioxidant analysis such as desiccator, benchtop pH meter (eutech do 6+ dissolved oxygen meter), hot plate (eyela magnetic stirrer rch-3), spectrophotometry.

This research used a Completely Randomized Design for analysis of physical (Rendement) and chemical properties (Water content, pH test, antioxidant activity) while a Randomized Block Design was used for analysis of sensory properties (Aroma, taste and preference). This research consisted of 5 treatments with added volumes of water, namely 100, 150, 200, 250, 300 mL and 4 repetitions to obtain 20 experimental units. The treatment in this study consisted of a ratio of ginger juice extract and water.

Table 1 Research treatment formulation

Ginger juice extract (g)	Volume of added water (mL)	Granulated Sugar (g)
100	100	100
100	150	100
100	200	100
100	250	100
100	300	100

2.1. Research Implementation

Clean the ginger rhizomes from the remaining soil and the black and dirty ginger skin and wash it using a knife until it is clean enough to get good and fresh ginger rhizomes. Ginger rhizomes that have been cleaned are sliced into small pieces measuring ± 1 cm to make crushing easier. Clean ginger is weighed as much as 100 g. then blended and added water according to the treatment (100, 150, 200, 250 and 300 mL), then blended at speed 2 for 3 minutes. After that, the extract liquid is separated from the dregs using a filter. The filter results are left for 1 hour to separate/precipitate the starch. Ginger juice is separated from starch by decantation and ginger juice is obtained

The process of making instant ginger drink begins by pouring ginger juice according to the treatment (150-350 mL) into a pan, and adding 100 g of granulated sugar. The mixture of ginger juice and granulated sugar is heated on the stove over medium heat while stirring for 30 minutes until it boils (temperature around 100-110° C) and dries, then remove the pan from the stove and continue to stir until powder forms. Then cool it to room temperature then put it in a blender then blend at speed 2 for 3 minutes then sift with a sieve until it forms fine instant ginger powder.

3. Results and Discussion

3.1. Rendement

Data from analysis of observations of the yield of instant red ginger drink at various volumes of added water had a very real influence on the yield value of instant red ginger drink. Based on research data on the yield of instant ginger drink, it was found that the highest value of instant ginger drink was in treatment (200) with an average value of 43.25 %, and the lowest yield value was in treatment (150) with an average value of 37.13 %. The data presented in Table 2 shows that differences in yield are influenced by the water content of a food ingredient. This is in line with [24], the smaller

the water content, the smaller the weight of water contained in the material. If water is removed, the material will be more compressible and lighter, thus affecting the yield of the final product.

The size of the yield obtained is influenced by the effectiveness of the extraction process. Factors that influence extraction results are time, temperature, stirring and solvent. Apart from that, the type of solvent and sample size also affect the yield. The smaller the sample surface area, the greater the contact and increase the interaction with the solvent [23].

The yield obtained from the results of making ginger powder greatly influences the size of the material lost or wasted when making the powder. The higher the yield value of the powder produced, the higher the loss of material produced. The lower the yield value of the powder produced, the higher the loss of material produced. The higher the yield value produced, the lower the level of material loss obtained. The rate of powder loss that occurs is usually inversely proportional to the amount of yield produced. [22].

Another factor that influences the difference in yield values is the difference in extraction time and temperature used in the extraction process. The temperature and length of extraction time result in optimal contact time between the solvent or sample, so that the penetration process between the solvent entering the raw material is better and causes more compounds to diffuse out of the cells [18].

Table 2 Average value of ginger drink yield instant red

Volume of added water (mL)	Yield (%)	Notation
100	40.13	b
150	37.13	a
200	43.25	c
250	41.63	bc
300	43.00	c

Information: Numbers followed by different letters indicate a significant difference based on the BNJ test at the 1% level.

