



Nutrition facts and antioxidant activity of spices biscuits as functional snacks to immune booster

Kandungan gizi dan aktivitas antioksidan biskuit rempah sebagai makanan kudapan fungsional untuk meningkatkan imunitas

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Abstract

The decline in the number of COVID-19 does not return people's conditions to the period before the pandemic. Efforts to prevent the spread of the coronavirus are still being carried out by implementing health protocols and keeping the body's immunity in top shape, one of which is by consuming balanced nutritious foods high in antioxidants. The research aims to develop high-antioxidant biscuits made from local flour and spices as a functional snack to increase the body's immune system. The research was held from September 2021 until January 2022 at the Faculty of Medicine and Health Universitas Muhammadiyah Jakarta. The research design was experimental, using a Completely Randomized Design (CRD). The biscuit formulation process was carried out by substituting wheat flour with purple sweet potato flour at five different ratios (4:0, 3:1, 2:2, 1:3, 0:4) and adding seven types of spices (Ginger, Cinnamon, Turmeric, Kencur, Lemongrass, Curcuma, and Cloves) with the same amount for each formula—a total of 30 semi-trained panelists in the sensory test. Data were analyzed using Kruskal Wallis. Proximate analysis and antioxidant analysis using the AOAC method and DPPH method. The results showed that the selected formula based on the sensory test was F2 with a ratio of wheat flour to purple sweet potato flour of 2:2. The hedonic test showed that there were significant differences in the color, texture, and aftertaste on biscuits ($p=0,000$, $p=0,031$, $p=0,023$ respectively). F2 is the formula the panelists chose, which has nutrition facts that meets SNI biscuits (2011) and has intense antioxidant activity (14,6 ug/mg).

Keywords: Cookies, curcuma, ginger, herbal, sweet potatoes

Abstrak

Penurunan angka COVID-19 tidak mengembalikan kondisi masyarakat ke masa sebelum pandemi. Upaya pencegahan penyebaran virus tetap dilakukan dengan menerapkan protokol kesehatan serta menjaga imunitas tubuh tetap prima. Salah satunya yaitu dengan cara mengonsumsi makanan bergizi seimbang dan tinggi antioksidan. Penelitian bertujuan untuk mengembangkan biskuit tinggi antioksidan yang berbahan baku tepung lokal dan rempah-rempah sebagai kudapan fungsional untuk meningkatkan daya tahan tubuh. Penelitian ekperimental berdesain Rancangan Acak Lengkap (RAL), dilakukan pada September 2021 - Januari 2022 di Fakultas Kedokteran dan Kesehatan Universitas Muhammadiyah Jakarta. Proses formulasi biskuit dilakukan dengan mensubstitusi tepung wheat dengan tepung ubi ungu pada lima rasio yang berbeda (4:0, 3:1, 2:2, 1:3, 0:4) dan penambahan tujuh jenis rempah (jahe, kayumanis, kunyit, kencur, lemongrass, Curcuma dan cengkeh) dengan jumlah yang sama untuk setiap formula. Uji sensori dilakukan pada 30 panelists semi-terlatih. Data dianalisis dengan menggunakan uji Kruskal Wallis. Analisis kandungan gizi dan kandungan antioksidan dianalisis menggunakan metode AOAC dan metode DPPH. Hasil, menunjukkan bahwa formula biskuit terpilih berdasarkan uji sensori adalah F2 dengan rasio tepung wheat dengan tepung ubi ungu sebesar 2:2. Hasil uji hedonik (daya terima)

menunjukkan terdapat perbedaan nyata pada atribut warna, tekstur dan *aftertaste* pada biskuit (berturut-turut $p=0,000$, $p=0,031$, $p=0,023$). Kesimpulan, formula F2 adalah formula biskuit yang terpilih dengan kandungan gizi telah memenuhi standar SNI biskuit dan memiliki aktivitas antioksidan kategori kuat (14,6 ug/mg).

