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FORMULATION AND ANTIOXIDANT ACTIVITY OF SELF-NANOEMULSIFYING DRUG DELIVERY SYSTEM (SNEDDS) FALOAK BARK

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ABSTRACT

Flavanoids and 3-hydroxy-octadecanoic acid in Faloak bark (Sterculia quadrifida R. Br) have low water solubility then it is formulated in the form of Self Nanoemulsifying Drug Delivery System (SNEDDS) to increase the solubility. This study aimed to formulate and measure the antioxidant activity of SNEDDS ethanolic extract of faloak bark. The optimum SNEDDS formula is characterized by percent transmittance, emulsification time in artificial gastric fluid (AGF), stability in artificial gastric fluid (AGF), and artificial intestinal fluid (AIF). The ethanol extract of Faloak bark and the optimum formula of Faloak bark was tested for their reducing activity against DPPH. The results of the SNEDDS formula composition of the optimum Faloak bark extract consisted of VCO, Tween 80, and PEG 400 in a ratio of 1: 6.65: 0.35 (ml) which could carry 7.14 mg per mL of Faloak bark extract. The optimum SNEDDS formula produces homogeneous and clear nano emulsions with transmittance values of 88.81 ± 0.02%, emulsification time in AGF of 6.53 ± 0.02 seconds, and stable in AGF and unstable in AIF media. IC_{50} value of ethanol extract of Faloak bark and optimal formula each has antioxidant activity with a very strong intensity (38,511 ppm) and strong (70,182 ppm).

INTRODUCTION

Faloak (*Sterculia quardrifida* R. Br) is traditionally used in typhus, ulcers, liver, menstrual shedding, shedding debris after birth, and recovery after delivery. Regular consumption of Faloak can increase stamina (reducing fatigue or fatigue for heavy workers). The extractive component contained in the Faloak tree shows the results of identification containing flavonoids, fenol and tannin. Activity of root and stem bark of faloak extract

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was classified as very strong (IC50 value < 50 µg/ml) (Dillak *et.al.*, 2019). Other research conducted results of measurements of H-NMR and C-NMR, supported by LC-MS measurement results, that the compound has a molecular weight of 300 (m z-1). The presence of hydroxy groups and carboxylic groups based on the results of FT-IR spectrum measurements of these compounds is 3-hydroxyoctadecanoic acid (Ranta *et al.*, 2012). Flavanoids and 3-hydroxyoctadecanoic acid have low bioavailability due to their low solubility in water so that their absorption is inhibited (TH *et al.*, 2014)(Trans *et al.*, 2014), so it has the potential to be formulated into a pharmaceutical form Self Nanoemulsifying Drug Delivery System (SNEDDS).

SNEDDS is an effort to increase the absorption and bioavailability of flavonoids and 3-hydroxyoctadecanoic acid in extracts of Faloac bark by reducing the size of the particles so that they are nano-sized due to droplet emulsions that are less than 100 nm (Singh *et.al*, 2009). SNEDDS is a lipid-based formulation method consisting of oil, surfactants and cosurfactants that will form nanoemulsions when inserted in aqueous media with mild agitation (Nazzal *et.al*, 2002).

SNEDDS formulation, using mineral oil and vegetable oil. Vegetable oil was chosen as the oil phase in this study because it is safe to use orally and is more easily degraded by microorganisms so it is more environmentally friendly. In addition, vegetable oil consists of saturated fatty acids which have antioxidant content that can inhibit the SNEDDS oxidation process to avoid rancidity (Annisa, *et.al*., 2020). This research, is expected to be an alternative and innovation in herbal formulations. The results of the SNEDDS formulation were analyzed through characterization of size and size distribution of nanoemulsion droplets, clarity, emulsification time in artificial gastric fluid (AGF), and stability in artificial gastric fluid (AGF) and artificial intestinal fluid (AIF) as well as antioxidant activity.

