BIOLOGY, MEDICINE, & NATURAL PRODUCT CHEMISTRY ISSN 2089-6514 (paper)
Volume 14, Number 1, April 2025 | Pages: 9-16 | DOI: 10.14421/biomedich.2025.141.9-16 ISSN 2540-9328 (online)

Identification of JAMU KU-HE-SE as an Alternative Health Supporting Ingredient

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Manuscript received: 20 September, 2024. Revision accepted: 18 February, 2025. Published: 18 February, 2025.

Abstract

Herbal plants have been used since ancient times in traditional medicine and continue to be maintained and preserved in Indonesia. They are called Jm. Each part of an herbal plant has active components in the form of secondary metabolite compounds, ranging from tubers, wood, sap, latex, leaves, flowers, fruits, and seeds that function to maintain life in their environment. Turmeric, ginger, and lemongrass are included in Jm plants, which are very useful in traditional medicine because they have various secondary metabolite compounds. This study aims to obtain an even distribution of secondary metabolite compounds through phytochemical tests, inhibition of free radicals through antioxidant activity tests, and an even distribution of nutrients through proximate analysis in JKHS samples with a certain formula. The results of the phytochemical test showed that JKHS contains several important phytochemical components with the intensity it shows. Phenolic content (++) can provide benefits in protecting body cells from oxidative damage. Saponin (+) has anti-inflammatory properties and has the potential as an antimicrobial agent. In addition, steroids (+) and terpenoids (++), play a role in regulating the body's physiological functions and can support hormonal balance and the immune system and the potential in treating certain diseases. Alkaloid content (+)can affect the nervous system and has analgesic and stimulant properties. JKHS samples also contain carotenoids (+), which protect body cells from free radicals and oxidative damage. With the IC_{50} value of 4.838 µg / mL of the sample, it shows that JKHS extract has very strong antioxidant potential. Through proximate analysis, it was obtained that the water content (15.38%) reflects the humidity level in JKHS which can affect the stability of product storage, the ash content (6.29%) indicates that JKHS can be a good source of minerals to support health, the crude protein content (3.79%) indicates that JKHS contributes to daily protein intake, especially in regular consumption, the fat content (6.43%) contributes energy and plays an important role in the absorption of fat-soluble vitamins and other bioactive compounds that may be contained in JKHS, the carbohydrate content (81.37%) indicates that the main component of JKHS is carbohydrates, which function as the main source of energy for the body that can support physical activity and daily energy needs, and the fiber content (5.45%) is an important component that helps smooth the digestion process, improves intestinal health, and helps prevent digestive disorders such as constipation, and plays a role in maintaining blood sugar levels and supporting weight management. Overall, the proximate composition of JKHS has good nutritional value, with carbohydrates as the dominant energy source, as well as additional protein, fat, and fiber that support overall health. This combination of formulas makes JKHS have great potential as a Jm drink that can provide various health benefits, especially in protecting the body from oxidative stress, inflammation, and other disease risks, including supporting the regeneration of cells, nerves, and other organs of the body that are weak due to climate, work, or old age.

Keywords: antioxidant analysis; JKHS; phytochemical analysis; proximate analysis; traditional medicine.

INTRODUCTION

Climate change (Botahala, Manimoy, et al., 2022) due to global warming (Botahala et al., 2021); (Botahala, Oualeng, et al., 2022) triggered by the rapid development of technological advances (Botahala, 2021a) today also plays a role in hurting public health. This negative impact on public health can also occur due to excessive work with a traditional lifestyle where people often ignore health principles (Botahala et al., 2023). For example, when working, people no longer pay attention to rest time, people pay less attention to their diet and the menu they consume, and so on. These conditions require people to use herbal medicinal plants as a traditional medicine to prevent contracting diseases caused by viruses by maintaining and even increasing immunity.

