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Article

Shallot Peel (*Allium cepa L.)* Snack Bar as Immunomodulator for Health Improvement in the Digital Era

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Abstract. The digital era has brought many changes, both positive and negative impacts. The challenges of this digital era cover various sectors, including the health sector. One of the effects is the radiation from electromagnetic waves due to the use of cell phones that can interfere with health in the long term, such as a decrease in the immune system. This study aims to determine the secondary metabolite content of shallot peel extract and the formulation of the snack bar as a nutraceutical product with antioxidant properties. It becomes a solution to increase the immune system or immunomodulator. An evidenced by the phytochemical screening test, which gave positive results. In addition, this snack bar also positively contains essential nutrients, such as carbohydrates, protein, and fat. From the hedonic test, the snack bar formulation has the appearance of a snack bar in general, with solid consistency and brownish-yellow color, a characteristic odor of wheat, and a savory taste with a small amount of sweetness. This snack bar formulation has the potential as an immunomodulator against the decline in the immune system. The tastes of the snack bar are acceptable to the public.

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1. Introduction

Technology is currently experiencing very rapid development and progress in various fields [1-3]. It can even be said that it has entered the digital era, where people often use various electronic devices or technology in everyday life [4-6]. This digital era certainly influences the form of positive and negative impacts on various aspects of life [7].

In modern life, using a cell phone (mobile phone) is an inseparable part of life [8-9]. A mobile phone is an electronic device that can produce electromagnetic waves [10-12]. High user interaction in mobile phones also leads to high radiation exposure [13]. This will undoubtedly increase the risk of experiencing health problems in the future [14-16]. Exposure to electromagnetic waves over a long period can affect the metabolism of living things, causing abnormalities in various functions and coordination between cells or tissues [17-20].

A study conducted in Finland stated that electromagnetic radiation/waves from mobile phones for an hour could cause disruptions in the production of body cells [21-24]. The position of the cell phone attached to the head can also cause brain cells to develop abnormally as an effect of the vital radiance from the cell phone radiation [25]. Even this can potentially cause cancer in the future [26-28]. The emissions and radiation from mobile phones can weaken the immune system because they can reduce melatonin production [29-31]. The electromagnetic waves emitted from mobile phones have many adverse effects, especially when used continuously, so it is necessary to strengthen the immune system [32-35].

Strengthening the body's immune system by consuming foods or drinks that are immunomodulators can be a way to overcome it [36-39]. An immunomodulator is a substance that can modulate the function and activity of the immune system [40-44]. Immunomodulators are aimed at improving immune function in immunosuppression conditions [45]. This immunomodulatory substance can regulate the body's immune system, including repairing and restoring its immunity, which decreases and suppresses the body's immunity if it is excessive [46-48].

Indonesia is an agricultural country rich in natural resources [49]. Various plants are found in Indonesia. These plants are then processed and used as food and medicines [50-52]. Its use and processing in a reasonably high society cause another problem, namely the problem of waste [53-55]. We can find one example of shallot peel waste (*Allium cepa L.*). This shallot peel waste is usually found in household waste. However, if studied more deeply, the peel of this shallot also has a substantial content that is no less important than the bulbs. Shallot peel extract contains flavonoid substances that are antioxidant compounds [56-59]. The antioxidant content in shallot peel can provide many benefits, such as improving the function of disturbed body cells and even preventing the development of free radicals that can cause the onset of cancer in the human body [60-61].

Therefore, researchers created an innovation, Snack Bar from *Allium cepa* L., as a solution for improving the immune system to prevent adverse impacts caused by radiation technology. This can undoubtedly increase the shallot peel's economic value and minimize waste.

2. Research Methods

2.1. Research Design

The research was conducted descriptively with a qualitative approach. Data were obtained using a proper experimental design related to laboratory testing (phytochemical and nutritional qualitative screening), questionnaires, and literature sources.

