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Utilization of Black Rice Var Wojalaka with Lemongrass Essential Oil as a Face Mask

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Abstract: Black rice contains antioxidants that neutralize free radicals, helping prevent wrinkles and skin damage. Fragrant lemongrass produces essential oils with citronellal, geraniol, and citronellol, which have antibacterial effects. This study aims to develop and evaluate a face mask combining black rice extract and citronella essential oil to nourish, cleanse, and tighten the skin. Masks were formulated with black rice concentrations of 30%, 40%, and 50%. Evaluations included phytochemical screening, antioxidant activity (DPPH assay), organoleptic properties, pH, homogeneity, dispersibility, and physical stability. Black rice extract showed antioxidant content of 0.037 mg/L, while the mask formulations exhibited strong antioxidant activity at 2.231 mg/L. The FII mask met Indonesian National Standard (SNI) criteria for physical stability. Clinical tests from week 2 to 6 on volunteers revealed that the FIII mask improved skin firmness, reduced acne and black spots, and increased moisture. This research demonstrates that combining black rice antioxidants with citronella essential oil produces an effective natural face mask that enhances skin health.

Keywords: Antioxidants, black rice, face masks, lemongrass, phytochemicals.

Introduction

Human skin can undergo premature aging primarily due to sun exposure, which is a major cause of unwanted progressive changes in its appearance (Kirana, 2023). This aging process is characterized by wrinkles, uneven pigmentation, darkening, thinning, sagging, and roughness (Hussein et al., 2024). A key factor in skin aging is the activity of free radicals, which initiate reactions in the mitochondria leading to the production of reactive oxygen species (ROS). These ROS contribute to oxidative stress, damaging skin cells and accelerating the aging process (Jomova et al., 2023).

Facial care can be done using natural masks that are believed to be safer for the skin, have no side effects, and are also cheaper because they can be made at home (Mohanty et al., 2024). Face masks function to prevent premature aging of the skin, reduce wrinkles, reduce acne and keep the skin always in a pleasant condition (Park et al., 2021).

Masks can be made from natural materials that contain antioxidant compounds (de Souza Silva et al., 2023). Antioxidants are substances that can neutralize free radicals so that they protect the body from disease by binding to free radicals and highly reactive molecules that can damage cells (Chandimali et al., 2025).

Black rice (*Oryza sativa* L.) contains pigments (Singh et al., 2022). It contains anthocyanin compounds, which function as antioxidants and free radical fighters, thus playing a role in preventing wrinkles and damage to the skin (M. Das et al., 2023). The content of citronellal, geraniol, and citronelol in citronellal oil is also able to inhibit bacterial activity (Sari et al., 2022). Rakhmadhan et al (2022) in her study reported that the essential oil of fragrant lemongrass leaves from Tawangmangu was able to produce an inhibition zone against bacteria.

Based on previous research on the

antioxidant content of black rice in the Sumba area, it has been conducted and the results found that the highest flavonoid levels were found in the Woja Laka rice cultivar (Ghello, 2025). Therefore, although there have been many studies conducted to test the antioxidant activity of black rice and the content of citronella oil which is only used as a food ingredient, it is necessary to process black rice and citronella leaves as a facial mask preparation. The purpose of this study was to determine the use of black rice (Oryza sativa L. varwojalaka) with citronella essential oil as a facial mask.

Method

Time and Place

This research was conducted at the Bioscience Laboratory of Udayana University, Bali, in October 2024. Black Rice (Oryza Sativa L.Var Wojalaka) with Lemongrass Essential Oil (Cymbopogon nardus L.) as a Face Mask.

Tools and Materials

The tools used in this study are dropper pipettes, analytical balances, volumetric pipettes, evaporators, analytical scales, micropipettes, blenders, erlenmeyer cups, funnels, test tubes, chemical cups, measuring cups, scissors, filter paper, plastic bags, pH meters, micro pipettes, measuring flasks, test tube racks, stopwatches, DSLR cameras, UV-Vis spectrophotometers.