Traditional medicine comprises a compendium of knowledge, skills, and practices that are grounded in various theoretical frameworks, beliefs, and experiential insights derived from diverse cultural backgrounds employed in health care, which have been transmitted across generations (Taek et al., 2019); (Fatemi et al., 2023). The genesis of traditional medicine is rooted in the personal experience of illness encountered by oneself or by others, thereby fostering the evolution of reasoning concerning the etiological factors of illness based on discernible signs or symptoms experienced, which subsequently catalyzes the conceptualization of methods

for the prevention and treatment of illness or disease (Taek, 2020). Herbal plants have been used traditionally since ancient times in traditional medicine (Taek, 2020), and continue to be maintained and preserved until now in Indonesia it is called Jamu (Jm) (Maharani et al., 2023). Each part of an herbal plant has active components in the form of secondary metabolite compounds, ranging from tubers, wood, sap, latex, leaves, flowers, fruits, and seeds which function to maintain life in their environment (Kawabata et al., 2019); (Fatemi et al., 2023).

Several spice plants that are rich in secondary metabolite compounds (Besituba et al., 2024) have the potential as Jm (Priyanto et al., 2024), among which are often used as kitchen spices. Their properties and benefits have been scientifically described in the book Herbal Bumbu Dapur (Botahala, 2021a). Turmeric from the *Zingiberaceae* family with the species name Curcuma longa L. contains compounds that have health benefits (Botahala, 2021b), including curing joint pain, preventing cancer, and others (Singletary, 2020); (Bhowmik et al., 2009); (Botahala et al., 2023). Ginger has a spicy taste caused by a ketone compound called *Zingerone*, which has antimicrobial, anti-inflammatory, antitumor activities, and others (Imo & Za'aku, 2019); (Azmat et al., 2019). Ginger also has a protective effect on the digestive tract and relieves nausea symptoms (Shahrajabian et al., 2019). Lemongrass from the *Poaceae* family or grasses is the *Cymbopongoncitratus* species (Spriha et al., 2021) which is quite abundant in Indonesia. Lemongrass also contains several secondary metabolite compounds (Spriha et al., 2021); (Mukherjee et al., 2024); (Sulaswatty et al., 2019). The benefits of lemongrass include anti-inflammatory, anti-inflammatory, antioxidant, improving blood circulation, relieving coughs, expectorant, and others (J. Thasrin & V. Anitha, 2023); (Madane, 2024).

These very beneficial turmeric, ginger, and lemongrass can be made into Jm with a specific formula. This Jm is made in powder form by drying it first. This is done to maintain the availability of raw materials. The powder of each sample is then formulated with a ratio of 50% turmeric powder because of its *curcumin* which can provide various benefits, compared to 33% ginger powder to avoid stomach irritation (Harwati, 2012) and even slightly interfere with liver function (Nwaopara et al., 2007) due to the properties of *zingiber*, compared to 17% lemongrass powder to maintain the safety of pregnant women and the quality of breast milk (Saphira, 2020), to avoid excessive dehydration (Royhanaty et al., 2018), even its role as a natural insecticide and antiseptic (Gaba et al., 2020) due to its citronellal properties. These three sample powders were mixed to obtain JAMU KU-HE-SE (JKHS) powder. This comparison formulation is made based on the chemical characteristics of each plant.

This study aims to obtain an even distribution of secondary metabolite compounds in JKHS samples through phytochemical screening (Sanni et al., 2023); (Sanni et al., 2024) and potent antioxidant properties in terms of antioxidant activity to determine the inhibitory power (IC_{50}) against free radicals in the body (Filbert et al., 2014); (Moghaddam et al., 2021), as well as proximate analysis to determine the distribution of nutrients (Sanni et al., 2023); (Sanni et al., 2024) from a mixture of turmeric, ginger, and lemongrass from Alor Regency, East Nusa Tenggara Province, Indonesia. The results of the study are expected to be used in maintaining body immunity, including supporting the regeneration of cells, nerves, and other organs that are weak due to climate, work, or old age.

