

Phytochemical Properties of Skin Care Cream Containing Essential Oil of Galangal

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Abstract—A research has been conducted on development and physicochemical characterization of skin care cream containing essential oils of galangal. The skin care cream containing essential oils of galangal developed consists of a red galangal cream that utilizes the essential oil ingredients extracted from red galangal rhizomes and white galangal cream that utilizes the essential oil ingredients extracted from the white galangal rhizomes. Cream is made by homogeneously mixing each of the red galangal essential oils and each of the white galangal essential oils with basic cream in concentration variations of 0.25%, 0.50%, 0.75%, 1.00%, and 1.50%. Each galangal cream then tested its physicochemical character and the acceptance level of its panellists. The results of this study are two types of galangal cream products, namely red galangal cream and white galangal cream. The galangal cream is a mixture that looks homogeneous, with white to slightly brownish colour, and has a typical odor of galangal. Each type of creams having a density range of 0.94 g/cm³ to 0.96 g/cm³ is a physically viscous mixture, with viscosity ranging from 37,007 cps to 37,413 cps for red galangal creams and 37,055 cps to 37,453 cps for white galangal creams. Spreading capacity of galangal creams is about 40.50 cm² to 44.50 cm², wider 0.50 cm² to 4.50 cm² compared to basic cream which have spreading capacity 40.00 cm². The results of the hedonic sensory test show that 75% - 80% or more panellists are quite acceptable up to strongly accept the physicochemical character of each red galangal creams and white galangal creams.

Keywords—*cream, galangal, galangal cream, physicochemical galangal cream*

I. INTRODUCTION

Galangal is a biopharmaca plant that has various medicinal benefits [1]. Galangal contains compounds such as acetoxy chavicol acetate, acetoxy eugenol acetate and others that are able to inhibit the enzyme xanthin oxidase in tumor prevention [2]. The main flavonoid content of galangin, quercetin and kaempferol, can inhibit fatty acids that can be used as an herb to treat rheumatism and arthritis [3]. Galangal also has an essential oil content that can increase skin permeation from fluorouracil [4].

Galangal can be used in various skin diseases treatment [5]. Galangal has a number of antioxidants that can protect the skin from premature aging [6]. Galangal antioxidants are able to get rid of toxins from the body and improve blood circulation [4]. This causes the release of extra nutrients for skin tissue, preventing the formation of free radicals that damage the skin, and maintain skin youthfulness [7].

Galangal can be used as an alternative to heal burns and to reduce the pain [8]. The fresh galangal slices can be rubbed on the skin to remove scars or calluses [9]. Galangal can also be used as an antiseptic cleanser that can keep skin clean, bright and smooth [2]. This material is able to revitalize and brighten the skin. In addition, galangal is a natural remedy for acne cure. Its content can reduce the formation of acne by cleaning bacteria from the skin [10].

Based on the benefits of galangal, which is widely used in the field of health, then the material is very potential to be increased its economic value. It is intended primarily for purposes related to skin care and prevention of premature aging. Alternative products that can be developed for this purpose are products that use in direct contact with the skin such as bath soap, shampoo, powder, cream and others.

The development of alternative products from galangal is considered important because it is useful to improve the economic quality of an abundant material available in the environment of everyday life. The development of such products can be considered as part of an eco-entrepreneurial development effort, or ecopreneurship.

This research is trying to develop skin care cream containing essential oils of galangal. Skin care cream is chosen as an alternative product developed because it can be used as a thin layer of skin protection. In the thin layer of skin protection, it is expected that the active ingredients of galangal can be used as an anti-bacterial, anti-fungal, anti-acne, anti-inflammatory, anti-oxidants that prevent premature aging and maintain skin youthfulness, and anti-septic that can keep skin clean and fresh. In order for this product development study to have a good scientific foundation, it is necessary to characterize the product of galangal creams, especially in its physicochemical properties.

II. MATERIALS AND METHODS

2.1. Materials

Materials used in the study consisted of extracts of essential oils of red galangal and white galangal as well as basic cream ingredients such as lexemul CS-20, laurex, dimethicone, liquid paraffin, methyl paraben, propyl paraben, TiO₂, mono propylene glycol, and aquades.

