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RESEARCH ARTICLE

CHEMICAL AND PHYSICAL CHARACTERISTICS OF MARGARINE MIXTURE OF COCONUT OIL AND PALM OIL STEARIN ADDED WITH CARROT JUICE.

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Abstract

This research aims to determine the effect of comparison of coconut oil and palm oil stearin added carrot juice on the characteristics of the resulting margarine. The research method was an experiment using a completely randomized design with 5 treatments and 3 replications. The treatment in this study is the comparison of coconut oil and palm oil stearin that are; A (40%: 60%), B (35%: 65%), C (30%: 70%), D (25%: 75%), and E (20%: 80%). Observations made were melting point, emulsion stability, spreadibility, water content, free fatty acid, iodine number, fat content, color analysis, antioxidant activity. The results showed that the treatment of the comparison of coconut oil and palm oil stearin had a significant effect on melting point, emulsion stability, spreadibility, free fatty acid, iodine number but has no effect on water content, fat content, color analysis and antioxidant activity the best treatment of the ratio 25% coconut oil and 75% oil palm stearin with the characteristics of a melting point 38.67^{o}C, emulsion stability 89.67%, spreadibility 6.33 cm, water content 11.28%, free fatty acid 1.66%, iodine number 12.41 g iod / 100 g, fat content 85.41%, antioxidant activity 10.34%.

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Introduction:-

Margarine is a semi-solid fat product which is an emulsion with the type of water in oil (w/o) that is the water phase is in the oil phase, with the requirement to contain no less than 80% fat. There are three methods of making margarine using the methods of hydrogenation, interesterification and blending. Margarine which is marketed generally uses the hydrogenation process which uses a high temperature process (Ketaren, 2008), so that it can produce trans fats that are not good for health because it can increase coronary heart disease.

Interesterification is the reaction of an ester with another ester with a triacylglycerol molecule and uses a catalyst to produce fat with new properties (Ketaren, 2008). Blending is a method of modifying oil and fat which is based on the equation of its nature, by physically mixing at a high speed at low temperatures so that it will form new molecules. Interesterification or blending methods can minimize the content of trans fat in margarine, compared to the use of the hydrogenation method.

Coconut oil has a low melting point, so coconut oil melts at room temperature. So in making margarine from coconut oil, other ingredients that can increase the melting point need to be added, one of which is the use of stearin (Ketaren, 2008). Palm oil stearin is obtained from refining palm oil which is processed in several stages, this stearin

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is produced from the fractionation that occurs during cooling. Palm oil stearin has triglyceride composition with a mixture of palmitate, oleate, sterate (POS), palmitate, oleate, laurate (POL), and stearate, oleate, stearate (SOS), which makes the stearin melt at 40-56 oC so that the stearin freezes at room temperature, therefore oil palm stearin has good physical chemical properties for the raw material for making margarine (O'Brien and Richard, 1998).

To give a margarine color from pale to reddish yellow, carrots are added. Besides carrots also contain pro-vitamin A which is an excellent anti-oxidant. Based on the description above, the authors are interested in conducting research with the title "Chemical and Physical Characteristics of Margarine Mixture of Coconut Oil and Palm Oil Stearin added with Carrot Juice"

Material and Methods:-

The materials used in this study were coconut oil obtained from PT. Lembah Krya in Padang, palm oil stearin obtained from PT. Lembah Krya in Padang, Palm oil stearin obtained from PT. Incasi Raya Group in Padang, carrots obtained from Pasar Raya traders in Padang and also some additional ingredients such as salt, cow's milk cream and egg yolks.

The tools used for this study are mixers, analytical scales, spoons/stirrers, plastic containers, hotplates, funnels, measuring cups, goblets, thermometers. The tools used for chemical analysis are aluminum plates, ovens, biceps, desiccators, burettes, water baths, natural fat extraction, vortex, pipette micrometers, universal centrifuge, centrifuge tubes, erlenmeyer, lid enlemeyers, goblets, mouthpieces, measuring cups, spatulas, dropper pipettes, stirring rods, thermometers, aluminum foil, analytical scales, capillary tubes and spectrophotometers.

Research Design

This research was designed using completely randomized design (CDR) with 5 treatments and 3 replications. The data obtained were analyzed statistically by using ANOVA test if results were significantly different, then Duncan's new multiple range test (DNMRT) test was used at the 5% real level.

