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Peel Off Face Masker from Coffee Grounds-Chitosan

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ABSTRACT

Face skin is one of the sensitive skin covering the human body. For the women, face skin was an important part of care. But sometimes skin care products cause bad side effects to the skin and the body's health. Because of this, Pharmaceutical and Cosmetics research was initiated to produce the advanced materials to be applied in Cosmetics formulations. In this study, the processing of Coffee grounds became a suitable compound for skin care. The Coffee grounds were activated to increase its performance. The Coffee grounds were mixed with the Chitosan to make the Biofilm and then applied as a peel-off face, Masker. The results of antibacterial, antioxidant, and SPF protection in all treatments showed a “strong” to “very strong” activity range. Based on these results concluded that this face masker was recommended for production as a skin care product.

Keywords: Antioxidant, chitosan, coffee, cosmetics, skincare

Introduction

Indonesia is a country with abundant natural wealth that can be used to care for the human body, among of the body parts commonly cared for is the skin, especially the face’s skin (Agustiningsih & Dwiyanti, 2017; Aljanah et al., 2022). There were many nature sources used as Cosmetics based on local wisdom (or local knowledge) for skin care (Agustiningsih & Dwiyanti, 2017; Aljanah et al., 2022; Handayani et al., 2021; Handayani & Muchlis, 2021). Nowadays, information about traditional Cosmetics is collected and researched, especially regarding the ingredients, compounds, and methods (processing, use, and utility) (Agustiningsih & Dwiyanti, 2017). Research (about organic/herbal Cosmetics) is initiated anymore because the usage of synthetic active compounds in Cosmetic sometimes give bad side effect to consumers (Agustiningsih & Dwiyanti, 2017; Aljanah et al., 2022), the worse side effect even can reach carcinogenic reactions (Agustiningsih & Dwiyanti, 2017; Hertina & Dwiyanti, 2013). Because of these problems Cosmetics and Medical producers initiated producing “biocompatible compounds” from organic or herbals that have low-risk side effects (Agustiningsih & Dwiyanti, 2017; Hertina & Dwiyanti, 2013). However, the problem with the usage of herbal and organic as active compounds in Cosmetics formulation for skin care was the slow effect (Aljanah et al., 2022; Handayani et al., 2021). Even organic or herbal compounds have to “strong effect” but it takes a long time to use fresh (and crude extract) organic materials to use until showing a significant effect (Agustiningsih & Dwiyanti, 2017; Aljanah et al., 2022; Handayani et al., 2021), while the cosmetic markets and consuments requesting the fast also strong effect (Agustiningsih & Dwiyanti, 2017;

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Hertina & Dwiyanti, 2013). So, the crude extract of organic materials (the herbals) must be modified to increase the acceleration of the (chemical) reaction to show the significant effect on the skin (Agustiningsih & Dwiyanti, 2017; Hertina & Dwiyanti, 2013; Irmayanti et al., 2021).

One of the organic materials famous in Cosmetic formulation is Coffee (Hertina & Dwiyanti, 2013; Pribadi et al., 2021). The Coffee used in Cosmetics in its crude extract, volatile extract (for perfume and aroma therapy), and grounds as skin scrubs (Agustiningsih & Dwiyanti, 2017; Handayani et al., 2021; Handayani & Muchlis, 2021; Hertina & Dwiyanti, 2013; Pribadi et al., 2021). But the same case with the usage of another organic material for skin care has to strong effect the usage of Coffee also takes a long time to show its significant effect on the skin [1][5][7]. So, the Coffee grounds need to be modified chemically to increase the effect and shorten the time until the effect appears. In this research, initiated to make the "peel off" face masker from Coffee grounds (Agustiningsih & Dwiyanti, 2017; Hertina & Dwiyanti, 2013; Pribadi et al., 2021; Puspitasari et al., 2021). The main materials were the waste Coffee grounds collected from the "Myristica Coffe café (located in the canteen hall in UKSW)". The waste Coffee grounds collected was from the Espresso processing. Coffee grounds from espresso processing are chosen. After all, it is predicted to still be in pure condition because it is not mixed with sugar or milk (or another compound) like common Coffee making. It only mixes and reacts with the vapor of boiling water. After the water extract was collected, the Coffee grounds were not used anymore. The production of waste Coffee grounds every working day very the potential to process as main compounds for Coffee base cosmetics. The waste Coffee ground production per day reaches 3-5Kg even more. Predicted that this waste Coffee grounds still contain the phytochemical potentially to apply as skin care. This prediction is claimed because espresso-making only extracts the water phase of the overall phytochemical contained in the Coffee powder. Even the Coffee grounds are made from various Coffee species (mostly Torajan and Arabica), but it is not contaminated by other compounds like sugar, so can claimed that the phytochemical and its effect come from the Coffee grounds itself and not interrupted by another compound.

The Coffee grounds were combined with Chitosan hydrogel to make the Biofilm sheet, to apply as peel-off face maskers (Wulandari et al., 2019; Yasir et al., 2022; Purwaningsih et al., 2014). Chitosan chose to combine (grafting) with Coffee grounds because it is also one of the advanced biomaterials used in cosmetic and medicine formulation (Purwaningsih et al., 2014; Simanjuntak et al., 2021). Chitosan also reported that has low toxicity, but high biocompatibility so very recommended to apply as skin care (Yasir et al., 2022; Purwaningsih et al., 2014; Simanjuntak et al., 2021; Pranoto et al., 2005; Sarwono, 2010; Sularsih & Soeprijanto, 2012; Zaiva & Wahyunindita, 2020). By combining the Coffee grounds with Chitosan expected that this research can produce the Biofilm applied as Peel Off Face Masker which contains many chemical benefits for the face's skin.