2.2. Methods

The development of galangal cream products begins with the preparation of basic cream and preparation of essential oil extract from red galangal and white galangal. Basic cream is made from lexemul CS-20, laurex, dimethicone 100 cps, liquid paraffin, methyl paraben, propyl paraben, TiO₂, mono propylene glycol, and aquades. While each essential oil of red galangal and white galangal produced from extraction of each powdered rhizome red galangal and white galangal with hexane solvent [11]. Chemical content of each galangal extract is then characterized by using the instrument Shimadzu LCMS - 8040 LC/MS.

Galangal cream is made by mixing each of the essential oils of red galangal and white galangal with basic cream, with a variation of concentration of 0.25%; 0.5%; 0.75%, 1%, 1.5% and then stirred until homogeneous. The resulting each red galangal creams and each white galangal creams are physicochemically Instrument characterized and then a hedonic sensory test is performed to determine the acceptance level of panellists. Characterization of each red galangal creams and each white galangal creams includes organoleptic observation and determination of density, viscosity, spreading capacity, and degree of acidity. Hedonic sensory test was conducted to determine the level of respondent's acceptance of each red galangal creams and each white galangal creams. This hedonic sensory test involved 20 panellists who did not have an understanding of galangal creams.

Organoleptic observations include observing the color, smell, and appearance of homogeneity of both type of each galangal creams. The density of both type of each galangal creams was determined using a pycnometer. The viscosity of both type of each galangal creams was determined using viscometer Brook field. 50 mg of galangal cream is added to the cup, the spindle is dipped in a preparation then the rotor is run at a speed of 2 rpm. The value obtained is then multiplied by a correction factor to produce the viscosity value of each measured galangal creams. Spreading capacity testing is carried out by placing 0.1 gram of each galangal creams preparation on the center of the round glass, covered with a cover glass. The condition is left for one minute and then the diameter of the spread cream is measured. After that on top of the cover glass added a load of 100 grams, left for one minute then just noted the diameter of the cream spread. Such experiments continued with the use of loads weighing 200 grams and 500 grams. The degree of acidity of each galangal creams was measured using the Eutech Ecoxan digital pH meter and ascertained by using a universal pH paper.

III. RESULT AND DISCUSSION

A. Basic cream

Basic cream produced through this study is shown in Figure 1. The basic cream that looks viscous, with pure white color, and homogeneous has a density of 0.95248 g/ml, viscosity 37.228 cps, and acidity around pH = 7.



Fig 1 Basic cream

The following table shows the composition of raw materials of basic cream.

TABEL 1 COMPOSITION OF RAW MATERIAL OF BASIC CREAM

Basic Cream Ingredients	Composition
Lexemul CS-20	5000 g
Laurex	1000 g
Dimethicone 100 cps	200 mL
Liquid paraffin	2800 mL
Methyl paraben	200 g
Propyl paraben	50 g
TiO ₂	50 g
Mono propylene glycol	1000 g
Hot aquades	60000 mL
Aquades	35000 mL

B. Galangal essential oil

Essential oil extracted from red galangal rhizomes and white galangal rhizomes is a dark red liquid as shown in Figure 2. The essential oil of the red galangal rhizomes appears darker than the essential oils of the white galangal rhizomes that appear more bright red.

Red galangal essential oil and white galangal essential oil is a rather viscous fluid. The liquid has a sharp distinctive aroma of galangal. The characteristic smell of galangal from red galangal essential oil is relatively sharper than the smell of white galangal essential oil.

TABEL 2 DENSITIES OF RED GALANGAL ESSENTIAL OIL AND WHITE GALANGAL ESSENTIAL OIL

Content of Essential Oil (%)		100
Red galangal essential oil	Initial container weight (g)	23.966
	The weight of the container filled (g)	49.433
	Sample weight (g)	25.467
	container volume (ml)	25
	Density (g/ml)	1.01868
White galangal essential oil	Initial container weight (g)	23.966
	The weight of the container filled (g)	48.409
	Sample weight (g)	24.443
	Container volume (mL)	25
	Density (g/mL)	0.97772

Both types of essential oils obtained through extraction of red galangal rhizome and white galangal rhizome are acidic. The acidity of essential oils from red galangal rhizome extract, as shown in Table 3, is relatively

higher than that of essential oils from white galangal rhizome extract.