Kata Kunci: Herbal, jahe, kukis, kunyit, ubi sweet potato

Introduction

The reduction in the number of COVID-19 cases did not necessarily restore the condition of society to the pre-pandemic period. Efforts to prevent the spread of coronavirus are still being carried out by implementing health protocols to break the virus's transmission chain. Educational efforts must continue to address the importance of increasing body resistance (Sumarmi, 2020). A good immune system is the body's defense force against disease-causing organisms, such as bacteria and viruses (Kementerian Kesehatan, 2020).

Maintaining normal body weight and consuming various nutritious foods are the principles for increasing body immunity. In the body, various nutrients, including macronutrients and micronutrients, work together to protect the body from various pathogen attacks that cause infection (Sumarmi, 2020). Sun et al. (2020) showed that proteins could play a role in boosting the body's immune system because of their function as a form of immunoglobulin. (Ig). The body forms IgM and IgG immunoglobulins to disrupt the SARS-Cov 2 virus. In addition to proteins, the body requires polyunsaturated fatty acids to boost the immune system and suppress inflammation caused by infections. Research has shown the role of double unsaturated fatty acids in the treatment of inflammation (Weylandt et al., 2015).

Every person has a difference in the level of risk of being infected by a virus and the severity of infection by the virus according to their immune capabilities (Mishra et al., 2020). Nutritional intake factors are one of many factors that affect the immune system and are part of a substantial part to prevent or recover from Covid-19 (Maggini et al., 2018)

Macro-and micronutrients (vitamins and minerals) are required to optimize the immune system. In addition, the bioactive content of plant polyphenols, such as caffeic acid, kaempferol, resveratrol, curcumin, quercetin, catechin, and hesperidin, also plays a role in reducing

inflammation and preventing oxidation processes (Giovinazzo et al., 2020).

Polyphenols are the main compounds found in humans that fight against various diseases (Adem et al. 2021). Based on Ali et al., consumption of bioactive plant contents such as thymoquinone, quercetin, caffeic acid, ellagic acid, vanillin, thymol, and rosmarinic acid can enhance the immune response, resulting in excellent therapeutic potential. Jamu is a traditional spice drink typical of Indonesia and is one of the sources of polyphenols. Jamu is traditionally produced from plant extracts or from simplisia of crab plants.

Jamu became a traditional drink, whose preferences increased during the Covid-19 pandemic. Traditional junk drinks have bioactive contents that act as antiviral, anti-inflammatory, antibacterial, and antioxidant agents, thus naturally boosting the body's immunity (Kusumo et al., 2020). Indonesian people, especially those on the island of Java, have become accustomed to the consumption of herbal plants in the form of jamu, and according to Ningsih et al. (2021), there has been an increase in herbal Consumption during the Covid-19 pandemic. It is suggested that the potential of spices as nutraceuticals is very wide open to being developed in other forms of food other than spice drinks.

As a result, researchers offer innovations in preparing juice in a more modern form, namely in food. Biscuits were chosen as a form of jamu food preparation because they have a preferred taste with a form that can be created according to the character of the target consumer and at a relatively affordable price (Panjaitan et al., 2021).

Indonesia has several jamu recipes with seven parts. However, it is not possible to explain with certainty the amount of jamu or the dosage used to make jamu, because jamu is only estimated by measurement units such as seagrass, sequku, and others (Isnawati & Sumarno, 2021). Therefore, the novelty of this study is the composition of the raw materials of biscuits consisting of seven types of spices based

on the jamu drink recipe inherited in Indonesian society, but with a measurable appreciation.

This study aimed to analyze the differences in the formula of spice biscuits with the raw materials of sweet potato milk in terms of sensory quality, receptivity of panels, nutritional content, and antioxidant activity.

Methods

The study was conducted using a complete random design (RAL) located in the Food Experimental Laboratory and Sensory Laboratory of the Faculty of Medicine and Health, Muhammadiyah University of Jakarta, from September 2021 to January 2022.

The formula for spice biscuit products was developed by determining the ratio of purple wheat flour to thin flour. Other ingredients such as sugar, margarine, eggs, and spices consisting of Ginger, Cinnamon, Peppermint, Turmeric, Curcuma, Lemongrass, and Cranberry were given in the same amount and saturation in powdered form for each formula.