Implementation of Research

Determination of Formulation

Table 1:-Formulation in Making Margarine

	Treatments				
Materials	A	B	C	D	E
Coconut Oil (%)	40	35	30	25	20
Palm Oil Stearin (%)	60	65	70	75	80
Carrot Juice (%)*	10	10	10	10	10
Egg Yolks (%)*	5	5	5	5	5
Salt (%)*	2	2	2	2	2
Cream Cow's Milk (%)*	5	5	5	5	5

Note : *% weight of total coconut oil and palm oil stearin

Carrot Juice Making

Fresh carrots are peeled, peeled carrots are washed with running water and cut into 0.5-1 cm pieces. Carrots that have been cut are crushed using a juicer, then the carrot juice is obtained.

Formula for Making Margarine

The formula for making margarine from coconut oil and palm stearin added with carrot juice is based on the formulation of margarine made by Sarungallo, Soekarto, dan Budijanto (2002) with modifications and based on preliminary research conducted. The stages of making margarine are as follow:

Mixing fat or oil-soluble ingredients such as coconut oil, palm oil stearin, and cow's milk cream according to the formula to be made and stirred for 5 minutes. Mixing the two oil and water phase ingredients added with egg yolk. Mixing (blending) with a mixer at room temperature for 30 minutes. After 30 minutes, the finished margarine is packaged using a polypropylene cup. Tempered at 5-7oC for 2x24 hours. This process is the final process of making margarine.

Observation
The observations made in this research are :

Analysis of Raw Materials
Analysis carried out on the raw materials of coconut oil are water content, free fatty acid analysis and iodine numbers. Analysis carried out on the raw material for palm oil stearin is the analysis of water content, determination of free fatty acids, iodine number and on carrot raw material namely water content and antioxidant activity.

Product Analysis
The resulting margarine will be tested for its characteristics and quality. Tests carried out include, water content, determination of free fatty acids, iodine numbers, fat content, melting point, emulsion stability, smearing power, antioxidant activity.

Result and Discussion:-

Result of Raw Material Analysis
The results of raw materials analysis can be seen in the following Table 2.

Table 2:-Analysis of Raw Materials

Component	Unit	Analysis Result		
		CO ± SD	POS ± SD	CJ ± SD
Water Content	%	0.13 ± 0.01	0.09 ± 0.01	92.88 ± 0.15
Free Fatty Acid	%	0.19 ± 0.02	0.17 ± 0.02	-
Iodin Number	g iod/100 g	6.61 ± 0.41	9.40 ± 0.25	-
Antioxidant Activity	%	-	-	31.88 ± 1.41

Note : (-) not tested, CO = Coconut Oil, POS = Palm Oil Stearin, CJ = Carrot Juice, SD= Standard Deviation

Based on this research the water content of raw materials of coconut oil, stearin and carrot extract produced were 0.13%, 0.09% and 92.88%. The value of the water content of stearin obtained in this study is lower than the research conducted lestari and Nami (2010) the water content of stearin obtained was 0.16% while according to Hastuti (2003) the water content of stearin obtained was 0.17%. Seen from the research results the value of water content of coconut oil produced has met the SNI-2902-2011 standard that is a maximum allowable of 0.5% and the water content of stearin has also fulfilled the SNI standard 01-0021-1998 ie a maximum allowable of 0.2%.

According to Winarno (2004), water content will affect free fatty acids in fat-containing substances, high water content in food products with high fat content accelerates the process of hydrolysis of fats into free fatty acids, so that it will increase the acid number and free fatty acid content of the product. Based on raw material analysis data can be seen the average value of free fatty acids of coconut oil and stearin obtained in this study are 0.19% and 0.17%. The results of stearin free fatty acid numbers obtained in this study are higher than the research conducted by Prima (2018) with stearin free fatty acid numbers that is 0.12%.

The value of iodine number from the chemical analysis of raw materials of coconut oil and stearin is 6.61 g iod / 100g and 9.40 g iod / 100 g. According to SNI-01-2902-2011 about coconut oil the value of iodine number is 4.1-11.0 g iod / 100 g and the chemical analysis of iodine stearin produced in this study is higher than the research conducted by Ramadhana and Kusnadi (2016) with the iodine number of stearin raw material produced is 8.14 g iod / 100 g while according to Dewi (2011), the iodine number of stearin is 7.11 g iod / 100 g and in SNI 01-0021-1998 about stearin numbers the maximum allowed iodine of 40 g iod / 100 g. The value of iodine number states the amount of iodine absorbed indicates the degree of unsaturation of fats or oils.