Material and Methods

Time and research location

The research is due from February – December 2022 at CARC Laboratory of Magister Biology UKSW Salatiga.

Research materials and instruments

The chemicals used in this research were Aquadest, Aquabidest, Ethanol, Ascorbic Acids, Acetic Acids, Quercetin, Katekin, $AlCl_3$, $FeCl_3$, Metyl Violet, Metylen Blue, DPPH, and NaOH. Those chemicals are classified into pro-analysis (PA) levels.

The instruments used in this research were an oven, furnace, moisture analyzer, laminar wardrobe, incubator, rotary viscometer, and spectrophotometer UV-Vi.

The main compound coffee grounds were collected from Myristica Coffe café (located in the canteen hall in UKSW). The coffee grounds selected for collection were from espresso making. The supporting compound, the Chitosan, is from the preliminary research.

Characterization of the coffe grounds

Water Contains (Moisture)

The moisture of the coffee grounds was measured automatically using an *Automatic Moisture Analyzer* with measurement intervals of 15 minutes (Simanjuntak et al., 2021; Gintu et al., 2023; Gintu & Puspita, 2020).

Ash

The ash contained was measured by incinerating the coffee grounds using Furnace at 550°C for 3 hours. The organic compounds are obtained from the differences between the ground mass against its ash mass. The volatile Carbons are obtained from the multiplying of organic compounds against 0,58 (Simanjuntak et al., 2021; Gintu et al., 2023; Gintu & Puspita, 2020).

Organic crude fats

Organic crude fats in the coffee grounds were measured by maceration. The coffee grounds are macerated in n-Hexane and P-Eter. The crude extract is noticed as crude fats (Simanjuntak et al., 2021).

Flavonoid

The 10mL water extract of coffee grounds was diluted to 100mL (using its solvents) then added 1mL $FeCl_3$ 1% (w/v) and incubated for 10 minutes at room temperature. The absorbansion of the extract was measured using a spectrophotometer Uv-Vis at λ 435nm and then plotted in the Quercetin: $AlCl_3$ standard curve (Septiani et al., 2018).

Saponin

The 10mL water extract of coffee grounds was diluted to 100mL (using its solvents) then added 1mL NaCl 0,9% (w/v) and incubated for 10 minutes at room temperature. The absorbansion of the extract measured using a spectrophotometer Uv-Vis at λ 650nm and then plotted in the Metilen Blue standard curve ((Septiani et al., 2018).

Tanin

The 10mL water extract of coffee grounds was diluted to 100mL (using its solvents) added 0,5mL $FeCl_3$ 1% (w/v) and incubated for 10 minutes at room temperature. The absorbansion of the extract was measured using spectrophotometer Uv-Vis at λ 235nm and then plotted in Catechin: $FeCl_3$ standard curve ((Septiani et al., 2018).

Antioxidant assay of coffee grounds

Antioksidant contains

The content of antioxidant were measured using Ascorbic Acids: $FeCl_3$ by spectrophotometer UV-Vis at λ 720nm. 1ml $FeCl_3$ 1% (w/v) was added to 10mL of the coffee ground solution and then incubated for 10 minutes at room temperature. After incubation 1mL Ascorbic Acid 1% (w/v). The absorbansion of samples were measured and plotted to the Ascorbic Acids standard curve (Septiani et al., 2018; Kedare & Singh, 2011; Lung & Destiani, 2017; Maesaroh et al., 2018).

Reducing ability

The reduction ability of each extract was measured using Metyl Violet by spectrophotometer UV-Vis (Septiani et al., 2018; Kedare & Singh, 2011; Lung & Destiani, 2017; Maesaroh et al., 2018).

Inhibitory concentration (IC 50%)

The IC_{50} of coffee water extract was measured using 1mL DPPH (1,1-Diphenyl-2-Picrylhydrazyl) 0,5M by spectrophotometer UV-Vis at λ 517nm (Kedare & Singh, 2011; Rosalia et al., 2021; Sawiji et al., 2022; Suena & Antari, 2020).

Sun Protecting Factor (SPF) Assay

The SPF ability of coffee ground was measured using the Mansur Method, the water extracts were scanned along λ 290, 295, 300, 305, 310, 315, and 320nm by spectrophotometer UV-Vis (Karina et al., 2015; Susanti et al., 2015).

The peel-off masker is made from coffee grounds mixed with chitosan

The peel-off maskers are made from a mix of coffee grounds and Chitosan. In this formula the Chitosan role as an adhesive compound to glue the coffee grounds to merge forming a thin biofilm. The treatments in the peel-off making are shown in Table 1.

Table 1. Details of Treatments

Code of Treatments	Definition	Detail
MC1	Main Compound 1	Coffee Grounds
MC2	Main Compound 2	Activated Coffee Grounds
SC1	Supporting Compound 1	Chitosan
SC2	Supporting Compound 2	Chitosan TPP
T1	Treatment 1	Chitosan – Coffee Grounds
T2	Treatment 2	Chitosan – Activated Coffee Grounds
T3	Treatment 3	Chitosan TPP – Coffee Grounds
T4	Treatment 4	Chitosan TPP – Activated Coffee Grounds

Characterization of peel-off maskers

Density

1ml of maskers hydrogels was weighed using a digital balance. The scale of the balance was calibrated with a mass of 1ml aquadest (Simanjuntak et al., 2021; Gintu et al., 2023; Gintu & Puspita, 2020).

Viscosity

The viscosity of masker hydrogels was measured using the digital rotary viscometer. The Molecular Weight (MW) is calculated by multiplying the absolute viscosity against the *Mark-Houwink-Sakurada* numbers (0,9671) (Simanjuntak et al., 2021; Gintu et al., 2023; Gintu & Puspita, 2020).