MATERIALS AND METHODS

Materials

The materials used are 3 kg each of turmeric rhizome, 2 kg of ginger rhizome, and 1 kg of lemongrass stalks, concentrated hydrogen chloride (HCl), iron (III) chloride ($FeCl_3$), concentrated sulfuric acid (H_2SO_4), chloroform ($CHCl_3$), distilled water, norite/charcoal, ammonia (NH_3), ethanol (C_2H_5OH) 95%, anhydrous acetic acid ($C_4H_6O_3$) or $(CH_3CO)_2O$, ammonia (NH_3), Meyer's reagent, Dragendorff's reagent, Wanger's reagent, 2,2-diphenyl-1-picrylhydrazyl (DPPH), hexane (C_6H_{14}), acetone (C_3H_6O), potassium sulfate (K_2SO_4), mercury (II) oxide (HgO), sodium hydroxide (NaOH), sodium thiosulfate ($Na_2S_2O_3$), boric acid (H_3BO_3), methylene red ($C_{15}H_{15}N_3O_2$), methylene blue ($C_{16}H_{18}N_3SCl$), and test samples in the form of turmeric rhizome, ginger rhizome, and lemongrass stalks taken from Alor Regency, East Nusa Tenggara Province, Indonesia. The types of equipment used in this study were: blender, knife, sieve, cotton, basin, stirrer, beaker, filter paper, frying pan, stove, mesh sieve, spoon, scale, analytical balance, test tube, Buchner funnel, water bath, dropper plate, measuring pipette, Pasteur pipette, porcelain cup, erlenmeyer, desiccator, oven, 1 ml micropipette, soxhlet apparatus, Kjeldahl flask, petri dish, thermometer, distillation flask, fat flask, incubator, refrigerator, UV-Vis spectrophotometer, burette and stand, measuring flask, cuvette, dark vial, and aluminum cup.

Methods

Sample Preparation

Each turmeric rhizome, ginger rhizome, and lemongrass stalk cleaned is taken, thinly sliced, and dried using sunlight. After drying, the samples are ground separately using a blender to produce powder and sieved using a sieve with a mesh size of No. 60 (0.25 mm). The powder of each sample is then formulated with a ratio of 50% turmeric powder compared to 33% ginger powder compared to 17% lemongrass powder to obtain a JKHS powder sample that is ready to be analyzed.

Phytochemical Analysis

The JKHS phytochemical test procedure was carried out based on the procedure by (Botahala et al., 2024) and (Sanni et al., 2024) with several modifications for this study. A total of 3 grams of JKHS sample was put into a test tube, then macerated with ethanol in a water bath for 15 minutes. Then, it was filtered hot into a test tube and left until all the ethanol evaporated to dryness. After that, the residue and filtrate were separated.

The filtrate was added with chloroform and distilled water (aquadest) in a ratio of 1:1, each as much as 6 mL. Shake until thoroughly mixed then transfer into a test tube, leave for a moment until a 2-layer solution is formed, namely the chloroform layer and the water layer. Furthermore, the chloroform layer and the water layer are separated. The water layer is used for testing phenolic, flavonoid, and saponin content while the chloroform layer is used for testing steroids and terpenoids (Botahala et al., 2020).

- ***Phenolic Test***

The water layer is inserted into a dropper plate, after which 10 drops of 1% $FeCl_3$ are added. If blue, purple, blackish green and solid black colors are formed, it indicates the presence of phenolic compounds.

- ***Saponin Test***

The water layer is pipetted into a test tube and then shaken vigorously. If foam forms after a few minutes, it indicates the presence of saponins.

- ***Steroid and Terpenoid Test***

The chloroform layer is inserted into a Pasteur pipette containing charcoal or norite. The filtrate from the pipette is inserted into three holes in the dropper plate and left to dry. Furthermore, concentrated sulfuric acid (H_2SO_4) is added to the first hole, a drop of anhydrous acetic acid and a drop of sulfuric acid are added to the second hole, while the third hole is used as a blank. If a blue-purple color is formed, it indicates the presence of steroids, while if a red color is formed, it indicates the presence of terpenoids.