Organoleptic testing followed the Indonesian National Standard (SNI) 01-2346-2006 on instructions for testing organoleptic and sensory tests, using non-standard panels with a minimum number of panels of 30 persons (SNI, 2006). The panelist conditions in this study, namely, students of the University of Jakarta, have obtained education on organoleptic test procedures, have good health conditions on the sense of smell, sensation, and vision, are not allergic to spices, and are not in a state of hunger or satiety. Consecutive sampling techniques were used to obtain panels.

The research phase consisted of the cookie formulation, organoleptic testing, nutritional

content analysis, and antioxidant content testing. The cookies were formulated at the Food Experimental Laboratory of the Faculty of Medicine and Health of the Muhammadiyah University of Jakarta. Organoleptic testing was performed at the Sensory Laboratory of the Faculty of Medicine and Health of Muhammadiyah University of Jakarta. Nutritional content and antioxidant activity analyses of selected biscuits were performed at the IPB University Integrated Chemical Laboratory. This research was conducted after obtaining valid ethical approval from the Poltekkes Mataram Research and Health Ethics Commission (number: LB.01.03/6/6006/2021).

Materials and tools

The raw materials used for biscuits consist of two types of dry ingredients consisting of flour, namely wheat flour, brown sugar flour, purple sweet potato flour and spice flour (Ginger, Cinnamon, Turmeric, Kencur, Curcuma, Lemongrass, and Cloves) and wet material composed of margarine, and egg yellow.

Equipment used to prepare biscuits, organoleptic testing equipment, proximity analysis (AOAC) equipment, and DPPH analysis.

Stages of Making Spice Biscuits

Stages carry out the process of making spice biscuits: the balance of the ingredients, then the mixture of those ingredients into the paste. The next step is the printing process. The cooked biscuits were cooled to room temperature. Adding Ginger and Cinnamon spices is 10 grams, while turmeric, kencur, curcuma, lemongrass, and cranberry are added as much as 0.4 grams to each formula. Purple sweet potato flour was then added. The recipes and cookie formulas used are listed in Table 1.

Table 1. The recipe for cookies

Materially	F0 (g)	F1 (g)	F2 (g)	F3 (g)	F4 (g)
Wheat	150	112,5	75	37,5	0
Purple sweet potato (flour)	0	37,5	75	112,5	150
Margarine	100	100	100	100	100
Brown sugar	50	50	50	50	50
Egg yolk (grain)	1	1	1	1	1
Ginger	10	10	10	10	10
Cinnamon	10	10	10	10	10
Aromatic ginger	0,4	0,4	0,4	0,4	0,4
Turmeric	0,4	0,4	0,4	0,4	0,4
Lemongrass	0,4	0,4	0,4	0,4	0,4
Curcuma	0,4	0,4	0,4	0,4	0,4
Clove	0,4	0,4	0,4	0,4	0,4

Note: F0 = 100% flour; F1 = 75% flour, 25% sweet potato flour; F2 = 50% flour, 50% sweet potato flour; F3 = 25% flour, 75% sweet potato flour; F4 = 100% sweet potato flour

Organoleptic tests

The biscuits produced were organoleptically tested through hedonic and hedonic quality tests by 30 semi-trained panelists. Organoleptic tests were performed to determine the level of panelists favoring the resulting research product. The semi-trained panel on this test was a Prodi Gizi Faculty of Medicine and Health student at Muhammadiyah University of Jakarta.

The assessment scale uses a Likert scale of 1 to 5 for the hedonic and hedonic quality tests that cover five sensory attributes: color, aroma, taste, texture, and *aftertaste*. In the hedonist test, the evaluation scale was 1 (very unlikely), 2 (not liked), 3 (very disliked), 4 (liked), and 5. (very like). In the hedonic quality test, the scale of assessment is based on each attribute. The color attribute of the cookies was higher. The scale shows a younger color:1 (old chocolate concentrated) to 5. (yellow). Regarding the aroma attributes of the Langu spices, the higher the scale, the lower the Langu smell:1 (very strong) to 5. (very weak). The rating scale was higher for the taste attributes of biscuits, and the added sweetness was higher:1 (very bitter) to 5. (very sweet). Regarding the texture attribute of the biscuit, the higher the scale, the more fragile the texture of 1 (very hard) to 5 (very fragile). For the *aftertaste* cookie attribute, a higher rating scale shows a stronger *aftertaste*:1 (very strong) to 5. (very weak). The cookie formula is acceptable if the average scale value is ≥ 3 (Setyaningsih et al., 2010).