Vapor uptake

The dry masker sheets were cut in ± 5cm diameters and then covered above the vessels containing saturated $CaCl_2$ and NaCl solutions for 24 hours in desiccators (room temperature). The WVP was measured based on the mass differences between before and after exposure to the ambient ((Simanjuntak et al., 2021).

Water uptake

The dry masker sheets were macerated in sterilized aquabides for 30 minutes at room temperature. The water uptake was measured based on the mass differences before and after the maceration process (Simanjuntak et al., 2021).

Methanol uptake

The dry masker sheets were macerated in methanol for 30 minutes at room temperature. The methanol uptake was measured based on the mass differences between before and after the maseration process (Simanjuntak et al., 2021).

Antibacterial assay

The antibacterial activity assay of masker is due against 5 species of skin bacteria: *P. acnes, S. epidermidis, S. aureus, P. aeruginosa,* and *P. cepacia*. The batteries used in this treatment were standardized (using McFarland solution series No.2). The treatments of the antibacterial assay for the maskers were due to disc methods. The masker's hydrogels were cut into a 5mm size of paperdisk then measured its antibacterial effect against 5 batteries in an NA medium. While the coffee grounds and Chitosan, the antibacterial assay was treated by gel well methods with good diameters 5mm and 10mm deep. Antibacterial activity is determined using the diameters of the inhibitory area against the batteries (Simanjuntak et al., 2021; Gintu et al., 2023; Gintu & Puspita, 2020).

Results and Discussion

Coffee was one of my favorite drinks which can be enjoyed when working or during breaks. The coffee is mostly drunk at home, office, café, or restaurants (Rahmat et al., 2020; Rohman & Maspiyah, 2016; Rohyani et al., 2021). Because of this, the coffee orders were never empty in its shops (or stage) Rohyani et al., 2021). The same situation was also found in the sampling location, at a coffee cafe in Satya Wacana Christian University Salatiga named Myristica Coffee Shop. Many customers order coffee every day, and because of this the production of coffee grounds also increased. The waste of coffee grounds is only thrown away, but many customers believe that these coffee grounds still can used for skincare and some customers collect the grounds especially the coffee grounds from espresso.

Some people believe that coffee grounds can used for skin care because of several preliminary research reports about it (Rohman & Maspiyah, 2016; Rohyani et al., 2021; Sari & Suhartiningsih, 2020), even some research claimed that coffee grounds are safer than the active ingredients in market cosmetics (Agustiningsih & Dwiyanti, 2017; Tiadeka et al., 2021). Coffee grounds still contain phytochemicals which beneficial for skin health 9(Agustiningsih & Dwiyanti, 2017; Handayani et al., 2021; Handayani & Muchlis, 2021; Rohman & Maspiyah, 2016; Rohyani et al., 2021). Based on this reason initiated to make the peel off face maskers from coffee grounds (Wulandari et al., 2019; Yasir et al., 2022). But before producing the masker with coffee grounds as active ingredients, need to analyze the physicochemicals and phytochemicals contained in the coffee grounds (Pribadi et al., 2021; Puspitasari et al., 2021). The results of the analysis are shown in Table 2.

Table 2. Physicochemical of coffee grounds

Sampel	Water (%)	Ash (g/g)	Organic (g/g)	Carbon (g/g)	Fats		Phytochemicals		
					Hexane (%)	Eter (%)	Flavon (g/g)	Saponin (g/g)	Tanin (g/g)
MC1	1,1 ± 0,00	0,6920 ± 0,0039	0,3080 ± 0,0039	0,1787 ± 0,0023	9,42 ± 0,0495	19,44 ± 0,8714	0,0512 ± 0,0014	0,0277 ± 0,0088	0,0853 ± 0,0069
MC2	1,1 ± 0,00	0,4953 ± 0,0040	0,5047 ± 0,0040	0,2927 ± 0,0023	3,46 ± 0,0230	13,12 ± 0,4538	0,0461 ± 0,0018	0,0256 ± 0,0062	0,0799 ± 0,0058

Based on Table 3 shows that the coffee grounds still contain phytochemicals recommended as active compounds in skin care such as Tanin, Flavonoids, and Surfactant (Saponin). Those phytochemical belongs to “strong antioxidant” and have already been applied as cosmetics since traditional cultures (Agustiningsih & Dwiyanti, 2017; Rosalia et al., 2021; Sawiji et al., 2022). To prove the antioxidant activity then measure the antioxidants in coffee grounds, the results showed in Table 3.

Table 3. Antioxidant assay of coffee grounds

Sample	Ascorbic Acid (%)	Crystal Violet (%)	DPPH (IC 50%)
MC1	3,41 ± 0,0069	9,07 ± 0,0019	4,46
MC2	3,25 ± 0,0079	8,71 ± 0,0051	5,25

From Table 3 can be known that the coffee grounds still produce the antioxidant effect at a "strong level" (Agustiningsih & Dwiyanti, 2017; Rosalia et al., 2021; Sawiji et al., 2022), so it is recommended to apply as skin care because the skin also needs antioxidants (Rosalia et al., 2021; Sawiji et al., 2022; Suena et al., 2020; Wati et al., 2021; Wulandari & Agustin, 2022). The antioxidants contained in the grounds necessary need as antiaging also anti anti-inflammatories (Agustiningsih & Dwiyanti, 2017; Wati et al., 2021; Wulandari & Agustin, 2022). The antiaging effect of the phytochemicals appears from the biochemical reactions when the phytochemicals act as proton donors to stabilize the Radical Oxygen (ROS) from outside and inside the body which can interfere with the health of the skin (Lung & Destiani, 2017; Maesaroh et al., 2018; Rosalia et al., 2021). The existence of ROS believed can trigger and accelerate the aging of the skin so with the antiaging effect of the coffee grounds the aging effect can be minimized, and the skin always looks tight (Rosalia et al., 2021; Sawiji et al., 2022). The anti-inflammatory effect from the coffee grounds predicted can minimize the inflammation (and bleeding) to the wounds or pimples on the face's skin. The phytochemicals in the coffee grounds predicted can stop bleeding and accelerate wound healing (of wounds or pimples scars) (Agustiningsih & Dwiyanti, 2017; Wati et al., 2021; Wulandari & Agustin, 2022).