The material used in this study is black rice *(Oryza sativa,* L. var. *wojalaka)* fragrant lemongrass (*Cymbopogon nardus* L.) methanol 70% (Merck), acetate buffer, HCL 4 N (Merck), Na acetate buffer (Merck), CH_3COONA, DPPH, Quades KCL (Merck), Whatman filter paper no.42, $AlCl_3$, $NaNO_2$..

Working Procedure

Extract manufacturing

Black rice is mashed with a blender until a fine powder is obtained. The powder is extracted by maceration with 96% methanol solvent for 3 x 24 hours. The filtrate obtained is collected and evaporated with *a rotary evaporator* until a coarse extract of black rice is obtained.

Phytochemical Screening and Antioxidant Testing

Phytochemical screening includes the examination of compounds of the alkaloid group, flavonoids, tannins, saponins, steroids/triterpenoids, and phenols. Test antioxidant activity with the DPPH method. Manufacture of 0.5 mM DPPH solution and 40 µg/ml concentration blank solution. The concentration of the test sample solution was made 50 ppm, 100 ppm, 200 ppm, 300 ppm, let it sit for 20 minutes, then its absorption was measured using a UV-visible spectrophotometer, wavelength of 516 nm while the ascorbic acid test solution as a comparison was made with a test solution concentration of 2 ppm, 4 ppm, 6 ppm, 8 ppm. Left to sit for 60 minutes, then its absorption was measured using a UV-Visible spectrophotometer, a wavelength of 516 nm whose result was expressed with an IC50 value calculated based on the percent inhibition against DPPH free radicals with the following formula:

$$\% \text{ inhibisi} = \frac{\text{ABS blank} - \text{ABS sample}}{\text{ABS blank}} \times 100\%$$

The calculation of the AAI value is used to determine the antioxidant activity index with the formula:

$$\text{AAI value} = \frac{\text{DPPH concentration (ppm)}}{\text{IC50 sample (ppm)}}$$

Determination of flavonoids, phenolics, and tannins content

The quercetin standard is used for the determination of total flavonoids (Stankovic, 2010). 15 mg of sample was taken and 10 mL of methanol (concentration 1500 ppm) was taken, then the solution was taken 1 mL plus 1 mL of 2% AlCl3 plus 1 mL of potassium acetate 120 mM. Incubated 1 hour at room temperature and absorbance is determined with a maximum wavelength of 435 nm. The phenolic test uses *the Follin-Ciocalteu method* as well as galic acid as a comparison (Lawag et al., 2023). A total of 19.80 samples were taken, 70% methanol was added in a flask, 5 mL was measured, divortex, then filtered with filtrate and 0.1 mL was added, 0.1 mL of *follin-Ciocalteu* reagent was added, 0.8 mL of Na_2CO_3, 5% was left to sit for 30 minutes, then measured at a wavelength of 760 nm. The

same method is used to determine the tannin content but the comparison uses tannic acid (Das et al., 2020).

Formulation of Antioxidant Masks

Combination mask formulation of black rice extract and lemongrass oil (Table 1). This natural face mask formulation is made by mixing five ingredients to produce a mask with a paste texture that is ready to use.

Table 1. Formulation Black rice mask and fragrant lemongrass essential oil

Material	Function	Formulation (%b/w)		
		I	II	III
Black Rice	Active ingredients	30	40	50
Lemongrass Essential Oil	Active ingredients	0,3	0.3	0,3
HPMC	Thickener	0,1	0,1	0,1
TEA	pH regulator	0,1	0,1	0,1
Aquades	Solvent	69,5	59,5	49,5
Mask concentration		100 %	100 %	100 %

Information:
TEA : Trietanolamine
HPMC : *Hidroxy Propyl Methyl Cellulose*)

Antioxidant Testing of Black Rice and Lemongrass Masks

A total of 2.5 grams of the preparation is dissolved with methanol in a 25 ml measuring flask, then stirred until homogeneous to make a 1000 ppm parent solution. After that, several series of concentrations of the preparation solution from the parent solution of 1000 ppm are made, to which 1 ml is added to each concentration. DPPH 0.4 mM, diluted with methanol, homogenized, and then kept in a dark room for half an hour. Additionally, the solution's absorbance was measured at 516.2 nm using a U-Vis spectrophotometer. Then the absorbance value of the sample solution is recorded and the % inhibition value is searched which will then be used to find the IC50 and AAI values.