2.2. Equipment and Materials

The Snack Bar has a composition of shallot peel extract, oats, salted caramel, soy milk, dates, red beans, crispy rice, and dry fruits.

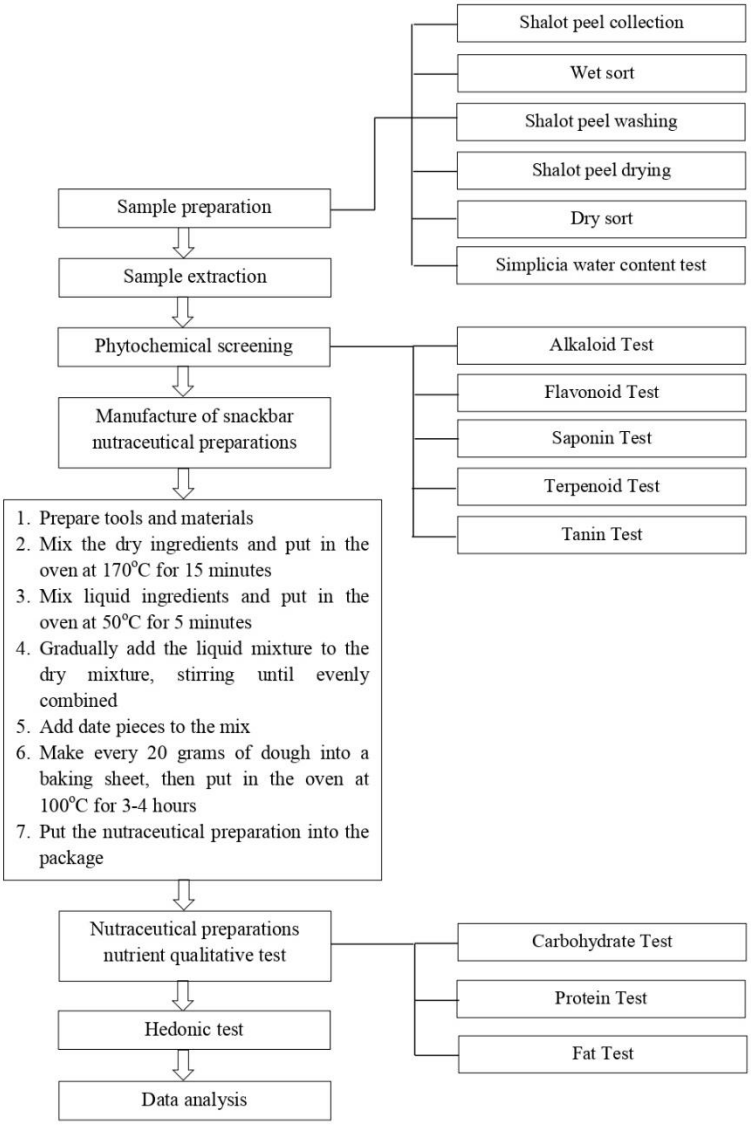

Figure 1. Flowchart methods

Extraction using the infusion extraction method on shallot peels obtained from Brangsong, Kendal district, Central Java. All ingredients other than shallot extract are obtained from the online market. The equipment that used in making the snack bars are an oven, rotary evaporator, analytical balance, blender, infusion extraction pan, baking sheet, beaker glass, measuring cup, rack, test tube, mortar, stamper, water bath, stirring rod, horn spoon, dropper, tissue, and snack bar packaging.

2.3. Sample Preparation

Sample preparation was started by collecting shallot peel, wet sorting by separating fresh shallot peel (*Allium cepa L.*) from other parts that were not needed, and washing and drying the shallot peel using an oven at 50°C for 24 hours. Drying using this method will produce the lowest water content.

Next, dry sorting was done manually to separate foreign agents, such as unwanted parts still in the dried simplicia. The water content of Simplicia was tested using the Moisture Content tool. The requirement for simplicia water content is <10%. Simplicia storage at room temperature, 15°C to 30°C, ensures the quality of Simplicia until it is used further.