Based on these benefits, then initiated to make the peel off-face maskers from coffee grounds waste collected from Myristica Coffee Shops. But to produce this masker, the adhesive compounds glue the coffee grounds to become one-layer biofilm sheets (Wulandari et al., 2019; Yasir et al., 2022). The adhesive used in this research was the Chitosan hydrogels (Simanjuntak et al., 2021). Chitosan hydrogels were chosen as an adhesive because they proved safe medically for the face skin ((Simanjuntak et al., 2021; Sularsih & Soeprijanto, 2012). The facial skin is one of the most sensitive parts of the human body so to manage it needs safe ingredients to care Sularsih & Soeprijanto, 2012). The combination of Chitosan and Coffee grounds is recommended for face skin care because it more safer, has minimum side effects, is biocompatible, and has low toxicity more importantly those two compounds do not belong to Hard Chemicals Sularsih & Soeprijanto, 2012). The Chitosan used (as adhesive) in this research were applied in two form the Chitosan Hydrogels and its nano form: Chitosan Tri Poly Phosphate (TPP). The coffee grounds were mixed with the Chitosan and Chitosan TPP to make the film mask. The physicochemical of the masker biofilm is shown in Table 4.

Based on Table 4 shows that the biofilm maskers already meet the criteria of biopolymers/biofilm so they can continue processing to produce the peel-off face maskers. The density, viscosity, and molecular weight of these hydrogels already belong to a small range. In a small range of those 3 parameters the skin pores will be easy to absorb the phytochemicals and the masker film will easy to firmly attached to the face skin. The biofilm from coffee-ground – Chitosan is shown in Figure 1.

Table 4. Physicochemical of the peel-off (Biofilm) face masker from the coffee ground mix with chitosan and chitosan TPP

Treatments	Density (g/mL)	Viscosity			Molecular Weight (g/Mol)	Permeability		
		Absolute (Pa)	Kinetic (CTs)	Dynamic (CPs)		Vapor Uptake (%)	Water Uptake (%)	Methanol Uptake (%)
MC1	0,9963 ± 0,0018	1,6 ± 0,00	1,6003 ± 0,0029	0,1600 ± 0,0002	1,6547 ± 0,0030	0,03 ± 0,0119	48,16 ± 1,2631	2,53 ± 0,0958
MC2	0,9460 ± 0,0233	1,5 ± 0,00	1,5875 ± 0,0400	0,1588 ± 0,0040	1,6415 ± 0,0414	0,03 ± 0,0059	47,76 ± 1,2520	3,80 ± 0,4037
SC1	0,9469 ± 0,0359	2,1 ± 0,00	2,2244 ± 0,0862	0,2224 ± 0,0086	2,3001 ± 0,0892	0,03 ± 0,0054	47,57 ± 1,7628	3,67 ± 0,3842
SC2	1,0015 ± 0,0005	1,4 ± 0,00	1,3978 ± 0,0008	0,1398 ± 0,0086	1,4454 ± 0,0008	0,03 ± 0,0044	42,37 ± 3,1285	2,89 ± 0,2322
T1	1,0514 ± 0,0020	2,5 ± 0,00	2,3778 ± 0,0044	0,2378 ± 0,0044	2,4586 ± 0,0046	0,59 ± 0,0092	44,44 ± 0,3819	2,99 ± 0,5930
T2	1,0208 ± 0,0063	2,2 ± 0,00	2,1552 ± 0,0013	0,2155 ± 0,0013	2,2285 ± 0,0014	0,01 ± 0,0074	47,45 ± 0,6905	4,09 ± 0,2154
T3	1,0555 ± 0,0035	2,4 ± 0,00	2,2738 ± 0,0075	0,2274 ± 0,0008	2,3512 ± 0,0077	0,03 ± 0,0029	46,24 ± 1,6277	3,76 ± 0,7061
T4	1,0550 ± 0,0006	2,4 ± 0,00	2,2750 ± 0,0013	0,2275 ± 0,0013	2,3524 ± 0,0013	0,58 ± 0,0177	45,47 ± 0,7186	3,26 ± 0,5645


Fig.1a. Coffee Grounds (Author's Documentation)


Fig.1b. Coffee Grounds Mix Chitosan Hydrogel (Author's Documentation)


Fig.1c. Coffee Grounds Mix Chitosan Hydrogel (Author's Documentation)


Fig.1d. Hydrogels (Author's Documentation)

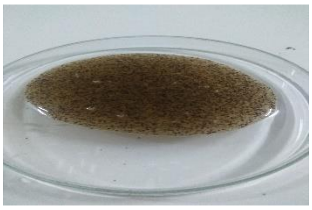
Fig.1e. Hydrogels (Author's Documentation)


Fig.1f. Dry Biofilm Coffee-Chitosan (Author's Documentation)


Fig.1f. Dry Biofilm Pure Chitosan (Author's Documentation)


Fig.1f. Dry Biofilm Coffee-Chitosan TPP (Author's Documentation)

During the treatments in Table 4, the most possible to continue producing peel-off face maskers were the T3 (Coffee Grounds-Chitosan TPP) and T4 (Activated coffee grounds – Chitosan) treatments. T3 and T4 treatments were chosen because it has higher absolute viscosity and lower water uptake, while other parameters of overall treatments belong to match. Higher absolute viscosity means that the film is very flexible and elastics but not easy to rip when in dry film form. The lower water uptake means that the film (peel-off masker) will not easily react with water, moisture, and sweat when applied as a face masker (Simanjuntak et al., 2021). Biopolymers are commonly easy to rip when absorbing water or water vapor too much out of their capacity, in the case of T3 and T3 treatments the vapor and water ions predicted absorbed by the Tripoly phosphate groups so it does not reach the Carbon structure of the biofilm.