Mask Quality Testing

Mask quality testing based on SNI includes;

1. Organoleptic test

Organoleptic analysis was carried out by observing changes in texture, color and smell from the preparation of the formulation of black rice antioxidant mask in combination with fragrant lemongrass.

2. Homogeneity test

This test is carried out by applying a sample of 0.1 grams to a glass object and then observed. The ingredients used in the formulation of the black rice antioxidant mask in combination with citronella must be evenly dispersed in the preparation. This test is done to see if there are any parts that are not mixed properly.

3. Mask Stability Test (pH Test)

pH testing is done to determine the compatibility of the pH of the preparation with the pH of the skin. As much as 1 gram of mask formulation is taken with the solution and placed on the pH meter. The pH result will appear on the screen after a while. The mixture is homogenized by turning it back and forth for 1 minute. The reading on the pH meter is done after 5 minutes to ensure that the number is stable and no longer moving (Lukić et al., 2021).

4. Dispersion Test

A total of 0.5 grams of face mask preparation was placed on a glass measuring 20 x 20 cm. Then it is covered with another glass of the same size and weighted on it until the weight reaches 125 grams and then measured in diameter after letting it sit after one minute. The good dispersion of the gel is 5-7cm (Annisa & Cahyaningrum, 2022).

The Effect of Mask Use on Facial Skin

The criteria for the inclusion of probandus are women aged around 35-40 years as many as 15 people for each formulation as many as 5 people, have not done treatments such as facials and peeling for the last 3 months, there are wrinkles, blemishes, acne, and dull skin around their face, and their skin is not sensitive to the ingredients contained in the natural face mask, does not use other cosmetics during the time span of wearing a face mask.

The face was cleaned first (wash the face) using soft soap provided by the researcher, then rinsed with cold water. The face is dried with a soft towel or tissue. The mask is applied to the

face until evenly distributed (except for the eyes and around the lips) using a mask brush and allowed to dry for approximately 15-30 minutes. Next, the mask is removed with warm water using a soft towel (damp and warm washcloth) until clean. Masks are used every 3 times a week until there are 18 masks (for 6 weeks).

The characteristics of the facial skin observed include aspects of skin type, texture, wrinkles, and skin disorders including acne on the facial skin will be presented with a table containing a description and score of one to four, where the lowest score will show poor skin characteristics and the highest score indicates good skin condition. Data is captured visually by being photographed using a 60D DSLR camera. The results of each subsequent observation were compared with control data (week 0) and compared with the results after mask use of each observation conducted in weeks 2, 4, and 6 (Wang et al., 2020).

Hedonic Test

Hedonic test or probandus' preference test for the resulting mask. The preference test was carried out visually on 15 probandus people with a scale of 1 = dislike, 2 = like, 3 = very like. Probandus data will be written S if you like it, SS if you like it very much, and TS if you don't like it. Then the percentage of preference for each preparation is calculated (Taebenu et al., 2023).

Discussion

The results of the phytochemical test qualitatively show that black rice extract contains flavonoid compounds, phenolics, saponins, triterpenoids and alkaloids and does not contain steroid compounds The results of the phytochemical test can be seen in Table 1 and the results of the antioxidant compound test in Table 2.