TABLE 3 PH OF RED GALANGAL ESSENTIAL OIL AND WHITE GALANGAL ESSENTIAL OIL

Percent of Essential Oil (%)	Red Galangal Essential Oil		White Galangal Essential Oil	
	pH-meter	Universal pH paper	pH-meter	Universal pH paper
100	3.86	3	4.70	5

The pH measurements were carried out in two ways, with pH meters and universal pH paper. Both types of measurements are used to ensure the pH range of each of the red galangal essential oil and white galangal essential oil.

Chemical analysis of red galangal extract and white galangal extract by using Shimadzu LCMS - 8040 LC/MS produced a chromatogram as shown in Figure 3.

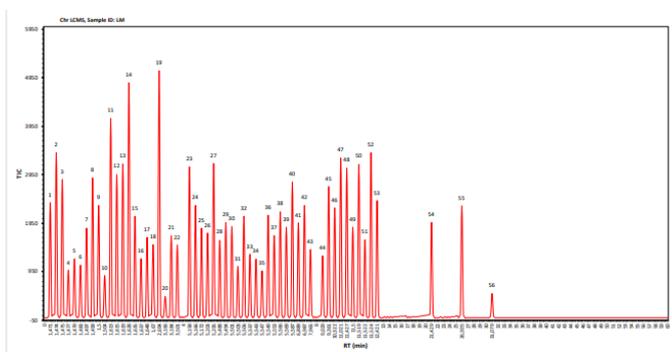
C. Physicochemical properties of galangal cream

Galangal cream is produced by mixing each of the red galangal essential oil which has a dark red color and white galangal essential oil which has a slightly brighter dark red color with a white basic cream.

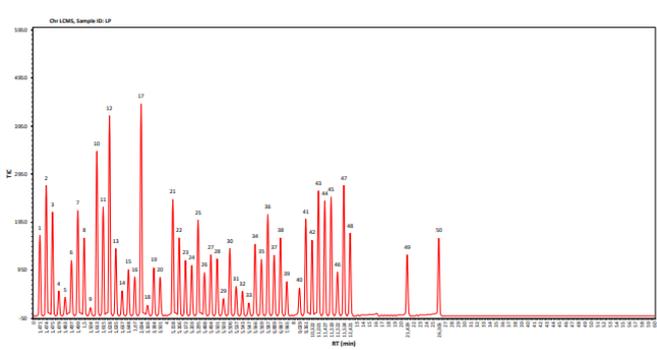


Fig 4 An example of mixing extracts of galangal essential oil and basic cream

Mixtures of each type of galangal extract and basic cream with a variation of 0.25%, 0.5%, 0.75%, 1%, 1.5% are very homogenized, even with manual stirring. The galangal cream produced is shown in Figure 5.



a. Chromatogram of red galangal essential oil



b. Chromatogram of white galangal essential oil

Fig 3 Chromatogram of extract of galangal essential oil as measured by shimadzu lcms - 8040 lc/ms

Both chromatograms show that extracts of red galangal essential oil contain 56 bioactive compounds, which are higher than extracts of white galangal essential oils containing only 50 bioactive compounds. Nevertheless, the content of bioactive compounds of the same type in white galangal extract tends to be higher than in red galangal extract.



(a)



(b)



(c)

Fig 5. (a) White galangal cream 5 bottles (), Red galangal cream 5 bottles (b). Basic cream (c)

The galangal cream stored in plastic bottles is labelled PA, PB, PC, PD, PE on the left side of Figure 5 marking white galangal cream with sequential galangal extract 0.25%, 0.50%, 0.75%, 1.00%, and 1.50% while those labelled MA, MB, MC, MD, ME on the right marking red galangal cream with sequential galangal extract levels of 0.25%, 0.50%, 0.75%, 1.00%, and 1.50%. Both types of galangal cream are a mixture that looks homogeneous white to brown with a distinctive smell of galangal. The color of both type of each galangal cream samples changed from white to increasingly brown to increase the content of galangal essential oil. The same thing happened to the smell

of cream that was increasingly stinging with its distinctive galangal smell to increase levels of galangal essential oil. From Figure 5, it can be observed that the average white galangal cream has a more pale color than the red galangal cream at the same concentration.