In the application as peel off face masker, the masker film must have an antibacterial effect, especially for the acne bacteria (Purwaningsih et al., 2014; Zaiva & Wahyunindita, 2020; Imasari & Emasari, 2021). Because of it then initiated to measuring the antibacterial effect of biofilm against 3 acne bacteries (*P. acnes*, *S. epidermidis* and *S. aureus*) and 2 skin bacteria (*P. aeruginosa* and *P. cepacia*) (Simanjuntak et al., 2021; Imasari & Emasari, 2021; Pariury et al., 2021; Puspita & Gintu, 2020; Wardani et al., 2020). The determination of the antibacterial effect is shown at Table 5.

Table 4. Antibacterial Effect Against Acne and Skin Bacteries by The Size of Inhibitory Zone

Treatments		Antibacterial Effect against				
		P. acnes (mm)	*S. epidermidis* (mm)	*S. aureus* (mm)	*P. aeruginosa* (mm)	*P. cepacia* (mm)
	MC1	18,53 ± 0,2603	18,27 ± 0,3844	18,80 ± 0,2000	20,03 ± 0,3528	18,87 ± 0,0882
	MC2	19,97 ± 0,2333	18,07 ± 0,2333	18,83 ± 0,2186	19,87 ± 0,1856	20,43 ± 0,4333
	SC1	23,63 ± 0,2963	23,33 ± 0,2333	23,90 ± 0,1526	23,63 ± 0,1453	23,90 ± 0,1528
	SC2	19 ± 0,1155	18,77 ± 0,2333	19,87 ± 0,5783	24,07 ± 0,0667	22,80 ± 0,2000
	T1	20,93 ± 0,2333	21,03 ± 0,0333	20,63 ± 0,3844	22,87 ± 0,1333	22,57 ± 0,1453
	T2	22,03 ± 0,0333	21,80 ± 0,1528	21,63 ± 0,4177	23,37 ± 0,1333	23,33 ± 0,1767
	T3	20,53 ± 0,2028	20,23 ± 0,1764	20,23 ± 0,3844	23,57 ± 0,1202	23,33 ± 0,0882
	T4	22,80 ± 0,1732	22,90 ± 0,1000	23,23 ± 0,1453	23,13 ± 0,1856	22,67 ± 0,3333
Control (+)	Tetracycline	24,07 ± 0,1453	24,03 ± 0,0333	24,10 ± 0,1000	24,43 ± 0,1856	24 ± 0,0000
	Erythromycin	23,87 ± 0,2333	24,07 ± 0,2603	24,33 ± 0,1764	24 ± 0,0000	23,97 ± 0,0333
	Cindamycin	23,87 ± 0,1764	24,13 ± 0,1202	23,93 ± 0,0667	24,80 ± 0,2082	23,67 ± 0,4372
	Streptomycin	24,33 ± 0,1764	24,17 ± 0,1667	23,80 ± 0,1528	24,47 ± 0,2603	26,10 ± 1,8520

The antibacterial effect of overall treatments (shown in Table 5) belongs to the "strong – very strong" range because it made the diameter of the inhibitory zone more than 17mm (Simanjuntak et al., 2021; Gintu et al., 2023; Gintu & Puspita, 2020). This antibacterial effect even can match the medical standard antibacterials (Control (+)). The strong antibacterial effect of peel-off maskers from coffee grounds caused by the existence of Caffeine (Agustiningsih & Dwiyanti, 2017; Handayani & Muchlis, 2021; Wulandari et al., 2019; Tiedeka et al., 2021; Wati et al., 2021). Caffeine is one of the alkaloids that also has an antibacterial effect in a strong range (Agustiningsih & Dwiyanti, 2017; Handayani & Muchlis, 2021; Wulandari et al., 2019; Tiedeka et al., 2021; Wati et al., 2021). The existence of Caffeine also causes these peel-off maskers predicted to have an anti-inflammatory effect, so it potentially manages the inflammation of the pimpled face (Agustiningsih & Dwiyanti, 2017; Handayani & Muchlis, 2021; Wulandari et al., 2019; Tiedeka et al., 2021; Wati et al., 2021). The antibacterial effect of this masker is also supported by the existence of Chitosan as a supporting compound (adhesives). Chitosan can produce an antibacterial effect because of the existence of polycationic (poly NH_3^+) which actively reacts with the batteries made inhibition (Simanjuntak et al., 2021; Pranoto et al., 2005; Sarwono, 2010; Sularsih & Soeprijanto, 2012; Zaiva & Wahyunindita, 2020).

Another parameter that can complete the peel-off masker is the Sun Protection Factor (SPF) parameter (Karina et al., 2015; Susanti et al., 2015). This parameter aims to measure the protection ability of the active ingredients (in the maskers) to cover the skin from sunburn or sunburn side effects (Karina et al., 2015; Susanti et al., 2015). The determination of SPF ability is shown at Table 6.

