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Research Article

FORMULATION AND EVALUATION OF RED PALM OLEIN NANOEMULSION

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ABSTRACT

Objective: The objective of this study is to formulate and evaluate the red palm olein (RPO) nanoemulsion using spontaneous emulsification method.

Methods: Nanoemulsion formulated by spontaneous emulsification method using the comparison of surfactant (tween 80) and cosurfactant (sorbitol) concentration with the variation of RPO concentration. Evaluation of the stability of the nanoemulsion preparation includes centrifugation test, viscosity, pH, organoleptic observation (odor, color, clarity, and phase separation), and particle size measurement during 12 weeks storage at room temperature.

Result: The results showed that all nanoemulsion preparations were transparent yellow, characteristic odor, type weights 1.0166–1.0641 g/ml, and stable for 12 weeks storage at room temperature. The smallest particle size was produced by the nanoemulsion preparation in a formula of the concentration of 5%, which was 67, 64 nm.

Conclusion: RPO can be formulated as a nanoemulsion by spontaneous emulsification method. RPO with a 5% concentration is very stable for 12 weeks storage.

Keywords: Red palm olein, Nanoemulsion, Spontaneous emulsification, Surfactant, Cosurfactant.

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INTRODUCTION

Palm oil is a vegetable oil that has many types of minor components such as carotenoids, which have the potential as a source of natural provitamin A and can replace the source of synthetic Vitamin A which is relatively expensive. Carotenoid compounds contained in palm oil are an important compound for the body that acts as an antioxidant. Antioxidant compounds are widely found in vegetables, fresh fruits, and spices because they contain Vitamin C, Vitamin E, carotene, lycopene and flavonoids that can prevent a free chain reaction of free radicals. The antioxidant compounds contained in the oil can be used to prevent damage caused by degradation. Antioxidant compounds in the body serve as an antidote to free radicals, so the body is protected from various degenerative diseases and slow the aging process (aging). Compared with synthetic antioxidants, natural antioxidants are safer, easily absorbed by the body, have more rapid biological functions, and more effective in preventing cancer [1].

Red palm oil contains β-carotene 375 ppm, Vitamin E 559–1000 ppm in the form of tocopherol 18–22% and tocotrienol 78–82%. Carotenoids contained in red palm oil consisted of β-carotene 54.4%, α-carotene 36.2%, γ-carotene 3.3%, lycopene 3.8%, and xantofil 2.2%. To improve the stability and solubility in water, carotenoids can be dissolved in the oil phase in an oil-in-water emulsion (o/w) so that it can be easily formulated. Nanotechnology provides an opportunity to increase the solubility of an active component and increase its bioavailability. In the field of pharmaceuticals, the manufacture of nanometer-scale particles shows increased solubility in water and biological availability (bioavailability) [2].

Nanoemulsion is a transparent, translucent emulsion system and is a water-in-oil dispersion stabilized by a film coating of a surfactant or surfactant molecule having a droplet size of 50–500 nm [3]. Nanoemulsion has a transparent or translucent physical form. Nanoemulsion has several advantages such as having a larger surface area and free of energy. Nanoemulsion shows no problem in instability as in macroemulsion, *i.e.,* creaming, flocculation, koalesens and sedimentation. Nanoemulsions can also be formed with various formulations such as cream, fluid gel, spray, and foam. In addition, the nanoemulsion is also not toxic, and not irritating; therefore, it can be applied easily through the skin or mucous membranes [4]. Nanoemulsions can also increase absorption and bioavailability of drugs, help to stabilize the hydriphobic active substances, and have the efficiency on rapid penetration of some drugs [5]. Nanoemulsion is one of the interesting vehicles, which is mostly developed to enhance *in vitro* and *in vivo* absorption and bioavailability of drug through the skin [6-10].

MATERIALS AND METHODS

Materials

Red palm olein (RPO) was received as gift sample from Indonesian Oil Palm Research Institute (Medan, Indonesia), tween 80, sorbitol, methylparaben, propylparaben, and Aquadest. All other chemicals were of analytical grade

Formulation of nanoemulsion

Formulation of nanoemulsion was using spontaneous emulsification method. RPO is added to the oil phase which has added methylparaben and propylparaben to homogeneous add a Smix solution which is a mixture of surfactant and cosurfactant, then stirred with the magnetic stirrer until homogeneous. Aquadest is added by means of titration, stirred continuously until nanoemulsion is formed which is marked by the formation of a translucent solution. The percentage of the ingredients of nanoemulsion formula (Table 1) was modified from the nanoemulsion formula which was carried out in the previous study by Asmarani and Wahyuningsih [11].