- ***Alkaloid Test***

A total of 4 grams of JKHS sample was put into a container, then 10 mL of 0.05 N chloroform-ammonia was added and stirred slowly. After that, the solution was filtered with a small funnel with cotton placed as a filter, and the filtered results were put into a test tube. The filtrate was added with 10 drops of 2 N sulfuric acid and shaken slowly. After that, it was left until an acid and chloroform layers formed. A drop of Meyer's reagent Dragendorff's reagent and Wanger's reagent were added to the acid layer to obtain the results. (The reaction with Mayer's reagent will form a white precipitate, with Dragendorff's reagent, a red-orange precipitate is formed, and with Wagner's reagent, a brown precipitate is formed)

Antioxidant Activity Test

The antioxidant test procedure was carried out based on the procedures carried out by (Moghaddam et al., 2021), (Botahala et al., 2024), and (Pratiwi et al., 2023) with some modifications for this study.

- ***Preparation of DPPH Solution***

Weighed 15 mg of DPPH solid using an analytical balance, dissolved with 20 ml of ethanol in a dark vial, and homogenized. The solution was then put into a 25 ml measuring flask to the limit mark and incubated in the refrigerator for 30 minutes. The DPPH control solution was ready to use. The DPPH control solution was tested on a UV-Vis spectrophotometer with a wavelength of 516 nm as an absorbance control in this test.

- ***Sample Preparation and Antioxidant Test***

A total of 3 mg of JKHS test sample was made into a solution with a concentration of 12.5 ppm, 25 ppm, 50 ppm, and 100 ppm. Each test solution was taken 1 ml and added 2 ml of DPPH and 1 ml of ethanol respectively then incubated for 30 minutes at room temperature. After that, samples of each concentration were transferred into a cuvette and measured using a UV-Vis spectrophotometer at a wavelength of 516 nm to determine the absorbance value. Furthermore, antioxidant activity was determined using the % inhibition formula in the equation.

$$\% \text{ antioxidant} = \frac{\text{Absorbance of blank} - \text{Absorbance of the test sample}}{\text{Absorbance of blank}} \times 100$$

The results of the calculation of this antioxidant activity were then used to calculate the inhibition value (IC_{50}) (Yuliani et al., 2016); (Botahala, 2024). The % Inhibition value at each concentration was then entered into the regression equation with the sample concentration as the x-axis and % inhibition as the y-axis. The IC_{50} value was obtained from the calculation when % inhibition was 50% from the equation $y = ax \pm b$.

Proximate Test

Next, a proximate test was carried out based on the procedure from Sanni et al. (2023) with several modifications in the interests of this study to determine the nutritional content of the JKHS sample. This nutritional content analysis includes testing water content, ash content, protein content, fat content, and carbohydrate content.

- ***Water Content***

The water content of the JKHS sample was analyzed using the gravimetric method. The aluminum cup was dried in an oven at 130 ± 3℃ for 15 minutes and then cooled in a desiccator for 10 minutes. A total of 3 grams of sample was weighed into an aluminum cup of known

weight (the cup must be dried in an oven before being used for weighing), then dried in an oven at a temperature of 105℃ for 3 hours, cooled in a desiccator and weighed until a constant weight was obtained (≤ 0.0005 g).

$$\% \text{ water content} = \frac{a-b}{a} \times 100$$

- ***Ash Content***

Ash content analysis of JKHS samples was carried out using the gravimetric method. An empty porcelain cup and lid were dried in an oven at 105℃ for 15 minutes and cooled in a desiccator. The dry porcelain cup was weighed, and its weight was recorded before use. A total of 5 grams of spice powder samples were weighed in the porcelain cup and put into an electric furnace at 550℃ until the ashing process was complete. After the ashing was complete, the sample was cooled in a desiccator. The sample can then be weighed and calculated.

$$\% \text{ ash content} = \frac{b}{a} \times 100$$

Description:
a : mass of the sample before heating
b : mass of the sample after heating