Table 6. The Sun Protection Factor (SPF) of Peel Off Face Masker from Coffe Grounds

Treatments	SPF				IC 50% DPPH
	Number of SPF	Class	Protection / Day		
MC1	72,75	Very Strong	1455 Minutes	24,25 Hours	4,46
MC2	86,41	Very Strong	1728 Minutes	28,8 Hours	5,25
T1	70,45	Very Strong	1409 Minutes	23,48 Hours	2,83
T2	76,88	Very Strong	1538 Minutes	25,63 Hours	2.86
T3	62,33	Very Strong	1247 Minutes	20,78 Hours	0,48
T4	59,62	Very Strong	1192 Minutes	19,87 Hours	0,12

The SPF determination in this research using Mansur Methods by UV-Vis spectrophotometer at 290-315nm. The results in Table 5 showed that the maskers have SPF belonging to a "very strong" level of protection because the SPF numbers more than 50 (Karina et al., 2015; Susanti et al., 2015). It means that the ingredients in this masker can protect the face skin for more than 18 hours a day (Karina et al., 2015; Susanti et al., 2015). The determination of SPF number is calculated using SPF 15 as the standard lower SPF ability and correction factors, also 20 minutes as a standard time for skin hold sunburn (Karina et al., 2015; Susanti et al., 2015). The high SPF number of this masker is also related to the phytochemicals compounds contained in coffee grounds (Table 2). The phytochemicals can donate the protons to stabilize the radical photon particles from sun exposure (Rosalia et al., 2021; Karina et al., 2015; Susanti et al., 2015). Because the SPF and antioxidant ability (in Table 3) are strong these maskers are potentially recommended for use after working all day under the sun exposures (Rosalia et al., 2021; Karina et al., 2015; Susanti et al., 2015). Besides protecting the face from sun exposure, the phytochemicals in coffee grounds predicted can manage the sunburn effect (Rosalia et al., 2021; Karina et al., 2015; Susanti et al., 2015). Sun exposure sometimes causes sunburn scars, in the scars are believed to contain radical compounds because absorb the high energy from the radical photons, this radicals can be stabilized by the phytochemicals from coffee and Chitosan (Karina et al., 2015; Susanti et al., 2015). The sunburn scars also feel hurt, this hurts can be managed with these maskers because coffee grounds contain Caffeine as an anti-inflammatory (Agustiningsih & Dwiyanti, 2017; Wulandari et al., 2019; Yasir et al., 2022; Sari & Suhartiningsih, 2020; Tiadeka et al., 2021). The SPF determination at Table 5 then recommended that to continue the production to the business production levels the T3 (Coffee Grounds-Chitosan TPP) and T4 (Activated Coffee Grounds – Chitosan) treatments more possible and suitable to produce because those 3 treatments producing the SPF protection under 24 hours (Karina et al., 2015; Susanti et al., 2015). Protection more than 24 hours is best protection but if considering the consumer needs, then the more suitable SPF protection under 24 hours (Karina et al., 2015; Susanti et al., 2015).

The overall test against the coffee grounds and their activating showed that the coffee grounds are recommended as the main ingredients to make face masker to care for the face skin ((Agustiningsih & Dwiyanti, 2017; Wulandari et al., 2019; Yasir et al., 2022; Tiadeka et al., 2021). The face masker initiated was peeled off face masker and to produce it treated the mixing with Chitosan as an adhesive. The mixing treatments showed that the most suitable to continue to production levels were the T3 (Coffe Grounds-Chitosan TPP) and T4 (Activated Coffe Grounds – Chitosan) treatments. Those two treatments are supported by physical conditions such as low density, high viscosity, and lower water uptake ability. In this condition, the film masker (sheets) is very elastic but not easy to rip. T3 and T4 treatments also show a strong antibacterial effect against acne and skin bacteria. Those two treatments also show strong protection against sun exposure (SPF) in about 19-21 hours range. Even if the SPF is less than 24 hours it is suitable for business production levels also with consumer desires.

Conclusion

1. The Coffee grounds in this research still contain high of phytochemicals that can be applied in skin care products
2. The existence of phytochemicals the Coffee grounds have strong antioxidant, antibacterial, and strong SPF protection, so it is recommended to use them as active compounds in Peel Off Face Masker
3. The more suitable for the production of overall treatments were the T4 and T3 treatments because it relatively closer to the market request

References

Agustiningsih, S. T. W., & Dwiyanti, S. (2017). Pemanfaatan ampas kopi dan biji kurma dalam pembuatan lulur tradisional perawatan tubuh sebagai alternatif "*Green Cosmetics*". *Jurnal Mahasiswa Universitas Surabaya, 6*(1), 41-50.

Aljanah, F. W., Oktavia, S., & Noviyanto, F. (2022). Formulasi dan evaluasi sediaan hand body lotion ekstrak etanol daun semangka (*Citrullus lanatus*) sebagai Antioksidan. *Formosa Journal of Applied Sciences (FJAS),1*(5), 799-818. http://dx.doi.org/10.55927/fjas.v1i5.1483

Gintu, A. R., & Puspita, D. (2020). Sintesis dan karakterisasi *Carbon Nanotube* (CNt) dari Arang Kayu Jati serta pemanfaatannya sebagai bahan aktif antibakteri. *Jurnal Kimia Riset, 5*(2), 127-133. https://doi.org/10.20473/jkr.v5i2.22505

Gintu, A. R., Kristiani, E. B. E., & Martono, Y. (2023). Antibacterial activity of Modified Hydroxyapatite (HAp) from Blue Turbo Snail (*Celeteiya presclupta*) Shells obtained from Poso Lake. *AIP Conference Proceedings April 26, 2023.* https://doi.org/10.1063/5.0119153