Analysis of Selected Spice Biscuits

The cookie formula selected based on the sensory test results was subsequently analyzed for its nutritional content (AOAC, 2015). Nutritional content analysis consisted of water content, ash content, protein content (micro Kjeldahl method), fat content (Soxhlet method), and raw fiber content. Carbohydrate analysis was performed using the difference method. In addition to nutritional content analysis, the selected formula was analyzed for antioxidant activity using the DPPH method. (1.1-Diphenyl-2-Picrylhydrazyl).

Statistics analysis

Data from the organoleptic test results (hedonic test and hedonic quality test) were analyzed descriptively to determine the percentage of panelist preference. The data

used in the hedonic test analysis are the average values. Before the different tests were carried out, the data were first tested for normality using the Shapiro-Wolf test. This is because the amount of data was less than 50. The normality test results showed that the data were not distributed normally ($P < 0,05$), this study used a different Kruskal-Wallis test. If the Kruskal-Wallis test results show real differences in the sensory attributes of the biscuit formula, the data will be further tested using the Mann-Whitney test.

The data of the selected cookies' nutritional content and antioxidant activity were processed in a way that was compiled, organized, and then analyzed descriptively.

Result and Discussion

Based on the characteristics of respondents, most mothers included productive age 20-45 years and did not work or were housewives. The fathers' and mothers' levels of education were very high. More than half of the babysitters were high school graduates or graduates.

Consumption of balanced nutritious foods is an effort to increase body resistance (Kementerian Kesehatan, 2020). Therefore, a balanced intake of nutrients, such as macro, micro, and antioxidant nutrients, is needed to play an important role in increase body resistance and prevent and curing Covid-19 infection.

Foods rich in bioactive compounds are also beneficial for boosting the immune system. According to Galanakis 2020), bioactive compounds of natural polyphenols are major protease inhibitor of Covid-19. The bioactive content of plants has potential as a nutraceutical, because it modulates the immune system. One of the nutraceuticals consumed by Indonesian people, which is characteristic of Indonesia, is turmeric, the main ingredient of jamu, besides ginger (Sasmito et al., 2020).

Biscuit Acceptance

The selected formula was determined by analyzing the panelistst preference level. Table 2 shows the average values given by the panels when performing hedonic tests on the five types of spice biscuit formulas.

Table 2 shows that color, texture, and aftertaste parameters differed significantly among the five biscuit formulas in this

study. After further testing with the Mann-Whitney test, the results are shown in Table 3.

Table 2. Preferred test value of spice biscuits

Criteria	F0	F1	F2	F3	F4	p-value
Color	2,60	3,37	3,73	3,60	3,73	0,000*
Aroma	2,93	3,23	3,23	3,30	3,23	0,608
Flavor	3,23	3,23	3,13	2,70	2,83	0,102
Texture	3,57	3,90	3,67	3,47	3,20	0,031*
Aftertaste	3,30	3,17	3,07	2,63	2,67	0,023*

*Significantly different from the p-value <0,05 based on the Kruskal Wallis test

Table 3. Advanced test results of color, texture and aftertaste attributes

The Difference	Colors	Texture	Aftertaste
F0 and F1	0,003*	0,067	0,462
F0 and F2	0,000*	0,562	0,253
F0 and F3	0,000*	0,735	0,007*
F0 and F4	0,000*	0,121	0,019*
F1 and F2	0,051	0,263	0,691
F1 and F3	0,195	0,044*	0,036*
F1 and F4	0,086	0,003*	0,064
F2 and F3	0,736	0,389	0,074
F2 and F4	0,986	0,052	0,115
F3 and F4	0,702	0,256	0,988