Physicochemical evaluation of RPO nanoemulsion

Organoleptic test

Observations on any changes of color, odor, clarity, and phase separation were made.

pH measurement

pH values were measured at 25°C using a digital pH meter. Three measurements were taken for one sample. Before the readings were observed, pH meter was calibrated using pH 7.01, 4.01, and 10.01 buffer solutions, respectively.

Viscosity

The viscosity of nanoemulsion was measured using the Brookfield viscometer at room temperature (25°C±2°C). Viscosity measurements used two spindles speed and experiments were conducted three times [12].

Nanoemulsion particle size measurement

Particle size was measured using Vasco$^{\gamma}$ CORDOUAN Technologies Particle Size Analyzer.

Centrifugation test

The centrifugation test was performed at the beginning and after the preparation was made by measuring one time. The microemulsion preparation was inserted into centrifugation tube then centrifuged at 3750 rpm for 5 h [13].

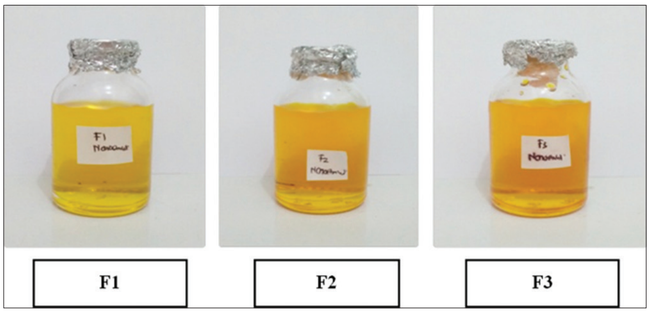

Fig. 1: Red palm olein nanoemulsion after 12 weeks storage

Table 1: Formulas of RPO nanoemulsion

Ingredients	Formula		
	I (%w/w)	II (%w/w)	III (%w/w)
RPO	5	10	15
Tween 80	40	40	40
Sorbitol	20	20	20
Methylparaben	0.1	0.1	0.1
Propylparaben	0.02	0.02	0.02
Aquadest ad	100	100	100

RPO: Red palm olein

RESULTS AND DISCUSSION

Organoleptic test

Fig. 1 and Table 2 shows that the nanoemulsion stored at room temperature remains clear for up to 12 weeks, the color and smell are unchanged and no any creaming. The formation of creaming in the preparation is due to the formation of aggregates from the inner phase which has a greater tendency to rise to the surface. According to Sinko [14], creaming is the emulsion separation into two layers, wherein the one layer contains drip grains (the dispersed phase) more than the other layers. If the dispersed phase density is smaller than the continuous phase, the sedimentation velocity becomes negative. In this nanoemulsion preparation, there were no any coarse grains from various concentrations of RPO.

pH measurement

Determination of pH value from RPO nanoemulsion was using digital pH meter for 12 weeks. Table 3 showed the results of pH value from three formulas for 12 weeks at room temperature.

Viscosity test

Determination of the viscosity of the nanoemulsion was performed using a Brookfield DV-E viscometer with the corresponding spindle number at room temperature for 12 weeks. Data of viscosity test result and graph of nanoemulsion viscosity change can be seen in Fig. 2.

Based on the viscosity test results in Fig. 2, it was concluded that the higher concentration of Tween 80, the viscosity will increase and the longer the storage time, the viscosity will increase. The viscosity of the nanoemulsion preparation was carried out at room temperature for 12 weeks in which the room temperature was a low temperature. This suggests that the lower the storage temperature will increase the viscosity of the nanoemulsion preparation while storage at room temperature also results in an increase in nanoemulsion viscosity. This is consistent with the theory that the storage period will increase the viscosity of the preparation [13]. However, the increase is not so significant.

Nanoemulsion particle size measurement and centrifugation test

The results of particle size analyzing are shown in Table 4.

Determination of particle size is done in the 1st week and week 12. The particle measurement results show that each formula has varying sizes, this is due to the difficulty of homogenizing two different systems, in addition to several other factors, such as duration or speed of stirring, also cause the formula is not homogeneous. Particle sizes from the 5 to 12 weeks increased, because of tween 80 experienced