The antioxidant activity of raw materials obtained from carrots is 31.88%, the antioxidant content is expected to be able to extend the shelf life of the resulting margarine. The results of carrot antioxidant activity obtained in this study were higher than in research conducted by Yudiar, Lindayani, Nugrahadi (2012) with carrot antioxidant activity of 27.52%, this result was due to the boiling process in carrots which resulted in decreased antioxidant activity.

Physical Analysis of Margarine

Melting Point

Based on the results of analysis of variance on the melting point of margarine at 5% level, it is known that the difference in the percentage of coconut oil and palm oil stearin significantly affects the melting point of margarine and is therefore continued with the DNMRT test (Duncan's New Multiple Range Test) at the 5% level. The yield of the margarine melting point can be seen in Table 3.

Table 3:-Average Temperature of Margarine Melting Point

Treatments	Melting Point (°C) ± SD
A (40% CO : 60% POS)	37.33 ± 0.58 a
B (35% CO : 75% POS)	37.67 ± 0.76 ab
C (30% CO : 70% POS)	38.00 ± 1.00 ab
D (25% CO : 75% POS)	38.67 ± 0.58 b
E (20% CO : 80% POS)	41.33 ± 0.58 c
CV = 1.77%	

Note : CO = Coconut Oil, POS = Palm Oil Stearin. The numbers in the same row are followed by different lowercase letters, significantly different at Duncan's New 5% level Multiple Range Test (DNMRT).

Based on the results the highest margarine melting point is in treatment E with a melting temperature of 41.33 ° C, and the lowest melting point is in treatment A with a melting temperature of 37.33 ° C. In Table 3 it can be seen that the higher the addition of palm oil stearin, the higher the melting point of margarine produced. In Prima research (2018) the melting point of margarine made from VCO and RBDPS with the addition of beeswax obtained the average temperature of melting point of margarine that is 36.67 to 42.50 ° C, in line with the research conducted by Darma (2018) about the effect the comparison of RBDPS and palm oil obtained by the melting point temperature of margarine is 33.83-41.17 ° C.

Emulsion Stability

Table 4:-Average Value of Margarine Emulsion Stability

Treatments	Emulsion Stability (%) ± SD
A (40% CO : 60% POS)	86.33 ± 2.08 a
B (35% CO : 75% POS)	87.00 ± 2.65 a
C (30% CO : 70% POS)	88.33 ± 2.89 ab
D (25% CO: 75% POS)	89.67 ± 1.53 ab
E (20% CO : 80% POS)	92.33 ± 0.58 b
CV = 2.38%	

Note : CO = Coconut Oil, POS = Palm Oil Stearin The numbers in the same row are followed by unequal lowercase letters, significantly different at Duncan's New Multiple Range Test (DNMRT) level.

Based on the results of research that has been carried out the average stability of the emulsion margarine from the comparison of coconut oil and palm oil stearin added carrot juice ranged from 86.33 to 92.33%. The highest emulsion stability was in treatment E with a value of 92.33%, and the lowest emulsion stability was in treatment A with a value of 86.33%. Emulsion stability testing is also carried out on commercial margarine as a comparison using the same analytical method obtained by the stability of commercial emulsion margarine that is 100%.

From Table 4 it can be seen that the higher the addition of oil palm stearin, the higher the stability value of the emulsion, this is influenced by the viscosity of high oil palm stearin. According to Prima (2018) states that the higher the viscosity of a material, the lower the average deposition value, the higher the stability of the emulsion. Whereas according to Darma research (2018) states the best results of making margarine from 90% RBDPS and 10% palm oil with an emulsion stability value of 97.67% this value is not much different from the research data obtained.

Spreadibility

Table 5:-Average Value of Spreadibility

Treatments	Spreadibility (cm) ± SD
E (20% CO : 80% POS)	4.50 ± 0.50 a

A (40% CO : 60% POS)	6.00 ± 0.0 b
B (35% CO : 65% POS)	6.17 ± 0.29 b
D (25% CO : 75% POS)	6.33 ± 0.58 b
C (30% CO : 70% POS)	7.67 ± 1.04 c
CV = 9.65%	

Note : CO = Coconut Oil, POS = Palm Oil Stearin The numbers in the same row are followed by unequal lowercase letters, significantly different at Duncan's New Multiple Range Test (DNMRT) level.