*Significant difference with p-value <0,05 based on Mann Whitney's further test

Table 3 shows that the panel's average preference level for colors in the F0 formula differed significantly from the other four. The color of formulas F1, F2, F3, and F4 is influenced by the composition of the purple peanut flour. The formula with purple strawberry flour had a preferred color compared to the control formula (F0). This is because the color produced on F0 is green-yellow, whereas the color on the formula biscuits with purple beads becomes brown. The green and yellow color on the biscuits becomes unflavored, so the color of the brown biscuit has a higher level of preference.

The data in Table 3 also show that the texture of formula F1 differs significantly from that of formula cookies F3 and F4. Adding purple peanut flour decreases the level of panelist preference for the texture of biscuits. Based on the hedonic quality test, the texture of the biscuits in the fifth average formula was in the same hard range. However, based on the hedonic test, the panelists' average preference value differed significantly from the highest value in the F1 formula with the smallest component of the purple dwarf.

The results of this study are in line with those of a 2017 woman who made a formula of

cookies mixed with corn flour. The result was that an increasing corn flour composition would lower the level of hardness of the texture of the biscuit, and the highest composition of the flour produced biscuits with the highest hardness level (Istinganah et al., 2017). Therefore, formula F1 is preferred because its level of hardness is below that of the control formula (F0), but is still more subtle compared to F3 and F4.

Table 3 also shows the differences in *aftertaste* preference levels among F0, F3, and F4. Increasing the composition of purple peanut flour tends to lower the level of panelist favorites. Based on the hedonic quality test, the *Aftertaste* on the F4 formula is in a strong category, while that of the other formula in the strength category is rather weak. The *Aftertaste* of biscuits can be attributed to the anthocyanin content in purple sweet potato flour. The anthocyanin content in fresh purple strawberries was quite high, ranging from 3.51-61.85 mg/100 g. (Husna et al., 2013). Anthocyanins in purple beets can taste bitter after the biscuits are swallowed. The more the composition of purple strawberry causes the *Aftertaste* of resulting bitter taste becomes stronger.

Biscuit Quality

The quality of the resulting spice biscuits was analyzed using a hedonic quality test to determine the physical characteristics of the

spice cookies, including color, aroma, taste, texture, and *aftertaste*. The average value of the hedonic quality results of the panelists' assessment for each formula is shown in Table 4.

Table 4. The average value of hedonic quality attributes of spice biscuits

Quality parameters	Control	F1	F2	F3	F4	p-value
Colour	4,47	2,87	1,97	1,57	1,43	0,000*
Aroma	3,40	3,67	3,40	3,90	3,47	0,394
Flavor	3,73	3,77	3,33	3,10	3,50	0,117
Texture	4,37	4,60	4,40	4,60	4,63	0,667
Aftertaste	3,60	3,50	3,20	3,10	2,90	0,139

* Significant difference with p-value <0,05 based on the Kruskal Wallis test

The data in Table 4 show significant differences in color quality, whereas the other quality parameters were not different. The F0 formula is categorized as yellow-green, which differs from the F1, F2, F3, and F4 formulas, which are categorized as brown. The substitution of purple-purple flour with thin flour causes a color difference. The purple color of sweet potato flour produces biscuits owing to the Maillard reaction. The darker the color of the biscuit, the higher the composition of the purple peanut flour. This is in line with other research (Fatmala & Adi, 2018) It is stated that the composition of purple peanut flour makes the color of the biscuits darker.

Choose the cookie formula

The determination of the chosen formula of spice biscuits was based on the level of preference of the panelists for all sensory parameters tested. Table 2 shows that all formulas can be said to have the same or not significantly different taste and aroma parameters. However, for color, texture, and aftertaste criteria, Table 2 shows that the value scores indicate that formulas F1 and F2 are preferred over formulas with the addition of other peanut flours, especially in color, texture, and aftertaste. If judged by the color quality, the F2 formula was the most preferred. If judged based on aroma and texture, the F1 formula was the most preferred by the respondents.