Table 2. Phytochemical Test Results of Black Rice (*Oryza sativa* L.var *wojalaka*)

Compound groups	Test Reagent	Test Results	Color Change
Flavonoid	Mg and HCl concentrates	+	Orange color formed
Tannins	FeCl3 1%	+	Formed a blue-black color
Saponins	HCl Concentrate	+	Permanent foam
Triterpenoid	Liebermann-Burchard	+	Brown rings formed
Steroids	Liebermann-Burchard	-	Color formation
Alkaloid	Mayer wagner	+	White deposits are formed
Phenolic	FeCl3 1 %	+	Formed a blue-black color

Table 3. Results of Flavonoids, Phenols, and Tannins of Black Rice Extract (*Oryza sativa* L. Var Wojalaka)

Compound Groups	Total Content
Flavonoid	332.58 (mg/100g QE)
Phenol	49.33 (mg/100g GAE)
Tannins	137,89 (mg/100g TAE)

Based on data, the results show that the formulation that is most preferred by probandus is formulation 3 mask because of its good texture, which is not too liquid and also not too thick, so it is easy to use. This is in accordance with the explanation of the mask quality test in the homogeneity test, namely that all mask materials are perfectly dispersed so that they produce a homogeneous texture. In addition, the results of using formula 3 masks also provide effective results, because the IC50 results in formula 3 masks are very strong, namely 2,231 mg/L.

The samples used in this study were black rice and citronella. The characteristics of black rice samples were selected from freshly harvested rice after having an age of between 100 to 120 days, with a height of about 130-140 cm (Rahim et al., 2022). The sample was mashed to obtain simplicia and then the extraction method was carried out in a meserical manner. The findings of the black rice extract test (Table1) demonstrate that there are categories of active components that have the potential to be antioxidants such as flavonoids, phenolics, tannins, steroids, terterpnoids, and alkaloids. Flavanoids are compounds of the polyphenol group that are known to have anticancer and anti-aging activities (Intharuksa et al., 2024).

Flavonoids have a broad spectrum of biological, antibacterial, anticarcinogetic, and antipolymeratic actions in addition to their high redox potential, which gives them antioxidant qualities (Liu et al., 2025). Flavonoids have

antibacterial activity by binding nucleophilic amino acids to proteins and enzyme inactivation (Mulyaningsih & Rachmadani, 2022). In this study, an orange or dark purple color was formed which indicates that it is positive for flavanoid compounds, then the total test results of the flavanoid content of black rice extract have a total flavanoid content of 332.58 (mg/100g QE). Phenolic compounds function as antioxidants because of their ability to deliver hydrogen atoms quickly. Phenolic compounds are analyzed by $FeCl_3$ in extracts, so extracts containing phenolic compounds will be characterized by the formation of blue to blackish colors (Shi et al., 2022). In this study, it was proven to be positive for phenolics due to the formation of a blackish-blue color. The results of the total phenolic level test using *the follin-ciocalteu* method with galic acid as the standard showed that black rice extract had a total phenolic content of 49.33 (mg/100g GAE).

Tannins have biological activity as antioxidants so that the tannin content in black rice will affect antioxidant activity. The extract will positively contain tannins if the addition of the $FeCl_3$ reagent will form blue, there are white or blackish-green deposits, this is because the tannins will react with Fe^{3+} ions so that they form a blackish-blue complex compound (Saptawati et al., 2022). The total tannin in black rice was determined using the phenol method using *the follin-ciocalteu reagent* and the tannic acid standard. The results of the total tannin content test obtained showed that black rice extract had a total tannin content of 137.89 (mg/100g TAE). Steroids and triterpenoids use the Lieberman-Burchard test (concentrated acetate-H_2SO_4 anhydration) where the steroid gives a dark blue color and triterpenoids give a red color and a brown ring is formed (Wutsqa et al., 2021). One part of triterpenoids is an asiacoside that has the function of strengthening skin cells and promoting skin repair, stimulating blood cells and the immune system and can function as a natural antibiotic. Triterpenoids can function to stimulate the formation of fats and proteins that are important for skin health. In addition, it can convert alanine and proline into collagen which functions to take care of the skin and accelerate the healing of post-operative wounds, acne and dark spots on the skin (Ghiulai et al., 2020)

Saponins are also contained in black rice extract which is done using an HCL solution and the results show that a stable foam is formed. Saponins function as antiseptic substances, so they have antibacterial abilities. These antibacterial substances block the formation and transport of cell wall components resulting in structural weakness accompanied by the removal of the cell wall and the release of cell contents so that the growth of bacteria is inhibited (Timilsena et al., 2023). Alkaloids are also contained in black rice extract which is carried out by Mayer test. In Mayer test, orange deposits were formed with Mayer reagents ($HgCl_2$ + KI) it is estimated that the sediment is a potassium-alkaloid complex. Alkaloids contain nitrogen atoms and are alkaline so to extract them sulfuric acid is needed. The nitrogen atoms on the alkaloids have independent electron pairs and will react with the metal ions K^+ of the Mayer reagent (Ningsih et al., 2024). Alkaloids are generally in the form of crystals called alkaloid salts.