3.2. Water content

Data from observations of the water content of instant ginger drinks shows that the volume of added water has a real influence on the water content of instant red ginger drinks. Data from water content analysis shows that the water content value ranges from 1.42 – 2.13%, Treatment (300) has the lowest water content compared to other treatments. However, if you look at SNI 01-4320-1996 concerning quality standards for powdered drinks, all treatments (100, 150, 200 and 250) are still within normal limits with a maximum figure of 5%. The thing that influences the high and low water content is caused by the oven temperature not being the same when drying the sample. This research is in line with [16] showing that one of the factors that influences the water content in food is the density of solids. The density of ginger juice drinks tends to increase with the ratio of red ginger: water, namely 1:10. The higher the water ratio, the lower the density of dissolved solids.

Water content affects the shelf life of the product. Products that contain additional ingredients in the form of liquids will affect the final results and product shelf life, and products that have high water content tend to have a short shelf life [20]. If the water content of the food does not meet the requirements, the food will experience physical and chemical changes characterized by the growth of microorganisms in the food, making the food unfit for consumption. The water content of the material decreases simultaneously. This is in accordance with the aim of drying, namely to reduce the water content in food [25].

The water content test is carried out to determine the percentage water content in the powder. Water content is the main parameter in determining the quality of dry products such as instant drink powder. Low water content can prevent the growth of destructive microorganisms such as bacteria and fungi which can damage the product [10].

Table 3 Average value of water content of ginger drinks instant red

Volume of added water (mL)	Water content (%)	Notation
100	1.65	ab
150	2.13	c
200	1.49	ab
250	2.07	c
300	1.42	a

Information: A number followed by the same letter means no real difference

3.3. pH

Data from observations of the pH of the instant red ginger drink shows that the volume of added water has a significant effect on the pH of the instant red ginger drink solution. The analysis results show that the lowest pH value for instant ginger drink is 6.22 and the highest pH value is 6.55. The lower the pH is in line with research [26], the higher the solvent concentration, the pH value tends to decrease because the greater amount of solvent is thought to increase the solubility of the acid. More and more organic acids contained in parijoto stalks are also extracted. So the level of ionization will also increase. If the solubility of the acid is better, then the tendency to release protons (H⁺ ions) is also greater. The higher the acidity level of an acid in a solution, the greater its tendency to release protons (H⁺) so that the pH drops.

The longer the extraction time for making ginger juice drinks, the resulting pH value will tend to decrease. The pH tends to decrease as the heating temperature increases. This is thought to be caused by the increase in heat energy contained in the solvent (water), which dissolves more of the chemical components in the ginger rhizome which are acidic. The higher the temperature, the faster the extraction process and the greater the extraction results. Ginger contains folic acid & pantothenic acid [12].

One of the important characteristics of a food product is the buffering capacity of the product itself (buffering), namely the product's ability to resist changes in pH. Food products with a low buffer capacity will easily change their pH quickly in response to acidic or alkaline compounds, while food with a high buffer capacity has the ability to withstand these changes better [3].

One of the factors that influences the quality of instant powder drinks is the crystallization process. What is very important in this process is the solid-liquid separation technique because it can produce product purity of up to 100%. The pH of the solution also affects the properties of sucrose, where if the pH of the solution is acidic, the sucrose will not undergo crystallization and will only form caramel. The optimum pH that can produce good instant powder products is around 6.7-6.8 [4].

Table 4 Average pH value of red ginger drink instant

Volume of added water (mL)	pH	Notation
100	6.55	b
150	6.44	b
200	6.40	b
250	6.39	b
300	6.22	a

Information : A number followed by the same letter means no real difference

3.4. Antioxidant Activity

Data from analysis of variance shows that the antioxidant activity of ginger has a very real influence on the treatment of instant red ginger drink. The results of the antioxidant activity analysis showed that the highest antioxidant activity of instant red ginger drink was obtained in the treatment (300), while the lowest was in the treatment (100). Treatment (300) is a treatment that contains stronger antioxidant activity compared to other treatments. Was reported earlier [21]

states that the smaller the IC_{50} value indicates the higher the antioxidant activity of a compound or substance with antioxidant activity.

Ginger has the phenol components gingerol and shogaol which are found in ginger oleoresin. Ginger oleoresin can prevent the oxidation process by blocking or capturing free radicals so that ginger acts as an antioxidant. The natural antioxidant compounds in ginger are quite high and very efficient in inhibiting free radicals. Gingerol, shogaol and zingeron in ginger provide pharmacological and physiological activities such as antioxidant effects [9].