Handayani, R., & Muchlis, F. (2021). REVIEW: Manfaat asam klorogenat dari biji kopi (*Coffea*) sebagai bahan baku kosmetik. *FITOFARMAKA: JurnalIlmiah Farmasi, 11*(1), 43-50 https://doi.org/.33751/jf.v11i1.2357

Handayani, R., Sriarumtias, F, F., & Sofwan, S, S. (2021). formulasi sediaan lipbalm dari ekstrak biji kopi arabika (*Coffea arabica* L.) Java Preanger sebagai Emolien. *Jurnal Ilmiah Farmasyifa, 4*(1), 105-111. https://doi.org/10.29313/jiff.v4i1.6497

Hertina, T. N., & Dwiyanti, S. (2013). Pemanfaatan ampas kedelai putih dan kopi dengan perbandingan berbeda dalam pembuatan lulur tradisional untuk perawatan tubuh. *Jurnal Mahasiswa Universitas Surabaya, 02*(03), 70-77.

Imasari, T., & Emasari, F. A. (2021). Deteksi bakteri *Staphylococcus sp.* penyebab jerawat dengan tingkat pengetahuan perawatan wajah pada siswa kelas XI di SMK Negeri Pagerwojo. *Jurnal Sintesis, 2*(2), 58-65. https://doi.org/10.56399/jst.v2i2.20

Irmayanti, M., Rosalinda, S., & Widyasanti, A. (2021). Formulasi *handbody lotion* (Setil alkohol dan karagenan) dengan penambahan ekstrak kelopak rosela. *TEKNOTAN, 15*(1), 47. https://doi.org/ 10.24198/jt.vol15n1.8

Karina, N., Luliana, S., & Susanti, R. (2015). Penentuan nilai Sun Protection Factof (SPF) ekstrak dan fraksi rimpang lengkuas (*Alpinia galanga*) sebagai Tabir Surya dengan Metode Spektrofotometri Uv-Vis. *Jurnal Mahasiswa Farmasi Fakultas Kedokteran UNTAN, 3*(1), 114-120.

Kedare, S. B., & Singh, R, P. (2011). Genesis and development of DPPH method of antioxidant assay. *J. Food.Sci.Technol., 48*(4), 412-422. https://doi.org/10.1007%2Fs13197-011-0251-1

Lung, J. K. S., & Destiani, D, P. (2017). Uji aktivitas antioksidan vitamin A, C, E dengan metode DPPH. Farmaka, 15(1), 53-62. https://doi.org/10.24198/jf.v15i1.12805

Maesaroh, K., Kurnia, D., & Al Anshori, J. (2018). Perbandingan metode uji aktivitas antioksidan DPPH, FRAP dan FIC terhadap asam askorbat, asam galat dan kuersetin. Chimica et Natura Acta, 6(2), 93-100. https://doi.org/10.24198/cna.v6.n2.19049

Pariury, J. A., Herman, J. P. C., Rebecca, T., Veronica, E., et al. (2021). Potensi kulit jeruk Bali (*Citrus maxima* Merr) sebagai antibakteri *Propionibacterium acne* penyebab jerawat. *Hang Tuah Medical Journal (HTMJ), 19*(1), 119-131. https://doi.org/10.30649/htmj.v19i1.65

Pranoto, Y., Rakshit, S, K., & Salokhe, V, M. (2005). Enhancing antimicrobial activity of chitosan films by incorporating garlic oil, potassium sorbate and nisin. *Science Direct: LWT, 38,* 859-865. https://doi.org/10.1016/j.lwt.2004.09.014

Pribadi, T. A., Harsojuwono, B. A., & Suwariani, N, P. (2021). Pengaruh presentasi ampas kopi robusta (*Coffea canephora*) dan suhu pemanasan terhadap karakterisasi *body scrub*. Jurnal Rekayasa dan Manajemen Agroindustri, *9*(4), 538-548.

Purwaningsih, S., Salamah, E., & Budiarti, T, A. (2014). Formulasi *Skin Lotion* dengan Penambahan Karagenan dan Antioksidan Alami dari *Rhizophora mucronata* Lamk. *Jurnal Akuatika, V*(1), 55-62.

Puspita, D., & Gintu, A. (2020). Optimalisasi pemakaian *handsanitizer* berdasarkan luas permukaan tangan. *Carolus Journal of Nursing (CJoN), 3*(1), 134-140. https://doi.org/10.37480/cjon.v3i1.46

Puspitasari, D. F., Sulistiyanto, F, X., Indriyanti, E., Pratiwi, A. D. E., Ramonah, D., et al. (2021). Pemanfaatan ampas kopi (*Coffea* sp) sebagai sediaan *Body Scrub* di desa Tempur Jepara. *Jurnal Pengabdian Kepada Masyarakat, 1*(2), 1-5. https://doi.org/10.53359/dimas.v2i1.15

Rahmat, A., Farida, N., Sadikin, Y., Ramadhani, W, S., Yanfika, H., Mutolib, A., & Widyastuti, R, A D. (2020). Pembuatan masker kopi sebagai produk unggulan kelompok wanita tani desa Manggarai, Kecamatan Air Hitam, Kebupaten Lampung Barat. *Jurnal Pengabdian Nasional, 1*(1), 19-25.

Rohman, F. A., & Maspiyah. (2016). Pengaruh proporsi buah kopi dan oatmeal tehadap hasil jadi masker tradisional untuk perawatan kulit wajah. *Jurnal Mahasiswa Universitas Surabaya, 5*(3), 72-79.