Antioxidant Activity Test Results of Black Rice (*Oryza sativa* L. Var Wojalaka

The results of the IC50 analysis of black rice antioxidant activity were obtained from the regression line equation by plotting the sample concentration with the percent of DPPH suppression, namely y=1202.4x+4.844 with a correlation coefficient value $(R)^2 = 0.9821$). Graph of black rice extract test results in figure 1

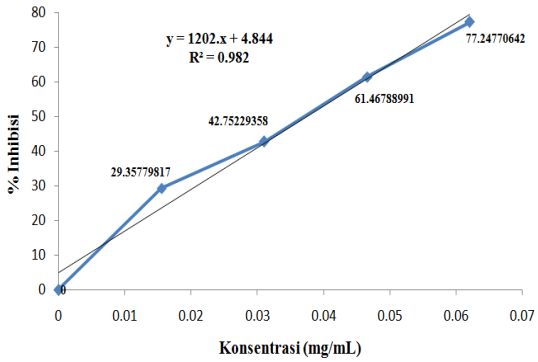

Figure 1. Linear Regression Equation Graph of Black Rice Extract (*Oryza sativa* L. Var Wojalaka

From the equation of the graph in figure 1, an IC50 value of 0.037 mg/L is obtained, which is included in the category of antioxidants that are very strong because it is <50 mg/L. Specifically, the antioxidant activity is very strong if IC50 is <50 mg/L, strong if it is 50-100 mg/L, while if it is valued at 100-150 mg/L, weak if it is >150 mg/L (Syakri et al., 2021). The AAI (*Antioxidant activity index)* value functions to determine the strength of

the antioxidant properties of extracts. Figure 1 shows an AAI value of 1.0 mg/L which is included in the category of strong antioxidants. Antioxidant activity based on AAI value is said to be weak as an antioxidant if the AAI value is < 0.5, moderate activity if 0.5 < AAI < 1.0, strong antioxidant activity 1.0 < AAI 2.0 and very strong activity if the AAI value > 2.0 (Insanu et al., 2022).

Antioxidant Activity of Black Rice Face Mask (*Oryza sativa* L.*Var.Wojalaka*) and Fragrant Lemongrass (*Cymbopogon nardus*, L)

Figure 2 illustrates how the mask's antioxidant content can prevent free radical activity in proportion to the amount of black rice it contains. A regression line equation with the percentage of DPPH suppression was produced by the findings of the IC50 analysis of the antioxidant activity of citronella masks and black rice, namely y=16,301x+13,622 with a correlation coefficient value $(R)^2 = 0.6749$. The graph of the results of the antioxidant activity test of black rice and lemongrass masks can be seen in Figure 2.

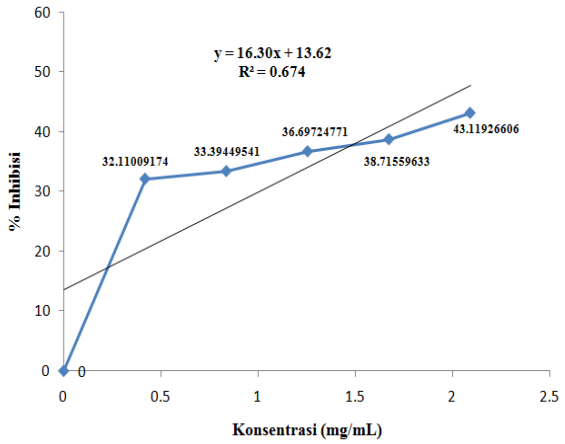

Figure 2. Linear Regression Equation Graph of Antioxidant Activity of Black Rice and Lemongrass Masks