2.4. Sample Extraction

The shallot peel extraction method (*Allium cepa L.*) begins with weighing 20 grams of shallot peel, blending with sufficient aquadest until smooth, then adding aquadest to 400 milliliters of the blended result, then heating for 15 minutes while stirring every 5 minutes. Next, sprinkle the shallot peel while hot using a flannel cloth and concentrate the information using a rotary evaporator until a thick extract is obtained.

Table 1. Materials

Materials	Amount (%)
Shallot Peel Extract	15%
Oat	25%
Salted caramel	12%
Soy milk	13%
Dates	12%
Red beans	11%
Crispy rice	4%
Dry fruits	8%

2.5 Phytochemical Screening

Phytochemical screening included tests for alkaloids, flavonoids, saponins, terpenoids, and tannins [62-64].

2.5.1. Alkaloid Test

Extract 1–2 milliliters in a test tube, add 2 ml of chloroform, and 2 ml of ammonia, shake and then filter. Then 3-5 drops of concentrated sulfuric acid were added to the filtrate and shaken until two layers were formed. The colorless/acidic layer was put into 2 test tubes, the 1st test tube was added with Mayer reagent, and the 2nd test tube was 4–5 drops of Wagner's reagent each.

2.5.2. Flavonoid Test

Extract 1 ml in a test tube added a few drops of 10% NaOH solution. The occurrence of color changes indicates the presence of flavonoids which are classified as phenolic compounds.

2.5.3. Saponin Test

Extract 1–2 ml in a test tube, and add hot water. The liquid was allowed to cool at room temperature, added 2N HCL and was shaken for 10 seconds. The formation of stable foam as high as 1-10 cm indicates the presence of saponins.

2.5.4. Terpenoid Test

Extract 1–2 ml in a test tube, and add ten drops of glacial acetic acid. Then add two drops of concentrated sulfuric acid and shake. The presence of steroids is indicated by the formation of a blue or green color. In comparison, the formation of red or purple indicates the presence of terpenoids.

2.5.5. Tannin Test
Extract 1–2 ml in a test tube, and add 1 ml of 1% $FeCl_3$. Tannins are indicated by the formation of a dark blue color (false tannins) or blackish green (adequate tannins), and the addition of gelatin forms a white precipitate.

2.6. Snack Bar Formulation
The first step in making a snack bar is preparing equipment and weighing the formulation's ingredients. Mix oats, red beans, crispy rice, and dry fruit as a dry mixture, and put in the oven at 170°C for 15 minutes. Mix the thick extract, salted caramel, and soy milk as a liquid mixture, and put in the oven at 50°C for 5 minutes. Gradually add the liquid mixture to the dry mixture, stirring until evenly combined. Add the date pieces to the mixture. Print every 20 grams of dough into a baking sheet, then in the oven at 100°C for 3-4 hours. Putting the nutraceutical preparation into the package and ready for organoleptic evaluation.

2.7. Nutritional Qualitative Test
After the formulation results were obtained, the snack bar was carried out with a qualitative nutritional test including carbohydrates, protein, and fat [65].

2.7.1. Carbohydrate Test
Sample solution into 2 test tubes of 2 ml each. Test tube one added 2-3 drops of Lugol's reagent, and a positive reaction of starch showed a blue or purple-black color. In test tube 2, 2 milliliters of Fehling A and Fehling B solutions were added, and then four drops of 10% NaOH solution were added. Glucose positive if a red brick precipitate occurs.

2.7.2. Protein Test
2% sample solution in aquadest, then 1 ml was taken to be put into a test tube. Then, 1 ml of 10% NaOH and 1 milliliter of 0.1% CuSO4 solution were added and shaken. The positive reaction for the protein is a purplish-blue.

2.7.3. Fat Test/Acrolein
In a test tube, three drops of sample solution were added to one spoon of $KHSO_4$ and then heated. The positive reaction of fat has the smell of burning fat with white smoke.