- ***Protein Content***

Analysis of protein content of JKHS samples was analyzed using the Kjeldahl method. A total of 200.0 mg of sample was put into a Kjeldahl flask then added with 1.9 ± 0.1 g K_2SO_4, 40.0 ± 10 mg HgO, 2 ± 0.1 ml concentrated H_2SO_4 and three boiling stones. The sample was heated at a gradual temperature until boiling for 2 hours until a clear liquid was obtained. After being cooled, the contents of the flask were transferred into a distillation flask by rinsing with 2 ml of distilled water 5 – 6 times. The washing water was transferred to a distillation flask and then added with 8 – 10 ml of 10% NaOH – 5% $Na_2S_2O_3$ solution. In a separate place, 5 ml of H_3BO_3 solution and 2 – 4 drops of methyl red indicator – methyl blue were put into an Erlenmeyer flask. The Erlenmeyer flask was then placed under the condenser with the tip of the condenser submerged under the H_3BO_3 solution. The distillation process was carried out until approximately 15 ml of distillate was obtained.

The distillate obtained was diluted to 50 ml with distilled water, then titrated with a standardized 0.02 N HCl solution until the color changed to gray. The volume of the standardized 0.02 N HCl solution used for titration was recorded. The same steps were carried out for the blank solution, so the volume of 0.02 N HCl solution was obtained for the blank. The protein content was calculated based on the nitrogen content (N in g/1000 g of material).

The nitrogen content value in the sample can be calculated using the formula:

$$\%N = \frac{(\text{mL HCl sample} - \text{mL HCl blank}) \text{x N HCl x } 14{,}007}{\text{mg sample}} \text{ x } 100$$

After obtaining the nitrogen content (%N), the protein content was calculated using the conversion factor.

$$Protein\ content\ =\ \%N\ x\ f\_k$$

f_k = correction factor (6.25)

- ***Fat Content***

The fat content of the JKHS sample was analyzed using the Soxhlet method. The fat flask was dried in an oven at 105℃ for 15 minutes, cooled in a desiccator, and weighed before use. A total of 10 grams of the JKHS sample was inserted into a filter cartridge lined with cotton.

The top of the paper cartridge containing the sample was plugged with cotton and then dried in an oven at no more than 80℃ for ± 1 hour. The paper cartridge was then inserted into a soxhlet apparatus connected to the fat flask. The fat sample was extracted with hexane for ± 6 hours. The hexane was then distilled to obtain the fat extract. The fat extract in the fat flask was then dried in an oven at 105℃ for 12 hours. The fat sample flask was then cooled in a desiccator and weighed. Drying was repeated until a constant weight was obtained.

- ***Carbohydrate Content***

Determination of carbohydrate content of JKHS samples using by difference with the following formula:

% carbohydrate = 100% - (% water content + % protein content + % ash content + % fat content).

- ***Fiber Content***

A total of 2 grams of JKHS sample was put into a 250 mL beaker and 50 mL of 0.3 N H_2SO_4 was added and then heated at 70℃ for 1 hour. Next, 25 ml of 1.5 N NaOH was added and heated for 30 minutes at 70℃. The solution was then filtered using a Buchner funnel. During filtration, the precipitate was washed successively with sufficient hot distilled water, 50 mL of 0.3 N H_2SO_4, and 25 mL of acetone. Filter paper containing the residue was put into a petri dish and dried in an oven for 1 hour at 105℃. Cooled and weighed.

$$\text{Crude fiber content (\%)} = \frac{b-a}{x} \text{ x } 100$$

Description:
b = weight of filter paper + sample after oven;
a = weight of filter paper;
x = weight of sample.

RESULTS AND DISCUSSION

Results

Phytochemical Composition

The results of phytochemical screening showed the presence of several compounds, such as phenolics, saponins, steroids, terpenoids, alkaloids, and carotenoids, as shown in Table 1 below.

Table 1. Results of JKHS phytochemical tests.

No	Compounds	Analysis Results
1	Phenolic	(++)
2	Saponins	(+)
3	Steroids	(+)
4	Terpenoids	(++)
5	Alkaloids	(+)
6	Carotenoids	(+)

Antioxidant Activity

The data obtained from the analysis of antioxidant activity are shown in Table 2.