Rohyani, I. S., Dewi, T, K. S., Septiani, Melani, W, W., & Alawiyah, Z, R. (2021). Ragam produk minuman dan masker kecantikan berbahan dasar kopi dalam menunjang perekonomian masyarakat di masa pandemi. *Jurnal Pengabdian Magister Pendidikan IPA, 4*(3), 167-172. https://doi.org/10.29303/jpmpi.v3i2.940

Rosalia, E., Marcellia, S., & Ulfa, A, M. (2021). Uji aktivitas antioksidan sediaan lotion dari ekstrak daun kopi robusta (*Coffea canephora*) menggunakan metode DPPH (2,2-difenil-1-pikrilhidrazil). *Jurnal Ilmu Kedokteran dan Kesehatan (JIKK), 8*(4), 342-349. https://doi.org/10.33024/jikk.v8i4.4836

Sari, Y. P., & Suhartiningsih. (2020). Formulasi *Body Scrub* dari ampas kopi dan rimpang temulawak (*Curcuma xanthorhiza* Roxb). *Journal Beauty and Cosmetology (JBC), 1*(2), 44-56.

Sarwono, R. (2010). Pemanfaatan kitin / kitosan sebagai bahan anti mikroba. *JKTI, 12*(1),5-10. https://doi.org/10.14203/jkti.v12i1.150

Sawiji, R. T., Jawa La, E, O., & Musthika, I. K. T. (2022). Formulasi dan uji aktivitas antioksidan body lotion ekstrak kopi robusta (*Coffea canephora*) dengan metode DPPH (2,2-difenil-1-pikrilhidrazil). *Jurnal Kimia Manuntung: Sains Farmasi dan Kesehatan*, 8(2), 255-265. https://doi.org/10.51352/jim.v8i2.629

Septiani, Ni Komang, A., Made, I., Parwata, O. A., & Putra, A, A, B. (2018). Penentuan kadar total fenol, kadar total flavonoid; dan skrining fitokimia ekstrak etanol daun gaharu (*Gyrinops versteegii*). Wahana Matematika dan Sains: Jurnal Matematika, Sains dan Pembelajarannya, 12(1), 78-89.

Simanjuntak, R. C. M., Riyoly, W., de Fretes, F., & Gintu, A, R. (2021). Biofilm chitosan as modern dressing for ulcers. *Jurnal Kimia dan Pendidikan Kimia, 6*(3), 335-342. https://doi.org/10.20961/jkpk.v6i3.50263 .

Suena, N. M. D. S., & Antari, N, P. U. (2020). Uji aktivitas antioksidan maserat air biji kopi (*Coffea canephora*) hijau pupuan dengan metode dpph (2,2-difenil-1-pikrilhidrazil). *Jurnal Ilmiah Medicamento, 6*(2). https://doi.org/10.36733/medicamento.v6i2.1106

Sularsih, & Soeprijanto. (2012). Perbandingan jumlah sel osteoblas pada penyembuhan luka antara penggunaan kitosan gel 1% dan 2%. *JMKG, 1*(2), 145-152.

Susanti, M., Dachryyanus; & Putra, D, P. (2015). Aktivitas perlindungan sinar UV buah *Garnicia mangostana* Linn. secara *In Vitro*. *Pharmacon: Jurnal Farmasi Indonesia, 13*(2), 1-5.

Tiadeka, P., Nasyanka, A., & Zahiriyah, A. (2021). Modifikasi kopi arabika menjadi becoffe scrub untuk perawatan tubuh. *Jurnal SINTESIS: Penelitian Sains Terapan dan Analisisnya, 2*(1), 16-24. https://doi.org/10.56399/jst.v2i1.15

Wardani, K. A., Fitriana, Y., & Malfadinata, S. (2020). Uji aktivitas antibakteri *Staphylococcus epidermidis* menggunakan ekstrak daun ashitaba (*Angelica keiskei*). *LUMBUNG FARMASI: Jurnal Ilmu Kefarmasian, 1*(1), 14. https://doi.org/10.31764/lf.v1i1.1206

Wati, E., Cahya, U, D., & Darmirani, Y. (2021). Formulasi sediaan lotion ekstrak etanol biji kopi robusta (*Coffea canephora*). *Jurnal Farmasimed (JFM), 3*(2), 53-56. https://doi.org/10.35451/jfm.v3i2.570

Wulandari, A., Rustiani, E., Noorlaela, E., & Agustina, P. (2019). Formulasi ekstrak dan biji kopi robusta dalam sediaan masker gel peel off untuk meningkatkan kelembaban dan kehalusan kulit. *FITOFARMAKA: Jurnal Ilmiah Farmasi, 9*(2), 77-85. http://dx.doi.org/10.33751/jf.v9i2.1607

Wulandari, S., & Agustin, Y. (2022). Biji kopi robusta peaberry green bean: Skrining fitokimia, formulasi herbal lotion. *Journal of Pharmaceutical and Sciences (JPS), 5*(2), 355-363. http://dx.doi.org/10.36490/journal-jps.com.v5i2.152

Yasir, A. S., Suryaneta, Fahmi, A, G., Saputra, I, S., Hermawan, D., & Berliyanti, R, T. (2022). Formulasi masker gel peel-off berbahan ekstrak biji kopi robusta (*Coffea canephora*) khas Lampung. *Majalah Farmasetika, 7*(2), 153-164. https://doi.org/10.24198/mfarmasetika.v7i2.37312

Zaiva, S., & Wahyunindita, R, N. (2020). Keunggulan wound dressing berbahan aktif alginat-chitosan-fucoidan dalam mempercepat proses penyembuhan luka. *Indonesian Journal of Nursing and Health Sciences, 1*(1), 1-8. https://doi.org/10.37287/ijnhs.v1i1.222