Based on the results of research that has been carried out the average topping margarine power from the comparison of coconut oil and palm oil stearin added with carrot juice ranges from 4.50 cm to 7.67 cm. The highest smear was found in treatment C with a value of 7.67 cm, and the lowest smear was found in treatment E with a value of 4.50 cm.

In Table 5 it can be seen that the melting point and the viscosity of raw materials affect the margins applied, the comparison of coconut oil and palm oil stearin is the determinant in producing the spreads obtained, if treatment A Table 5 obtained the values of rubles is 6.00 cm, this value is lower than treatment C which is 7.67 cm and the value of rubbing power of treatment E is lower than treatment A which is 4.50 cm. In line with this statement the value of the results of the topical power research in Table 5 is almost the same as the value of the topical power obtained in the research conducted by Prima (2018) with topping margarine power is 7.00-9.00 cm, while the research conducted by Darma (2018) obtained the value of marginal topping power is 10.33-12.50 cm.

Chemical Analysis of Margarine

Water Content

Tablel 6:-Average Value of Water Content

Treatments	Water Content (%) ± SD
A (40% CO : 60% POS)	11.72 ± 0.97
B (35% CO : 65% POS)	11.33 ± 1.01
C (30% CO : 70% POS)	11.20 ± 1.20
D (25% CO : 75% POS)	11.28 ± 1.01
E (20% CO : 80% POS)	11.16 ± 1.41
CV = 9.98%	

Note : CO = Coconut Oil , POS = Palm Oil Stearin The numbers in the same row are followed by unequal lowercase letters, significantly different at Duncan's New Multiple Range Test (DNMRT) level.

Based on data analysis of water content can be seen on average ranges between 11.16 - 11.72%. The highest water content is in treatment A (40% CO : 60% POS) with an average value of 11.72%, while the lowest water content is in treatment E (20% CO : 80% POS) with an average value 11.16%.

In Table 6 the average water content data shows that the higher the addition of coconut oil, the higher the water content of margarine, this is due to the water content of coconut oil used in making margarine has a water content of 0.13%, which is higher from the water content of palm oil stearin that is 0.09%. Based on SNI 01-3541-2014 the water content of margarine produced has met the standard which is a maximum of 18%.
According to research Darma (2018) get a water content of 10.96-11.96%, the water content is almost the same as the water content of the research results obtained.

Free Fatty Acid (FFA)

Table 7:-Average Value of Free Fatty Acid Content

Treatments	Free Fatty Acid (%) ± SD
E (20% C0 : 80% POS)	1.52 ± 0.13 a
C (30% CO : 70% POS)	1.63 ± 0.02 b
D (25% CO : 75% POS)	1.66 ± 0.02 c
B (35% CO : 65% POS)	1.72 ± 0.04 cd
A (40% CO : 60% POS)	1.83 ± 0.02 d
CV = 1.89 %	

Note : CO = Coconut Oil, POS = Palm Oil Stearin The numbers in the same row are followed by unequal lowercase letters, significantly different at Duncan's New Multiple Range Test (DNMRT) level.

Based on data analysis of free fatty acids that have been done seen an average range of 1.52-1.83%. In Table 7 it can be seen that the highest free fatty acid value is in treatment A (40% CO: 60% POS) and the lowest free fatty acid value is in treatment E (20% CO : 80% POS). According to SNI 01-3541-2002 maximum free fatty acid levels are allowed on margarine which is a maximum of 4%. Based on research the value of free fatty acids has fulfilled SNI 01-3541-2002. From the research of Darma (2018) found free fatty acids that is 1.06% -1.23% is not much different from the results of the research obtained.

Iodin Number

Tablel 8:-Average Value of Iodin Number

Perlakuan	Iodin Number (g iod/100 g) ± SD
A (40% CO : 60% POS)	11.57 ± 0.49 a
B (35% CO : 65% POS)	11.86 ± 0.31 a b
C (30% CO : 70% POS)	12.15 ± 0.27 b c
D (25% CO : 75% POS)	12.41 ± 1.22 b c
E (20% CO : 80% POS)	12.69 ± 0.07 c
CV = 2.50%	

Note : CO = Coconut Oil, POS = Palm Oil Stearin The numbers in the same row are followed by unequal lowercase letters, significantly different at Duncan's New Multiple Range Test (DNMRT) level.