Table 2. Results of the antioxidant activity test of JKHS samples.

Concentration (µg/mL)	Abs. Blank	Abs. Sample	Antioxidant activity (%)
12.5	0.79	0.69	12.6582
25.0	0.79	0.56	29.1139
50.0	0.79	0.43	45.5696
100.0	0.79	0.1	87.3417

The data from the antioxidant activity test results were then entered into a linear regression to produce data as shown in the graph in Figure 1 below.

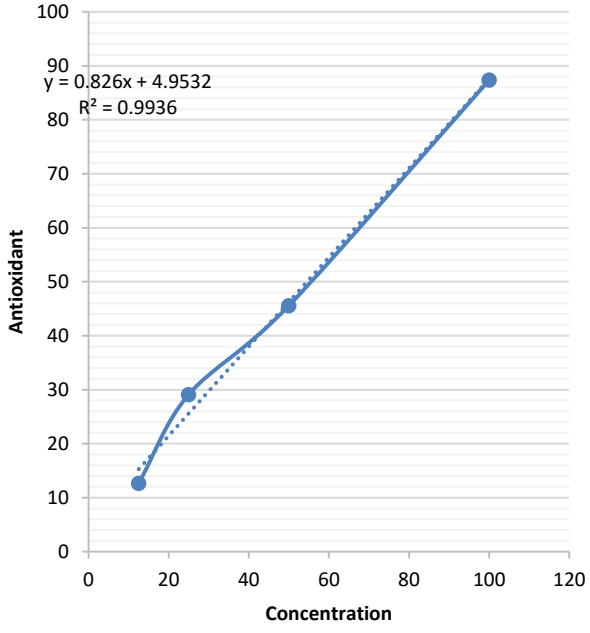

Figure 1. Graph of the relationship between concentration and antioxidants JKHS.

Proximate Composition

The proximate analysis of JKHS includes analysis of water content, ash content, protein content, fat content, carbohydrates content, and fiber content, as in Table 3 below.

Table 3. Proximate test results of JKHS samples.

No	Content	Analysis Results
1	Water (%)	15.38
2	Ash (%)	6.29
3	Crude Protein (%)	3.79
4	Crude Fat (%)	6.43
5	Carbohydrate (%)	81.37
6	Fiber (%)	5.54

Discussion

Phytochemical Test

The results of the phytochemical test showed that JKHS contains several important phytochemical components with the intensity shown. The phenolic content was detected as very high (++), which indicates its potential as an antioxidant agent. It plays an important role in protecting the body from oxidative damage caused by free radicals. Saponins were also found in positive amounts (+), which have a role in anti-inflammatory and immunomodulatory activities. This indicates that JKHS can help fight infections and reduce inflammation. In addition, steroids (+) and terpenoids (++), which have antimicrobial and anti-inflammatory activities, were also detected. Terpenoids have various benefits, including as antioxidants, anti-cancer, and anti-microbial. This indicates that this Jm has the potential to help reduce inflammation and support immune system health. The alkaloid content (+) is known to have analgesic (pain reliever) and antispasmodic effects. Its presence in herbal kitchen spice samples indicates that this herbal medicine can help reduce pain and fight damage caused by free radicals. JKHS samples also contain carotenoids with (+) intensity which function as antioxidants, and pro-vitamin A, which are also found in JKHS. Carotenoids are known for protecting the skin and eyes from UV damage.

Antioxidant Activity

The test results indicate that antioxidant activity increases with increasing extract concentration. Data obtained from the analysis of antioxidant activity are shown in Table 2. Among the various concentrations tested, 100 µg/mL concentration showed the highest antioxidant activity, while 12.5 µg/mL concentration showed the lowest. At a concentration of 12.5 µg/mL, the extract showed significant antioxidant activity (12.6582%). This shows that at low concentrations, the extract has begun to provide antioxidant effects. At a concentration of 25 µg/mL, antioxidant activity (29.1139%) showed an increase with increasing concentration. This shows a positive correlation between extract concentration and the ability to capture free