Based on the chromatogram at Fig 3.a., the red galangal extract contained 56 types of bioactive compounds, for example p-cymene, chavicol, zingiberene, eugenol, kaempferol, and quercetine. They would give effect on red galangal creams properties. While there were 50 type of bioactive compounds in white galangal extract and they would give effect on white galangal creams properties. Each cream sample from both types of galangal creams contains bioactive compounds that are very important for skin health that can prevent premature aging and maintain skin youthfulness. Kaempferol which is a compound with high antioxidant ability for example, is able to become melanogenesis inhibition, anti-acne, anti-allergic, psoriasis treatment. These phenolic compounds have great potential to treat various diseases, injuries, skin disorders, and also treat signs of aging [12]. The density of each red galangal creams and each white galangal creams did not differ greatly, which ranged from 0.94 g/cm³ to 0.96 g/cm³.

Both types of each galangal creams are viscous mixture with white to brownish color. The viscosity of each galangal creams is not much different, ranging from 37.007 cps to 37.413 cps for each red galangal creams and ranging from 37.055 cps to 37.453 cps for each white galangal creams, as shown in Table 4.

TABLE 4. VISCOSITY OF GALANGAL CREAM

Content of Essential Oil (%)	Viscosity (cps) of	
	Red Galangal Cream	White Galangal Cream
1.50	37.007	37.055
1.00	37.183	37.423
0.75	37.88	37.848
0.50	37.623	37.122
0.25	37.413	37.453
0.00	37.228	37.228

The viscosity of both types of each galangal creams is not much different from the basic cream viscosity. Viscosity of both types of each galangal creams tends to decrease with respect to the increase of each essential oil contents.

Spread capacity of both type of each galangal creams is almost similar, which is around 40.5 cm² to 44.5 cm². The details are the spread capacity of each red galangal creams ranging from 41.0 cm² to 44.0 cm² and the spread capacity of each white galangal creams ranging from 40.5 cm² and 44.5 cm². Spread capacity of each galangal creams is greater than the spread capacity of the basic cream. This is indicated by the spread area expansion range of the both type of each galangal creams compared to the basic cream of 0.5 cm² to 4.5 cm².

The measurement results of pH from each red galangal creams and each white galangal creams were shown in Table 5. Cream with essential oil of 0.00% is basic cream that have a pH around neutral pH, i.e. pH = 6.64 measured with a pH meter or pH = 7 measured by universal indicator paper.

TABLE 5. THE DEGREE OF ACIDITY OF THE GALANGAL CREAM

Content of Essential Oil (%)	Red Galangal Cream		White Galangal Cream	
	pH	pH-universal indicator paper	pH meter	pH-universal indicator paper
1.50	3.56	4	6.37	6
1.00	4.68	5	6.57	7
0.75	6.12	6	6.67	7
0.50	6.28	6	6.74	7
0.25	6.47	7	6.77	7
0.00	6.64	7	6.64	7

The acidity of each red galangal creams is higher than the acidity of each white galangal creams in the same content of galangal essential oil. The acidity of each red galangal creams with the content of essential oils that are greater or equal to 1.00% is very different from the originality of the basic cream. Whereas all white galangal creams have acidity that is close to neutral pH and close to the basic cream pH.

Based on the research, it can be seen that density, viscosity, and spread capacity of both types of galangal creams do not deviate from standards listed in SNI 16-4399-1996, the Indonesian National Standard for skin moisturizers [13]. The density of both types of galangal creams is still in the range of 0.95 g/cm³ to 1.05 g/cm³. While the viscosity of the two types of galangal creams, is still in the range of 2,000 cps to 50,000 cps.

Acidity of almost all samples of galangal creams from both types of creams is in the range of pH that corresponds to the natural safety of the skin listed in the literature which is around pH = 4 to pH = 7 [14], except for the sample red galangal cream with 1.5% galangal essential oil content which has little acidity higher that is around pH = 3.56 to pH = 4. This is also in accordance with SNI 16-4399-1996, which gives acidity requirements for skin moisturizing creams around pH 4.5 to pH = 8 [13].

D. The level of acceptance of galangal cream

The level of acceptance of panelists on the texture of the both type of each galangal creams is presented in table 9.a-b. Options information on the table are 1 very unacceptable, 2 not acceptable, 3 quite acceptable, 4 acceptable, 5 very acceptable.