METHOD

Faloak Bark Extraction (Sterculia quardrifida R. Br)

Faloak bark (*Sterculia* sp) was determined at the Faculty of Biology, Gadjamada University, Yogyakarta so that the result of determination was *Sterculia quardrifida* R. Br. Faloak bark (*Sterculia quardrifida* R. Br) made simplicia. Simplicia powder was extracted using a percolation method using 70% ethanol extraction fluid. The extract obtained was concentrated with an evaporator at 50 ^{o}C, then evaporated in a water bath to obtain a thick extract. The percent yield is calculated, then organoleptically analyzed, and flavonoid and triterpenoid compounds are analyzed .

Preliminary test of SNEDDS formulation

Determination of the composition of oil, surfactants and cosurfactants that can form a homogeneous SNEDDS system and produce a clear emulsion. The composition of oil and cosurfactant each 1 part and surfactants ranging from 3-7 parts. Mixtures of oil, surfactants and cosurfactants in various proportions were homogeneous with a stirrer for 15 minutes and incubated with a water bath at 45^{o}C for 15 minutes. The resulting system is seen its

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homogeneity visually, stability and percent transmittance measured to see the level of clarity of the emulsion formed.

Determination of the upper and lower limits of the carrier (oil, surfactants, and cosurfactants). The composition of the system that has been obtained from the screening results then changes to the composition of the cosurfactant (Table 1) to get the upper and lower limits of surfactants and cosurfactants. The upper and lower limits of surfactants and co-surfactants are determined by observing the clarity and transmittance values close to 100% (Wahyuningsih and Putranti, 2015).

Table 1. Optimized cosurfactant of the selected SNEDDS system

Minyak (mL)	Surfaktan % = (mL)	Kosurfaktan % = (mL)
1	75 % = 5,25	25 % = 1,75
1	80 % = 5,60	20 % = 1,40
1	85 % = 5,95	15 % = 1,05
1	90 % = 6,30	10 % = 0,70
1	92,5 % 6,65	7,5 % 0,35
1	95 % = 6,48	5 % = 0,52

Note: total system volume is 7.0 mL

Formula SNEDDS extract of Faloak Bark (*Sterculia quardrifida* R. Br)

Optimization of the SNEDDS formula was carried out using the selected upper and lower boundary matrices added with 200, 100, and 50 mg Faloak bark ethanol extract. The formula is made with the same treatment as making the matrix at an initial stage of 7 ml with Faloak bark extract (*Sterculia quardrifida* R. Br) as much as 50 mg and re-homogenized using a stirrer, then incubated in a 45^{o}C water bath. The upper and lower limits are determined based on the visual appearance of the emulsion formed and the transmittance value close to 100%.

The selected matrix resulted from the optimization of the SNEDDS formula consisting of oil, surfactants, cosurfactants (90%: 10%; 92.5%: 7.5%; and 95%: 5%), and 50 mg of Faloak bark extract was added. Replication with the same procedure as previously done 3 times the replication.

Testing the characteristics of SNEDDS

SNEDDS clarity test. Determined based on visual appearance of homogeneity and% transmittance value measured by UV-Vis spectrophotometer at a wavelength of 650 nm with distilled water as a blank. The clearer the emulsion (transmittance value is close to 100%), it is estimated that the emulsion droplets have reached nanometer size (Wahyuningsih and Putranti, 2015).