The last indicator, *aftertaste*, indicates that F1 has the most preferred *aftertaste* receiver compared to the other formulas. In Table 3, Mann Whitney's test results show that formula F1 did not differ significantly from formula F2. Therefore, the formula F2 was chosen because it has a larger composition of flavonoids with

hedonic test results that do not differ significantly from those of the F1 formula (Figure 1).



Figure 1. Selected formula spice cookies (F2)

The nutritional and antioxidant content of biscuits

The quality standards of biscuits in Indonesia are regulated in SNI 2973-2011, which consists of several quality standards that biscuit producers must meet, including the physical characteristics of biscuits (color, smell, and taste), water content, protein content, metal content, and microbial content.

Nutritional content and antioxidant activity tests were subsequently performed on F2. The variables tested for nutritional content were water, protein, fat, ash, raw fiber, and carbohydrates. The energy levels were calculated based on the percentage of macronutrients. (protein, lemak, karbohidrat). Table 5 shows the results of the nutritional content and antioxidant activity tests of F2 spice biscuits.

The water level affects the storage capacity of biscuits. The water content of the selected spice cookies met the SNI quality standard of biscuits, which is a maximum of 5%. The conformity of the water level with the SNI

condition is very important in determining the quality of biscuits because it has hygroscopic properties; therefore, the water content can increase if the biscuit is not packed and stored in an air-tempest place (Normilawati et al., 2019). High water levels in biscuits trigger the growth of bacteria and cloves and damage the quality of the biscuit (Susanto, 2019). The low water content of spice biscuits F2 indicates that the spicy biscuit F2 will be awake during storage because bacteria and cloves will not grow easily. The raw materials of spice biscuits, mostly in the shape of flour, can be one of the causes of the low water content due to the presence of the process. According to Susanto (2019), the water content of each food varies depending on the moisture content of the raw material. The more humid a food item is, the higher the amount of water.

Table 5. The nutritional content and antioxidant activity of spice cookies formula F2

Variable	F2	SNI Biscuits (2011)
level of water	3,56%	Maks. 5%
by Abu	1,43%	-
Protein is	6,82%	Min. 5% (b/b)
Fatty	13,55%	-
carbohydrate	74,64%	-
Rough fiber	1,10%	-
Energy per 100g	448Kkal	-
Antioxidant	14,6	-
Activity	ug/mg	

Protein levels are nutrient content parameters found in SNI standards, in addition to water levels. The protein content of the spice biscuits met the SNI criteria of at least 5% (b/b). One of the raw materials for biscuits containing proteins is wheat flour. The level of gluten protein in thin flours affects the level of cooling. The higher the levels of gluten protein, the harder the biscuits will be or the lower the level of cooling (Normilawati et al., 2019). The raw ingredients of spice biscuits are low-protein flour. This is in line with the results for the hedonic quality of spice biscuits, which indicates that the control biscuit (F0) has a fairly high level of cooling. It increased with the substitution of the sweet potato ubi flour.

Other nutritional contents were not regulated under the SNI conditions. However, it remains important to be known as a reference for calculating the energy content of biscuits derived

from the macronutrient content. Carbohydrates are the most dominant macronutrients in spice biscuits, followed by fat. This follows the type of raw material of spice biscuits that are a source of carbohydrates, that is wheat flour and purple ubi flour. The source of fat in the cookies was obtained from the raw ingredients of margarine.

The energy content of these spice biscuits is based on research (Mokodompit et al., 2017) and (Pratama, RI & Liviawaty, 2014) on speculative spice biscuits (sweetwood, nutmeg, and cloves) based on purple flour and banana flour, as well as research on cooking with the addition of fish bone flour. However, these findings are not consistent with those of Wulandari et al. (2019), who studied the nutritional content of biscuits fortified with belut flour and reported very high levels of protein (15.89%), high fat content (30.72%), and low carbohydrate content (46.92%). This is because of the differences in the composition of the raw materials. High values of protein and fat are obtained from the addition of butterfly flour in the range of 10 - 50% of the total flour material, so that the protein content in biscuits becomes very high.