radicals. At a 50 µg/mL concentration, antioxidant activity increased (45.5696%), indicating that the extract has practical components in counteracting free radicals at medium concentrations. At a concentration of 100 µg/mL, antioxidant activity peaked (87.3417%). The strong potent antioxidant effect indicates that the extract has excellent potential as a source of natural antioxidants at high concentrations. Furthermore, based on the linear regression equation (Figure 1), $y = 0.826x + 4.9532$ was obtained with a correlation coefficient of R^2 (0.9936). The R^2 value describes the linearity of concentration to the percentage of inhibition. A value approaching 1 indicates that with increasing extract concentration, antioxidant activity also increases. By entering the value of y = 50 (the inhibitory power at 50% of free radicals), the x value will be obtained (where x is the value of Ln IC_{50}). Thus, the IC_{50} value (which is the value of anti-Ln value x) is 4.838 µg/mL sample. This value shows that JKHS extract has very strong antioxidant potential.

Proximate Analysis

Overall, the proximate composition of JKHS has good nutritional value, with carbohydrates as the dominant energy source and additional protein, fat, and fiber that support overall health. Table 3 above, shows that the results of the proximate analysis of JKHS show several main nutritional components that provide an overview of its quality and nutritional potential.

- The water content of 15.38% reflects the humidity level in JKHS. This relatively high water content indicates that JKHS still has a significant water content, which can affect the stability of product storage. Therefore, it is necessary to pay attention to proper drying and storage techniques so that JKHS remains stable and is not easily damaged during the shelf life.
- The 6.29% ash content indicates the mineral content in JKHS. Ash content indicates the amount of minerals remaining after the sample combustion process, which reflects the content of mineral elements such as calcium, magnesium, potassium, and other microelements that are important for the body. This fairly high ash content indicates that JKHS can be a good source of minerals to support health.
- The crude protein content of 3.79% indicates that JKHS contains moderate protein. Protein is an important component in supporting the growth and repair of body cells. Although not the primary source of protein, JKHS still contributes to daily protein intake, especially in regular consumption.
- The crude fat content of 6.43% provides a significant energy contribution. Fat also plays an important role in absorbing fat-soluble vitamins and other bioactive compounds that may be contained in JKHS. This fat also provides texture and flavor to the mixture, which can improve the palatability or taste of the product.
- The carbohydrate content of 81.37% shows that the main component of JKHS is carbohydrates, which function as the primary source of energy for the body. High amounts of carbohydrates provide the potential for JKHS as a good source of calories, supporting physical activity and daily energy needs.
- The fiber content of 5.45% is an important component that benefits digestive health. Fiber helps smooth the digestive process, improve gut health, and helps prevent digestive disorders such as constipation. In addition, fiber also plays a role in maintaining blood sugar levels and supporting weight management.

CONCLUSIONS

The results of the phytochemical test showed that the JKHS sample is rich in various bioactive compounds, including phenolics, saponins, steroids, terpenoids, alkaloids, and carotenoids, which have great potential as a Jm drink that can provide health benefits. The results of the antioxidant activity test showed that JKHS is a good choice as a natural source of antioxidants, to provide body protection against free radical attacks. The results of the proximate test indicate the potential for JKHS extract to be used as a health supplement. The combination of the three plants (turmeric, ginger, lemongrass) in one balanced formula makes JKHS have great potential as a Jm drink that can provide various health benefits, especially in protecting the body from oxidative stress, free radical attacks, inflammation, and other disease risks, including supporting the regeneration of cells, nerves, and other organs that are weak due to climate, work, or old age.

***Authors' Contributions*:** Loth Botahala and Hemy Ratmas Djasibani designed the study and wrote the manuscript draft. Hemy Ratmas Djasibani, Martasiana Karbeka, and Maria Hendrina Nahak performed the laboratory work and managed the analysis of the research results. Martasiana Karbeka and Maria Hendrina Nahak managed the literature search. All authors read and approved the final manuscript.

***Competing Interests*:** The authors declared that they have no competing interests.

***Funding*:** The authors declare that it is not funded.

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