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Emulsification time in artificial gastric fluid (AGF**).** Emulsification time calculation is done in AGF media to get an idea of the ease of emulsion formation when SNEDDS meets gastric fluid. The emulsification time test was carried out by emulsifying as much as 1.0 mL of SNEDDS formula into 250.0 mL of AGF media at ± 37 ^{o}C while stirring using a magnetic stirrer at slow speeds to make it similar to the atmosphere and movement of the stomach. The time taken for the SNEDDS formula to form the emulsion is recorded as the time of emulsification (Annisa, *et.al*., 2020)

Stability in artificial gastric fluid (AGF) and artificial intestinal fluid (AIF). This test was conducted to determine the effect of pH of the media or digestive tract on the stability of the emulsion droplets produced by SNEDDS. The AIF media has a pH of 7.4 while the AGF media is 1.2. This test is done by emulsifying the SNEDDS formula into each media in the same way as the emulsification time testing stage. Observations were carried out at 37^{o}C for 3 hours in AGF media and 4 hours in AIF media. Stable nanoemulsion is characterized by the absence of mist or sediment formed (Wahyuningsih *et al.*, 2017).

Stability Evaluation by Centrifugation

The preparation is put into a centrifuge tube at 3000 rpm for 30 minutes. Centrifugation test illustrates the stability of nanoemulsion due to the equivalent effect of gravity for 1 year (Dantas *et al.*, 2021).

Antioxidant activity test

Test solutions from the optimum formula of ethanol extract of Faloak bark (*Sterculia quardrifida* R. Br) were made in several concentrations. Blanks, test solutions, and positive controls that have been made in several concentrations, each taken as much as 4 ml, added 1 ml of DPPH 0.5 mM reagent solution, put in a vial, and then shaken. The solution is allowed to stand for 30 minutes then the absorption is read at the maximum wavelength. The blank used was 96% ethanol and the positive control used was vitamin C (Sopianti, *et.al*., 2020).

Data Anaysis

Analysis of the characterization data optimization of the SNEDDS formula of Faloak Bark (*Sterculia quardrifida* R. Br.) ethanolic exctract with a clear presentation (transmittance) response and emulsification time was carried out by the mixture D-optimal design method with Design Expert®7.1.5 software so that each the response produces a graph ANOVA analysis contained in Design Expert®7.1.5 with 95% confidence rate to see the significance of the response. Each response is combined so that the optimum formula is obtained. Verification of the optimum formula is analyzed by Comparison Single Sample Test with a confidence level of 95% ($\alpha = 0.05$) using Open Stat software.

The absorbance measurement results using a UV-Vis spectrophotometer are used to calculate the percentage of DPPH free radical reduction. The antioxidant activity of the

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optimum formula microemulsion ethanol extract of Faloak bark (*Sterculia quardrifida* R. Br) and vitamin C and each IC_{50} value was calculated using linear regression analysis.

RESULTS AND DISCUSSION

Ethanolic Extraction of Faloak Bark (*Sterculia quardrifida* R. Br)

Faloak bark (*Sterculia quardrifida* R. Br) powder extraction obtained 26.88 grams thick dark brown color and typical odorous extract with a yield of 13.44%.

The Preliminary test of SNEDDS formulation

Determination of oil concentrations, surfactants, and cosurfactants. The results of determining the ratio of oil to a mixture of surfactants and cosurfactants can be seen in table 2, which is a ratio of 1: 7.

Table 2. Determination of the ratio of oil to a mixture of surfactants and cosurfactants

Comparison **M : S + K**	homogeneity	Emulsification Results	Transmission (%
1 : 4 (3 +1)	homogeneous	Cloudy	71,41 ± 3,42
1 : 5 (4 +1)	homogeneous	Clear	81,28 ±4,13
1 : 6 (5 +1)	homogeneous	Clear	86,29 ± 4,30
1 : 7 (6 +1)	homogeneous	Clear	97,56 ± 0,91
1 : 8 (7 +1)	homogeneous	Clear	98,94 ± 0,15
1 : 9 (1 +1)	homogeneous	Clear	99,22 ± 0,17

(Source: Primary research data)

The ratio of oil and mixture of surfactants and cosurfactants ranging from 1: 7 to 1: 9 results in a homogeneous and clear system with a transmittance value of > 97%. Good nanoemulsions are those that produce a clear visual appearance with transmittance values close to 100% (Bali and Ali, 2010). A system that can form nanoemulsions is a system that produces clear emulsification because of the droplet size of less than 100 nm. A 1: 7 ratio system is preferred because it is the smallest ratio that can form a clear emulsion.