2.8. Research Variable
This study uses two types of variables, including the independent variable and the dependent variable. The independent variable used was the thick red onion peel extract (*Allium cepa L.*), while the dependent variable used was the result of a qualitative test of snack bar preparations.

2.9. Research Sample
A total of 50 panelists were randomly selected, male and female, to try the "Snack Bar of Shallot Peel Extract (*Allium cepa L.*)," conducted in Malang, East Java, Indonesia.

2.9. Hedonic Test
The hedonic test measured the panelists' preference for the product. In this study, the panel used is a consumer panel of 30 panelists in the Malang area. This hedonic test uses human senses, including packaging, color, texture, aroma, and product taste, measured on a scale [66]. Panelists conduct a physical product evaluation and then complete a Google form questionnaire. The panelists' hedonic test scale starts from 1 (dislike very much) and 5 (likes very much).

3. Results and Discussion

3.1. Phytochemistry Test

3.1.1. Alkaloid Test

Table 1 shows that the positive sample for alkaloids was marked by a change in the color of the sample to cloudy white with Mayer's reagent and yellow-red-purple with Wagner's reagent [67-68]. The addition of ammonia and agitation can cause the extraction of samples that have previously been extracted by chloroform in an alkaline atmosphere (the tested samples become free bases), and the presence of ammonia can increase the solubility of the samples. Mayer and Wagner's reagent was used because the alkaloids can react with metals that have high density, such as mercury and iodine. Alkaloids are optimistic if there will be a change to a cloudy white liquid after the administration of Mayer's reagent. A yellow-red-purple colour will be formed on the administration of Wagner's reagent.

Table 1. Phytochemistry Test

Phytochemistry Test	Reactor	Observation	Results
Alkaloids	Chloroform + Ammonia + Concentrated sulfuric acid	• Mayer : The formation of a cloudy white color • Wagner : The formation of a purple color	+
Flavonoids	NaOH 10%	The color change to brownish yellow	+
Saponins	Hot water + HCL	Foam is formed as high as 1-10 cm for not less than 10 minutes	+
Terpenoids	Glacial acetic acid + concentrated sulfuric acid	The formation of a red ring	+
Tannins	$FeCl_3$ 1% + gelatin solution	The formation of black color on the administration of 1% $FeCl_3$ and the occurence of white precipitate on the administration of the gelatin solution	+ (faulty tannins)

Table 1 shows that the sample is positive for flavonoids, marked by a change in the color of the sample from yellow to brown, which indicates that the sample of onion peel extract (*Allium cepa L.*) contains flavonoid compounds. 10% NaOH can trigger a brownish-yellow color change because the phenol group meets alkaline compounds, and a conjugation system of aromatic groups occurs.

Flavonoids are antioxidant compounds that can improve the function of disturbed body cells and prevent free radicals from developing in the body [69-71]. Antioxidant activity can be measured by the IC50 value, which is the concentration of the sample solution required to inhibit 50% of free radicals. The level of antioxidant power is said to be very strong if the IC50 value is < 10 ppm. If the IC50 value is 10-50 ppm, it is said to have potent antioxidants. IC50 values of 50-100 ppm are said to have moderate antioxidants. However, it is called a weak antioxidant if it has an IC50 value of 100-250 ppm [72-74].

In the research of Rahayu and Ardana in 2017, it is known that the IC50 value of onion skin is 39.22 ppm [75]. From these results, it can be concluded that the antioxidants in the onion skin are included in the group of potent antioxidants. The presence of antioxidant activity of flavonoid

compounds makes onion skin efficacy as an immunomodulator [76]. The flavonoid content can cause an increase in IL-12 activity and affect CD^{4+} cells to proliferate lymphocytes, causing Th-1 cells to become active [77]. The result is that $IFN^{-\gamma}$ will activate macrophages. It is characterized by an increase in the speed and efficiency of phagocytosis in killing antigens [78].