Based on the levels of carbohydrates, fats, and proteins in spice biscuits, a fairly high energy content is produced, resulting in lower intake. The resulting spice biscuits are intended as staple foods that provide energy about 10-15% of the daily energy needs. If the average daily energy requirement is 2100 kcal, the recommended calorie content contained in the meal is approximately 210-315 kcal. Therefore, one serving of spice biscuits can be given as much as 50 g/day, with an energy of 224 kcal.

The antioxidant activity of the cookie formula F2 is 14.6 ug/mg. This amount can be categorized as having strong antioxidant activity. This category refers to research (Zhang et al., 2022), which showed that the IC50 value of ginkgo biloba extract showed strong antioxidant activity on the components of procyanidins (IC50 = 4,01 ug/mg), Ginkgo flavones (IC 50 = 19,56 ug/mg) and organic acids (IC50). In contrast, ginkgolide showed weak activity (IC50 = 672,2 ug/mg). The analysis results of the antioxidant activity of F2 formula biscuits are consistent with those of previous research (Mao et al., 2019). The antioxidant activity of dried ginger was higher than that of fresh ginger because the number of phenolic compounds was 2.4 times higher.

Recent research related to ginger found that ginger has biological activities, such as anti-inflammatory (M. Zhang et al., 2016), antioxidant activity (Nile & Park, 2015), antimicrobial (Kumar et al., 2014), and anticancer (Citronberg, J et al., 2013). The main phytochemicals in ginger are phenolic compounds such as gingerol, shogaols, and paradol (Stoner, 2013).

In addition to ginger, curcumin spices, such as turmeric and curcumin, have antioxidant content. Zorofchian et al. (2014) showed that curcumin can inhibit viral infections, including parainfluenza virus type 3 and respiratory viruses. (Zorofchian Moghadamtousi et al., 2014). Curcumin's potential comes from its ability to interact with various molecular targets, thus triggering cellular signalling pathways, such as apoptosis and inflammation.

Curcumin also has the potential to modulate a variety of molecular targets, making it a suitable candidate for managing Covid-19 infection. Curcumin modulates a variety of molecular targets that contribute to the bonding and internalization of Covid-19 in various organs, including the liver, kidneys, and cardiovascular organs. Curcumin also has the potential to modulate cellular signalling pathways, such as inflammation, apoptosis, and RNA replication. Curcumin can also suppress lung edema and fibrosis-related pathways during Covid-19 infection.

Singh et al. (2013) it states that there is a synergistic therapeutic effect between curcumin with natural or other synthetic compounds. The anti-inflammatory and immunomodulatory effects of curcumin are also supported by evidence that curcumin has anti-fibrotic and pulmonoprotective effects on lung tissue, making it one of the herbal ingredients that has prospects for Covid-19 treatment (Rattis et al., 2021).

The results of this research enrich the innovations that society can make in exploiting spices that have potential, as mentioned above. when the Covid-19 pandemic began to decline, the population remained encouraged by the government to consistently follow health protocols and boost the immune system by consuming balanced nutritional foods as well as antioxidant supplements if needed.

Many researchers in the field have trained the public on how to consume spices in the form of spicy drinks to increase body resistance (Britany & Sumarni, (2020); Faznur et al., (2020);

Handayani & Khasanah, (2021); Budiman et al., (2021); Huda, (2022); Zarwinda et al., (2021)). The production of spice drinks carried out by many researchers in community service activities showed high public confidence in the health potential of spices. However, the presence of spices in food remains limited. The spice biscuits produced in this study became pioneers in the presentation of spices in the form of snacks expected to help maintain the health of the public's immune system.

Conclusion

The chosen biscuit formula was spicy biscuits with a milk ratio with purple wheat flour of 2:2. Spice biscuits have strong antioxidant activity (14.6 µg/mg) with a nutritional content that meets the SNI standard of biscuits.

It is necessary to disseminate information regarding the results of this research to the wider community using outreach and education in various community service activities, so that the potential of Indonesian spices can have an impact on improving the health of the wider community.

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