IC_{50} is the concentration that reduces 50 percent of DPPH free radicals. Specifically, a compound is said to be a very strong antioxidant if the IC_{50} value is <50 ppm, strong if the IC_{50} value is 50-100 ppm, moderate if the IC_{50} value is 100-150 ppm, and weak if the IC_{50} value is 151-200 ppm [31]. Determination of antioxidant activity using the DPPH method can provide information on the reactivity of the compound being tested with a stable radical. The parameter to show antioxidant activity is the inhibitory concentration (IC_{50}) [11].

The greater the concentration of the red ginger solution, the more antioxidant compounds will become hydrogen or electron donors for DPPH radicals, resulting in a change in the color of DPPH which causes the resulting absorbance to be smaller. The greater the concentration of the solution, the greater the resulting trapping percentage. This shows a proportional relationship between concentration and percent fishing activity [13].

Table 5 Antioxidant activity of ginger drinks instant red at various volumes adding water

Water Added Volume (mL)	Antioxidant Activity	IC_{50} (ppm)	Information
100	42.185	101.595	Currently
150	43.504	92.672	Strong
200	43.307	75.701	Strong
250	47.598	65.479	Strong
300	54.665	49.596	Very strong

3.5. Aroma

Data from observations of the aroma scores of instant red ginger drinks at various volumes of added water had a very real influence on the treatment of instant ginger drinks. The BNJ test results show that the aroma scores for instant ginger drinks differ in the level of liking for the aroma of instant red ginger drinks. The aroma score ranged between 3.85 – 6.30, with the highest aroma panelist score in the ginger and water ratio treatment (300) with a value of 6.30 and the lowest aroma score in the ginger and water ratio treatment (100). The data presented shows that the treatment (300) is preferred more by panelists because the aroma of the ginger drink produced is not too strong, while the treatment aroma score (100) is least liked by panelists because the aroma of the instant ginger drink tends to be strong.

Red ginger has a distinctive aroma and spicy taste. By extracting the ratio of ingredients and water, the aroma with more ingredients than water will be sharper because the process produces essential oils in it, thus affecting the aroma [16].

A food ingredient that is considered delicious and has a good texture will not be consumed if it has a color that deviates from its proper color. Determining the quality of a food ingredient depends on several factors, but before other factors are taken into account visually, the color factor appears first to determine the quality of the food ingredient [8].

Aroma is a sensory sensation that is known to have a sense of smell which can influence the level of consumer acceptance of a product. Aroma is also a sensory property that is difficult to classify or explain because its variety is so great [15].

A compound has an aroma or odor when two conditions are met, namely that it is easy to smell at the top of the nose and requires sufficient concentration to interact with one or more other smells [5].

Table 6 Average drink aroma scores instant red ginger

Volume of added water (mL)	Aroma	Notation
100	3.85	a
150	5.10	ab
200	6.25	bc
250	5.35	ab
300	6.30	c

Information : Numbers followed by different letters indicate a significant difference based on the BNJ test at the 1% level.

3.6. Flavor

Data from observations of the taste scores of instant red ginger drinks in various volumes of added water has a very significant effect on the treatment of instant ginger drink. The BNJ test results showed that the average results of the panelists' descriptive assessments of the taste of instant red ginger drink ranged from 3.75 – 6.40. The highest score was in treatment (200) with a score of 6.40 and the lowest score was in treatment (100), namely 3.75. Score analysis the taste of instant ginger drinks is significantly different, influenced by the raw materials used. Ginger contains oleoresin which consists of zingerol, shogaol and resin components which cause the spicy taste of ginger.

The taste assessed in this study is the taste that comes from spicy ginger. The ratio of ingredients and water in the extraction process can determine the total chemical compounds that dissolve and influence the appearance and taste. The resulting taste comes from the ingredients themselves. The number of ingredients is an important part in some food processing which means that the color, taste and appearance of the food can have an influence [28].