Based on the equation of the graph above, an IC50 value of 2,231 mg/L was obtained which is included in the category of very strong antioxidants because it is <50 mg/L. The AAI (*Antioxidant activity index)* value in figure 2 is 0.01 mg/L which is included in the category of weak antioxidants. Comparison of the inhibition percentage of antioxidant activity of black rice extract and antioxidant activity of black rice mask with citronella can be seen in Figure 3

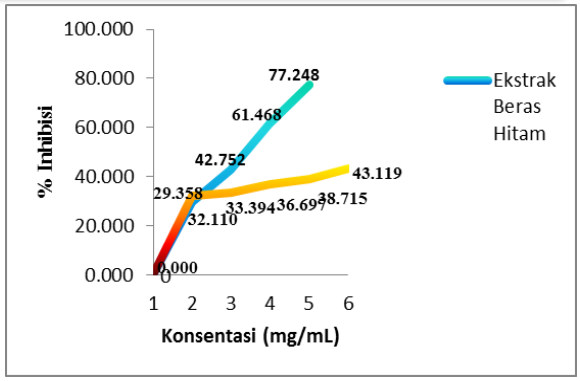

Figure 3. Inhibition Rate of Antioxidant Activity of HItam Rice Extract (*Oryza sativa*, L. *var wojalaka*) and Antioxidant Activity of Black Rice Mask with Fragrant Lemongrass (*Cymbopogon nardus*, L)

Based on the image above, it can be seen that the inhibition percentage of black rice extract is higher before rice extract is combined with citronella essential oil. The results of the antioxidant activity test of black rice extract with concentration differences using the DPPH (*1,1-diphenyl-2-picrylhydrrazyl*) method, which was measured at a maximum wavelength of 516 nm. Figure 5.1 shows that the greater the concentration of the test laurtan, the greater the percentage of immersion (% inhibition). The antioxidant activity of black rice can be measured by looking at the IC50 (*Inhibitory Concentration* 50%) value, which is a concentration that can reduce 50% of DPPH free radicals. The IC50 value of black rice in this study was 0.037 mg/L.

This value shows that black rice has very strong antioxidant activity. The potential of black rice extract as an antioxidant is supported by various active compounds contained in black rice (Table 1) where there are groups of flavanoid, phenolic, tannin, saponins, tritrpenoids, and alkaloids. In this study, the results of the flavanoid content test were higher than the levels of polyphenols and tannins, specifically 253.901 mg/100g of QE. Therefore, it can be said that the total flavanoid content has a positive and strong correlation, the higher the total flavanoid content, the higher the antioxidant activity. Flavanoids are the largest group of phenol compounds that have the ability to effectively inhibit the growth of viruses, bacteria, and fungi.

The results of the IC50 analysis of the antioxidant activity of black rice masks with citronella obtained a regression line equation with the percent damping of DPPH, namely y=16,301x+13,622 with a correlation coefficient

value $(R)^2 = 0.6749$. The graph of the results of the antioxidant activity test of black rice mask with citronella in Figure 5.3 obtained an IC50 value of 2,231 mg/L which is included in the category of very strong antioxidants because it is <50 mg/L.

The AAI (*Antioxidant activity index)* value in figure 5.3 is 0.01 mg/L which is included in the category of weak antioxidants. Based on figure 6, it shows that there is a difference in IC50 black rice after being combined into a face mask with the addition of citronella essential oil. Where IC50 black rice mask with citronella essential oil decreased IC50 black rice. This is due to the radical capture activity of DPPH from phenolic compounds and flavonoids. Since hydrogen ions have only one proton and no electrons, radicals in the nitrogen atoms of the DPPH compound are related to hydrogen ions and produce reduced DPPH. Flavonoid compounds function as antioxidants because they contain hydroxyl groups that can release protons in the form of hydrogen ions (Purwaningsih et al., 2023).