Based on data analysis of iodine number, it can be seen that the average iodine number shows an increase along with the increasing amount of palm oil stearin added, this is due to the unsaturated fatty acid content at high stearin which is an average of 51% when compared to the fatty acid content saturated in coconut oil which is 12%. Data analysis of iodine number that has been done can be seen the highest average iodine number found in treatment E (20% CO: 80% POS) in the amount of 12.69 g iod / 100 g and the lowest iodine number is in treatment A (40% CO: 60% POS) which is 11.57 g iod / 100 g.

According to Darma (2018) explains that the increase in iodine number is influenced by the content of unsaturated fatty acids in the raw materials used, the higher the use of raw materials containing high unsaturated fatty acids, the value of iodine numbers will increase, the results obtained from the study namely the average value of iodine numbers 10.93 - 12.96 g iod / 100g and Prima research (2018) obtained iodine numbers that is 10.78-14.02 g iod / 100g.

Fat Content

Table 9:-Average Value of Fat Content

Treatments	Fat Content (%) ± SD
A (40% CO : 60% POS)	84.60 ± 0.82
B (35% CO : 65% POS)	85.69 ± 0.42
C (30% CO : 70% POS)	84.95 ± 0.58
D (25% CO : 75% POS)	85.41 ± 0.74
E (20% CO : 80% POS)	85.02 ± 0.87
CV = 0.83%	

Note : CO = Coconut Oil, POS = Palm Oil Stearin The numbers in the same row are followed by unequal lowercase letters, significantly different at Duncan's New Multiple Range Test (DNMRT) level.

Based on data analysis of fat content that has been done can be seen an average range of 84.95-85.69%. Based on the average fat content data shows that the difference in the percentage of the addition of coconut oil and palm oil stearin does not significantly affect the fat content of margarine, this is because both raw materials have the same fat and oil content. Based on SNI 01-3541-2014 levels of margarine fat produced have met the standard of at least 80%.

Antioxidant Activity

Antioxidant activity is important in extending the shelf life of food products. Based on the results of various analysis of the effect of the comparison of coconut oil and palm oil stearin did not significantly affect the analysis of the antioxidant activity of margarine. The results of the analysis of antioxidant activity can be seen in Table 11.

Table 11:-Average Value of Antioxidant Activity

Treatments	Antioxidant Activity (%) ± SD
A (40% CO : 60% POS)	10.22 ± 1.35
B (35% CO : 65% POS)	8.62 ± 1.45
C (30% CO : 70% POS)	8.99 ± 1.48
D (25% CO : 75% POS)	10.34 ± 1.63
E (20% CO : 80% POS)	11.18 ± 0.36
CV = 13.49%	

Note : CO = Coconut Oil, POS = Palm Oil Stearin The numbers in the same row are followed by unequal lowercase letters, significantly different at Duncan's New Multiple Range Test (DNMRT) level.

Antioxidant activity obtained has an average of 8.62-11.18%, this value is far lower than the initial concentration of raw material 31.88%, this is influenced by the use of a small raw material that is 10% of the total coconut oil and palm oil stearin so Antioxidant activity on margarine is very small. Antioxidant activity testing was also carried out on commercial margarine as a comparison using the same analytical method obtained by commercial margarine antioxidant activity which is 21.93%, this value is higher than the research value in Table 11. This is due to the material used which is different using beta hydroxy acid (BHA) and ascorbyl palmitate.

Conclusion:-

Based on the results of research that has been done can be concluded as follows:

1. Comparison of coconut oil and palm oil stearin added with carrot juice in the production of margarine has a significant effect on melting point, emulsion stability, smearing power, free fatty acids, iodine number but does not significantly affect to water content, fat content and antioxidant activity.
2. Comparison of the best coconut oil and palm stearin added with carrot juice in the best margarine production based on margarine characteristics is at a ratio of 25% coconut oil and 75% palm oil stearin with characteristics of a melting point of 38.67oC, emulsion stability of 89.67 %, 6.33 cm topping power, water content 11.28%, free fatty acids 2.31%, iodine number 12.41g giod / 100g, fat content 85.41%.

Significance Statements

Based on the results of research that has been done, suggestions that must be considered for further research, namely:

Apply the best results to analyze sensory tests and use to make product such as cookies, cakes and other processed product.

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