Taste is influenced by several factors, namely chemical compounds, temperature, concentration, and interactions with other flavor components. The combination of high temperature and long drying time causes the inversion of sucrose into glucose and fructose so that the sweet taste of the instant drink is reduced, causing the spicy taste of ginger to become dominant. Meanwhile, the spicy taste of instant drinks comes from the chemical compound of ginger, namely zingerone, which has a boiling point of 187-188°C so that no evaporation occurs during the drying process at lower temperatures [7].

Taste can be determined by taste and mouth stimulation. The texture and consistency of an ingredient will influence the taste produced by that ingredient, and taste has an important role in the quality of a food ingredient. Changes in the texture or viscosity of food can change the taste that occurs because it can affect the stimulation of olfactory receptors and salivary glands [29].

Table 7 Average drink taste scores instant red ginger

Volume of added water (mL)	Flavor	Notation
100	3.75	a
150	5.25	b
200	6.40	c
250	5.85	bc
300	6.20	c

Information : Numbers followed by different letters indicate a significant difference based on the BNJ test at the 1% level.

3.7. Favorite

Data from observations of the preference scores for instant red ginger drinks at various volumes of water addition had a very real influence on the treatment of instant ginger drinks. The average rating of the panelists' liking scores for the level of liking for instant ginger drinks ranged from 3.95 – 6.35. The BNJ test results showed that the highest score of panelists' preference for instant ginger drink was obtained in the ginger to water ratio treatment (300) with a score of 6.35, this is because the taste of ginger is slightly spicy and the taste is not too sweet, the color and aroma are good. does

not overpower the spicy taste of ginger. Meanwhile, the lowest liking score was found in the treatment (100) with a value of 3.95. This is because the taste of ginger is too spicy so the panelists don't like the taste, color and aroma from the ginger that pierced the nose, the panelists didn't like it. A person's level of preference can be influenced by several things, namely color, taste and attractive appearance, high nutritional value and benefits for consumers. Based on the level of preference in giving an assessment on the questionnaire that was given, most of the panelists emphasized their preference for taste and were more dominant in choosing the sample with the highest concentration, namely 70%. This happened because the 70% concentration had a sweet taste and was not too spicy, then ginger which the original and fresh ginger used was used so that it could increase the panelists' preference for instant ginger powder drinks [17].

The more ginger you add, the spicier the instant drink will taste. The addition of more ginger juice than palm sugar in each treatment produces an instant drink that tastes more spicy than ginger. This ginger juice drink sweetness level test was carried out to measure the panelists' liking for the sweet taste of ginger juice drink products. The test carried out is a hedonic quality test.

This is a test carried out to assess the specific properties of a product. In this case, the hedonic quality test carried out was the level of panelists' preference for the spiciness of ginger. Ginger juice is a drink that contains aromatic compounds with a spicy smell and a distinctive spicy taste [2].

The dual reaction of the aroma and taste of a food can create taste. If the taste (thickness and texture) of a food ingredient is combined in the mouth, consumers can differentiate one food ingredient from another. Apart from that, the level of heating can also change the taste components and physical properties of food ingredients, thereby influencing the panelists' level of preference [19].

Table 8 Average drink preference score instant red ginger

Volume of added water (mL)	Favorite	Notation
100	3.95	a
150	5.90	b
200	6.15	c
250	6.00	bc
300	6.35	c

Information: Numbers followed by different letters indicate a significant difference based on the BNJ test at the 1% level.

4. Conclusion

The results of research and discussion regarding the best instant red ginger drink with various additions of ginger and water can be concluded that the ratio of 300 mL of ginger extract provides optimal characteristics and sensors for instant ginger drink with a yield value of 43.00%, water content of 1.42%, pH 6.22, antioxidant activity 43.30%, aroma score 6.30, taste 6.20, and liking 6.35.

Suggestion

In order to carry out further research regarding the ratio of ginger and water with solvents other than water with the addition of a sugar concentration that is in accordance with quality standards so that it can provide a taste that the panelists like.

Compliance with ethical standards

Disclosure of conflict of interest

No conflict of interest to be disclosed.

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