Quality Analysis of Black Rice Mask (*Oryza sativa,* L *var wojalaka*) with Fragrant Lemongrass (*Cymbopogon nardus,* L) according to SNI

Based on the mask formulation, the results of the organolepric test, homogeneity, stability, and dispersion are as follows:

1. Organoleptic test

The difference in consistency between formulas is due to the concentration of extracts used is different and the type of fragrance used is the same so that the aroma is the same. From the results of organoleptic evaluation of masks, which include shape, color and smell, it shows that mask preparations do not change during storage.

Table 4. Organoleptic Test Results

Formula	Consistency	Color	Smell
F1	Liquid	Light purple	Typical lemongrass oil slightly acidic
F2	Thickened slightly liquid	Light purple	Lemongrass oil and black rice
F3	Thick	Dark purple	Lemongrass oil and black rice

This happens because of the compatibility between the ingredients and the storage method so that there are no chemical interactions between the ingredients that can cause changes in the preparation and produce a stable preparation in storage.

2. Homogeneity Test

This test is done to see if there are any parts of the material that are not mixed properly. Table 5 shows the homogeneity of each formulation. In the three formulations, the mask shows a formulation of three (F3) whose ingredients are evenly dispersed so that the results are homogeneous. Homogeneity testing aims to determine the homogeneity of a preparation when it is made.

Table 5. Homogeneity Test Results

Formula	Homogenites
F1	Not homogeneous
F2	Not homogeneous
F3	Homogeneous

The results of homogeneity testing on black rice face masks are known to be that formula 1 and formulation 2 are not homogeneous while formulation 3 is homogeneous. The homogeneity of the preparation has an effect on the effectiveness of the antibacterial. A homogeneous preparation causes the distribution of the active compounds in the mask preparation to be evenly distributed so that the release of the active compound by the base provides maximum results. This shows that the preparation of the 3rd formulation mask made has a homogeneous arrangement (Nemati et al., 2024).

3. pH Test

The stability test includes pH testing which is carried out to determine the compatibility of the pH of the preparation with the pH of the skin and can be seen in Table 6. It can be seen in Table 6 that the formed paste mask still meets the requirements of the skin pH, which is 4.5-6.5 (Rosaini et al., 2021).

Table 6. pH Test Results

Formula	pH
F1	5.0
F2	6.0
F3	6.0

The pH test results of the paste mask preparation in the three formulations of face masks

made have a pH that is in accordance with the pH of the skinThe pH requirement for the skin is 4.5 - 6.5 (Pratiwi & Wijianto, 2023). If the pH of the preparation is outside the pH interval of the skin, it is feared that It will cause scaly skin or even irritation, while if it is above the pH of the skin, it can cause the skin to feel slippery, dry quickly and can affect skin elasticity. From the results of the evaluation of the three black rice mask formulas, it showed a pH with the appropriate criteria in the three formulations, namely showing pH 5.0 – pH 6.0. Because if the pH is too acidic or alkaline, it will irritate the skin. A stable pH will help avoid or prevent damage to the product during storage or use.

4. Mask Spreadability

The results of observations on the diameter of the spread of masks made in each formulation range from 5.0 – 5.5 cm, have met the dispersibility requirements, can be seen in Table 7

Table 7. Mask Dispersion Test Results

Formula	Spreading Power (cm)/min
F1	5.5
F2	5.3
F3	5.0

A good gel dispersion is 5-7 cm. In this range of dispersion the mask shows a very comfortable consistency in use (Jamilatun et al., 2024). Consistency measurement can be done by means of a dispersion power test, the principle is to calculate the increase in area given to the preparation after being given a load of 2 grams. From the results of the third evaluation, the black rice mask formula showed that the dispersability with the appropriate criteria was 5.0-5.5 cm at the 60th second (1 minute). The good spreading capacity of the mask is 5-7 cm. In this range of spread, masks show a very comfortable consistency in use ((Kollepara et al., 2021).