3.1.3. Saponin Test

Based on table 1, the sample contains saponin compounds characterized by forming foam as high as 3 cm and stable in a few minutes [79]. The addition of 2N HCl makes samples containing saponins not affected by acid so that the foam formed is stable and does not disappear.

3.1.4. Terpenoid/Steroid Test

Based on table 1, the sample contains terpenoid compounds because red color is formed [80]. This happens because adding glacial acetic acid can break the steroid-terpenoid groups with other groups [81]. In contrast, adding H2SO4 can break the sugar bonds so that the sugar bonds are released, and free steroid-terpenoids will cause a red ring [82].

3.1.5. Tannin Test

Table 1 shows that the sample contains tannin, which is indicated by the formation of a dark blue color. This happens because adding 1% $FeCl_3$ can cause the formation of a complex between tannins and Fe^{3+} [83**].**

3.2. Nutrritional Qualitative Test

3.2.1. Glucose/Benedict Test

Table 2 shows that the snack bar contains glucose due to the formation of a brick-red color. This can happen because Benedict contains CuSO4 sodium carbonate, and sodium citrate carried out in alkaline conditions can cause isomeric transformation. Cu2+ ions from CuSO4, by reducing sugar, take place quickly and will then form Cu2O in the form of a brick-red precipitate.

Table 2. Nutritional Qualitative Test

Compound Test	Reagen	Results
Carbohydrate	• Benedict (Fehling A and Fehling B) • Lugol	+
Protein	NaOH 10% + $CuSO_4$ 0,1 %	+
Fat	$KHSO_4$	+

3.2.2. Carbohydrate/Lugol Test

Table 2 shows that the snack bar is positive for starch because there is a change in color from brown to blue-black. The starch solution contains several minimal glucose units.

3.2.3. Protein Test

Table 2 shows that the snack bar contains protein due to the formation of a purplish blue color. This can happen because the 10% NaOH solution functions to dilute proteins so that compounds containing acidic amide groups will be together with other amide groups.

3.2.4. Fat/Acrolein Test

Table 2 shows that snack bars contain fat due to the formation of white smoke and an odor like burning or rancidity. This can occur due to a reaction between the O2 molecule double bound to fatty acids, causing a rancid odor due to triacylglycerol containing unsaturated fatty acids undergoing an oxidation process.

3.3. Hedonic Test

There is a consumer panel consisting of 30 panelists who are following the product marketing target. The method used is scoring using panelists trying snack bar products and then filling out a questionnaire via a google form.

Table 3. Hedonic Test Results

Questions	1	2	3	4	5
Product Form	0 (0%)	0 (0%)	4 (5,9%)	30 (44,1%)	16 (53,3%)
Taste of the product	0 (0%)	0 (0%)	11 (16,2%)	22 (32,4%)	35 (51,5%)
Color of the product	0 (0%)	4 (5,9%)	13 (19,1%)	34 (50%)	17 (25%)
Smell of the product	0 (0%)	4 (5,9%)	13 (19,1%)	34 (50%)	17 (25%)
Packaging	0 (0%)	1 (1,5%)	1 (1,5%)	35 (51,5%)	31 (45,6%)

The results of the hedonic test based on Figure 1 show that the snack bar has an attractive shape, solid like a typical Snack Bar. Its attractive color is brownish yellow, the pleasant odor characteristic of wheat, and does not have an unpleasant odor, savory taste, slightly sweet, and attractive packaging. So it can be concluded that in terms of appearance and taste, consumers can accept.

4. Conclusion

Shallot peel (*Allium cepa L.*) extract can be formulated into a nutraceutical snack bar with immunomodulatory substances and contains essential nutrients for the body. It contains secondary metabolites of alkaloids, flavonoids, saponins, terpenoids, and tannins. The flavonoids contained can act as antioxidants and are efficacious as immunomodulators. Snack bars with onion peel extract received a positive response from the public regarding their appearance and taste.

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