TABLE 6.A. LEVEL OF ACCEPTANCE OF PANELISTS TO RED GALANGAL CREAMS TEXTURE

Red Galangal Cream Contains Essential Oils (%)	Amount of Assessment of Panelist Acceptance Level Based on Choice:				
	1	2	3	4	5
1.50		1	14	5	
1.00		1	9	9	1
0.75		1	10	8	1
0.50			10	8	2
0.25			10	7	3

TABLE 6.B. LEVEL OF ACCEPTANCE OF PANELISTS AGAINST WHITE GALANGAL CREAMS TEXTURE

White Galangal that Contains Essential Oils (%)	Amount of Assessment of Panelist Acceptance Level Based on Choice:				
	1	2	3	4	5
1.50		1	12	6	1
1.00		1	10	8	1
0.75			10	7	3
0.50			8	11	
0.25			8	9	2

The panelists on average, around 95 percent or more, assess the texture of galangal cream with various variations of essential oil content by choosing enough acceptable options (3) until the option is very acceptable (5). Only an average of 5% or less of panelists assessed the texture of the galangal cream with unacceptable values (2), namely 3 panelists from 3 types of red galangal creams and 2 panelists from 2 types of white galangal creams.

Similar to Table 6.A-B, Table 7.A-B shows the level of acceptance of panelists for the color of each red galangal creams and each white galangal creams.

TABLE 7.A. LEVEL OF ACCEPTANCE OF PANELISTS TO THE COLOR OF RED GALANGAL CREAMS

Red Galangal Cream that Contains Essential Oils (%)	Amount of Assessment of Panelist Acceptance Level Based on Choice:				
	1	2	3	4	5
1.50		3	13	6	
1.00		2	12	6	
0.75			8	9	3
0.50			6	10	4
0.25			6	10	4

TABLE 7.B. LEVEL OF ACCEPTANCE OF PANELISTS TO THE COLOR OF WHITE GALANGAL CREAMS

White Galangal Cream that Contains Essential Oils (%)	Amount of Assessment of Panelist Acceptance Level Based on Choice:				
	1	2	3	4	5
1.50		3	6	1	
1.00		2	7	9	2
0.75			7	9	4
0.50			8	8	4
0.25			8	8	4

From the distribution of levels of acceptance, an average of 85% or more of the panellists chose the enough acceptable option (3) to the very acceptable option (5) against of each type of red galangal creams and each type of white galangal creams. From each sample of both types of galangal cream, panellists tend to more easily accept the white galangal creams color than the red galangal creams color.

The average level of acceptance of panellists against odors from each red galangal creams and each white galangal creams is shown in Table 8.A-B.

TABLE 8.A. LEVEL OF ACCEPTANCE OF PANELLISTS AGAINST THE SMELL OF RED GALANGAL CREAMS

Red Galangal Cream that Contains Essential Oils (%)	Amount of Assessment of Panelist Acceptance Level Based on Choice:				
	1	2	3	4	5
1.50		3	12	5	
1.00		3	9	8	
0.75		2	10	8	
0.50		2	12	5	1
0.25		2	13	4	1

TABLE 8.B. LEVEL OF ACCEPTANCE OF PANELLISTS AGAINST THE SMELL OF WHITE GALANGAL CREAMS

White Galangal Cream that Contains Essential Oils (%)	Amount of Assessment of Panelist Acceptance Level Based on Choice:				
	1	2	3	4	5
1.50	2	1	12	5	
1.00	2	1	12	5	
0.75	2	1	12	5	
0.50	2		13	4	1
0.25	1		14	4	1

The level of acceptance of panellists to the odor of each galangal creams reached a range of 85% or more. Panellists only 15% or less, who chose the option not acceptable to the smell of each red galangal creams. The panellists who chose the option not acceptable to the smell of each white galangal creams were only 5% or less. About 20% or less of panellists chose very unacceptable to the smell of each white galangal creams.

In Table 9.A-B, the level of panellists' acceptance of the stickiness of each red galangal creams and each white galangal creams is shown. The description of the options in the table is 1 very sticky, 2 sticky, 3 not sticky enough, 4 not sticky, 5 not very sticky.