Effect of Mask Use on Probandus Skin

The masks that have been tested for mask quality are followed by the application of masks on the facial skin of probandus as many as 15 people, probandus is divided into 3 groups where 3 groups of probandus each get different mask treatments, namely formulation 1, formulation 2, and mask formulation 3. The mask is used for 6 weeks and is observed at weeks 2, 4 and 6. The results of the effect of mask use in week 0 to week 6 can be seen in Figure 4.

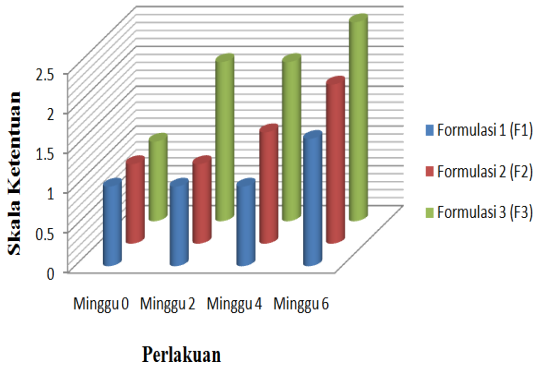

Figure 4. Average Effect of Mask Use on Probandus Skin

Based on Figure 4, it can be seen that in week 0 to week 6. The determination scale in week 0 is scale 1 indicated by unhealthy skin conditions, namely wrinkled, dry, dull, oily skin, there are blemishes/dark spots, and acne. The effect of face mask use on the skin of the fifth probandus began to be seen in the 2nd to 6th consecutive week. Based on the above statement, in week 0 to week 6, it can be seen that effective formulation 3 masks show changes in the condition of facial skin. This is because based on the antioxidant test and the mask quality test, it shows that the antioxidant content of the mask formulation 3 is higher than formulation 1 and 2. Furthermore, it is based on the mask quality test which includes organolepic test, homogeneity test, pH test, and dispersion test.

Natural face masks in this study are face masks that can dry and soft when applied to the face and are classified as *exfoliating masks*. *Exfoliating masks* are useful for removing dead cells. Meanwhile, masks that cannot dry are classified as a type of *moisturizing mask* that is useful for increasing moisture levels in dry facial skin (Xu et al., 2022). The use of this black rice and lemongrass face mask formulation is proven to reduce wrinkles and remove spots and other abnormalities on the skin such as acne because it is affected by the skin condition where the black rice mask and lemongrass essential oil are applied. The skin can absorb certain ingredients contained in masks, namely fat-soluble substances such as antioxidants including flavonoids, tannins, triterpenoids, alkaloids and steroids, but water and electrolytes are difficult to penetrate through the skin. Fat-soluble substances are easier to enter the skin and enter the bloodstream

because they can mix with the fat that covers the surface of the skin. The entry of these substances is through the hair follicles and only a small part enters through the mouth of the sweat glands (Schwinn & Jackson, 2020).

Based on the results of the assessment of the effect of mask use on probandus in this study, it is best obtained from the results of formulation 3, because formulation 3 is homogeneous with the highest concentration of black rice which is 50% with an IC50 of 0.037 mg/L which is included in the category of very strong antioxidants because it is <50 mg/L. The difference in the speed of wrinkle change in each probandus is suspected to be due to the difference in activity in each probandus, Probandus too often uses soap that can reduce the level of fat on the surface of the skin so that the skin becomes drier, psychological stress, and repetitive or long-lasting use of facial muscles such as pouting and frowning and too often being exposed to UV.

Conclusion

The results of the research obtained, it was concluded that the antioxidant activity of black rice (*Oryza sativa*, L Var Wojalaka which was tested with IC50 of 0.037 mg/L is classified as a very strong antioxidant. The antioxidant activity of masks containing black rice (*Oryza sativa*, L *Var* Wojalaka) and citronella essential oil (*Cymbopogon nardus*, L) tested with IC_{50} was 2,231 mg/L which is included in the category of very strong antioxidants. The best quality of masks according to SNI is a 3-formula mask with the addition of 50% black rice flour. The mask formulation that Probandus likes the most is the 3 formulation mask which contains 50% black rice.

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