Table 2: Organoleptic result of RPO nanoemulsion

Weeks	Organoleptic														
	Color			Odor			Clarity			Creaming			Phase seperation		
	F1	F2	F3	F1	F2	F3	F1	F2	F3	F1	F2	F3	F1	F2	F3
0	Y	Y	Y	S	S	S	T	T	T	-	-	-	-	-	-
1	Y	Y	Y	S	S	S	T	T	T	-	-	-	-	-	-
2	Y	Y	Y	S	S	S	T	T	T	-	-	-	-	-	-
3	Y	Y	Y	S	S	S	T	T	T	-	-	-	-	-	-
4	Y	Y	Y	S	S	S	T	T	T	-	-	-	-	-	-
5	Y	Y	Y	S	S	S	T	T	T	-	-	-	-	-	-
6	Y	Y	Y	S	S	S	T	T	T	-	-	-	-	-	-
7	Y	Y	Y	S	S	S	T	T	T	-	-	-	-	-	-
8	Y	Y	Y	S	S	S	T	T	T	-	-	-	-	-	-
9	Y	Y	Y	S	S	S	T	T	T	-	-	-	-	-	-
10	Y	Y	Y	S	S	S	T	T	T	-	-	-	-	-	-
11	Y	Y	Y	S	S	S	T	T	T	-	-	-	-	-	-
12	Y	Y	Y	S	S	S	T	T	T	-	-	-	-	-	-

*Y: Yellow, S: Specific, T: Translucent. RPO: Red palm olein

Table 3: pH value of RPO nanoemulsion

Formula	Time (week)												
	0	1	2	3	4	5	6	7	8	9	10	11	12
F1	7.0	7.0	6.8	6.7	6.7	6.7	6.6	6.6	6.5	6.5	6.3	6.2	6.0
F2	6.8	6.8	6.8	6.7	6.7	6.6	6.6	6.5	6.5	6.4	6.3	6.3	6.2
F3	6.8	6.8	6.8	6.8	6.7	6.7	6.6	6.5	6.5	6.5	6.4	6.3	6.3

RPO: Red palm olein

Table 4: Data of particle size analyzing

Distribution of particle size (nm)		
Formula	0 week	12 week
F1	67.64	136.11
F2	94.17	150.35
F3	113.38	187.09

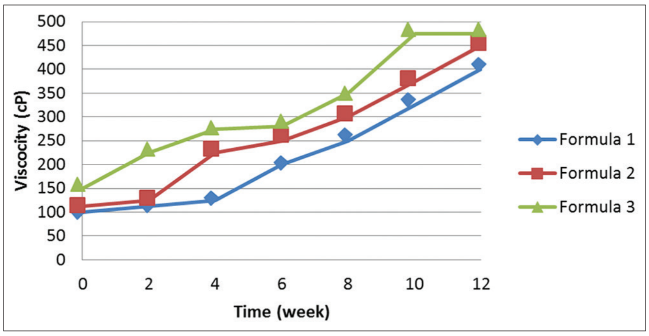

Fig. 2: Viscosity result of red palm olein nanoemulsion

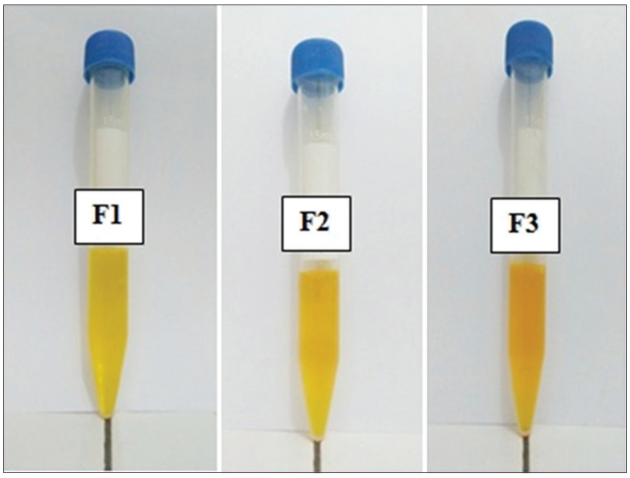

Fig. 3: Centrifugation result of red palm olein nanoemulsion

hydrolysis thus reducing the effectiveness of the nanoemulsion globule interface film layer [15]. Temperature modification during storage can cause a decrease in the effectiveness of surfactants so that oil droplets tend to close together and eventually produce larger droplets. Globule size distribution is an important characteristic of the nanoemulsion system, as it may affect drug release and stability of the preparation [16,17].

The data of the nanoemulsion centrifugation test results can be seen in Fig. 3. All formulas are stable, and there is no phase separation, which means that all formulas are stable against the gravitational force experienced for 1 year. The centrifugation test describes the stability of the dosage because of the effect of Earth's gravity equivalent to 1 year [13]. After testing on all three formulas, F1-F3 showed no any separation. This shows that these three formulas are stable for 1 year because of the influence of gravity.

CONCLUSIONS

RPO is suitable for preparation of nanoemulsion, and it gives an o/w emulsion. Best formula consisting with RPO 5%. As this is the pre-formulation study stage and further studies will include the need for incorporation of the drug to the best formulations and *in vitro*, *in vivo* evaluation of topical delivery.

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CONFLICTS OF INTEREST

Declared none.

AUTHORS' CONTRIBUTION

All the authors have contributed equally.

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