TABLE 9.A. LEVEL OF ACCEPTANCE OF PANELLISTS FOR THE STICKINESS OF EACH RED GALANGAL CREAMS

Red Galangal Cream that Contains Essential Oils (%)	Amount of Assessment of Panelist Acceptance Level Based on Choice:				
	1	2	3	4	5
1.50	1	4	8	7	
1.00		1	10	9	
0.75			12	6	2
0.50			11	9	
0.25			10	8	2

TABLE 9.B. LEVEL OF ACCEPTANCE OF PANELLISTS FOR THE STICKINESS OF EACH WHITE GALANGAL CREAMS

White Galangal Cream that Contains Essential Oils (%)	Amount of Assessment of Panelist Acceptance Level Based on Choice:				
	1	2	3	4	5
1.50		1	15	4	
1.00		1	13	6	
0.75			12	7	1
0.50		1	9	9	1
0.25			11	9	

About 75% or more panellists can accept stickiness from galangal creams. The chosen ones tend to lead from not sticky enough to very non-sticky. Even for each white galangal creams, panellist acceptance rates reach 95% or more.

The convenience of using each red galangal creams and each white galangal creams is shown in Table 13.A-B.. The description of the options in the table are 1 very uncomfortable, 2 uncomfortable, 3 quite comfortable, 4 comfortable, 5 very comfortable.

TABLE 10.A. LEVEL OF ACCEPTANCE OF PANELLISTS FOR THE CONVENIENCE OF USING EACH RED GALANGAL CREAMS

Red Galangal Cream that Contains Essential Oils (%)	Amount of Assessment of Panelist Acceptance Level Based on Choice:				
	1	2	3	4	5
1.50	1	3	10	5	1
1.00			12	8	
0.75		1	10	9	
0.50		1	12	7	
0.25		2	9	6	3

TABLE 10.B. LEVEL OF ACCEPTANCE OF PANELLISTS FOR THE CONVENIENCE OF USING EACH WHITE GALANGAL CREAMS

White Galangal Cream that Contains Essential Oils (%)	Amount of Assessment of Panelist Acceptance Level Based on Choice:				
	1	2	3	4	5
1.50	1	1	12	5	1
1.00		2	12	5	1
0.75		1	10	8	1
0.50		1	13	6	
0.25		1	15	4	

About 80% or more panellists feel comfortable enough up to be very comfortable using galangal creams. The lowest acceptance rate, which is 80%, is in red galangal creams containing 1.5% essential oil. Whereas for all samples of galangal creams with other essential oil contents, the level of acceptance reaches 90% or more.

The level of acceptance of the panellists for the moist taste of each of the red galangal creams and each white galangal creams is shown in Table 14.A-B. Description of options on the table are 1 not very moist, 2 not moist, 3 quite moist, 4 moist, 5 very moist.

TABLE 11.A. LEVEL OF ACCEPTANCE OF THE PANELISTS FOR THE MOIST TASTE OF EACH RED GALANGAL CREAMS

Red Galangal Cream that Contains Essential Oils (%)	Amount of assessment of panelist acceptance level based on choice:				
	1	2	3	4	5
1.50	1	1	5	13	
1.00		1	6	13	
0.75		3	7	10	
0.50		3	7	10	
0.25		4	7	7	2

TABLE 11.B. LEVEL OF ACCEPTANCE OF THE PANELISTS FOR THE MOIST TASTE OF EACH WHITE GALANGAL CREAMS

White Galangal Cream that Contains Essential Oils (%)	Amount of Assessment of Panelist Acceptance Level Based on Choice:				
	1	2	3	4	5
1.50		3	3	14	
1.00		1	5	14	
0.75		3	5	11	1
0.50		1	10	8	1
0.25	1		9	10	

About 80% or more of the panellists chose that the galangal creams was moist enough up to be very moist. This is consistent with the comfort of using galangal creams as shown in Table 5.A-B.

Based on the results of the hedonic sensory test questionnaire, it was known that panelists tend to receive enough up to receive each sample of red galangal cream and each sample of white galangal cream in terms of texture, color, odor, stickiness, comfort and moisture.

IV. CONCLUSIONS

Bioactive compounds, especially flavonoids, contained in red galangal cream and white galangal cream were chemically very important for skin care. Cream characteristics such as color, odor, and acidity are influenced by the concentration of galangal essential oil in the cream. Spread capacity, density, and viscosity of galangal cream are not affected by changes in concentration unless it is different from the character of basic cream. The physicochemical character of almost all galangal creams products is in accordance with the standards. The level of acceptance of panellists against galangal creams, both red galangal creams and white galangal creams can be acceptable enough until very acceptable, reaching 75% or more. The level of acceptance of the panellists included the texture, color, smell, stickiness, comfort of use, and the moist taste of the cream.

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