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Table 3. Determination of upper and lower limits

Formula	Comparison S : K (%)	Comparison S : K (mL)	Emulsification Results	Transmission (%	Emulsification time in aqua (second)
F1	75 : 25	5,25 : 1,75	Inhomogeneous	52,10 ±2,87	-
F2	80 : 20	5,6 : 1,4	Inhomogeneous	47,42 ± 3,99	-
F3	85 : 15	5,95 : 1,05	Clear	74,26 ± 0,11	-
F4	90 : 10	6,3 : 0,7	Clear	99,07 ± 0,05	28,2
F5	92,5 : 7,5	6,48 : 0,52	Clear	99,10 ± 0,03	22,,8
F6	95 : 5	6,65 : 0,35	Clear	99,49 ± 0,13	11,7

The results in table 3 show that the F1 and F2 formulas cannot form a homogeneous system so that they cannot be used for further formulations. Formula F3 cannot be used for advanced formulas because even though the visual appearance is clear but the transmittance value is below 75%. Formulas F4 to F6 produce a clear visual appearance of the emulsion and transmittance values above 99% so that formulas F4 through F6 can be used for advanced formulas to be used as upper and lower limits. Formula F4 is preferred because it is the smallest ratio that can form clear preparations.

The lower limit (F4) was then added with 200 mg of ethanol extract of Faloak bark, 100 mg and 50 mg. Table 4 shows that the addition of ethanol extracts of 200, and 100 mg produces turbid formulas and transmittance values below 70%, so the concentration of extracts of 50 mg is used for further formulas.

Table 4. Optimization of SNEDDS Formula for Faloak bark extract (*Sterculia quardrifida* R. Br)

Formula	Comparison S : K (%)	Comparison S : K (mL)	Extract amount (mg)	Emulsification Results	Transmission (%
F4	90 : 10	6,3 : 0,7	200	Cloudy	7,605
F4	90 : 10	6,3 : 0,7	100	Cloudy	45,605
F4	90 : 10	6,3 : 0,7	50	Clear	73,767

The upper and lower limits of surfactant concentrations of 90 and 95% and 5 and 10% cosurfactants and 50 mg extract were used for further testing of the characterization of the SNEDDS formula.

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Testing and Analysis of the Characteristics of the SNEDDS Formula Extract of Faloak Bark (*Sterculia quardrifida* R. Br)

Determination of the optimum formula is done using Design-Expert software version 7.1.5 Mixture method, namely D-Optimal design. The basic principle is to find out the profile of the mixture's effect on a parameter.

SNEDDS clarity test. Emulsion clarity formed by the SNEDDS system can be seen from the appearance of visual clarity and% transmittance values measured using a UV-Vis spectrophotometer. Table 5 shows that SNEDDS extract of Faloak F6 bark with a composition of 95% surfactant and 5% cosurfactant produced the clearest emulsion with a transmittance value of 88.81%.

The results of the transmittance test are then modeled and analyzed using Design Expert 7.1.5 software to determine the effect of each component or the interactions between the components of the transmittance value. The D-Optimal design equation obtained from the results of the optimization calculation with Design Expert 7.1.5 is the following linear equation Y = 88.81 A + 80.02 B + 12.29 AB. Y = response transmittance value, A = Tween 80, B = PEG 400, A * B = tween 80 interaction and PEG 400. The effect of each component and its interaction on the transmittance clarity value of SNEEDS Formula of Faloak bark extract can be known from the coefficient values in the equation. Positive notation (+) in the equation shows that Tween 80, PEG 400 and a mixture of tween 80 and PEG 400 increase the value of clarity (transmittance). Tween 80 can increase the value of clarity (transmittance) with greater ability followed by PEG 400, and a mixture of Tween 80 and PEG 400, seen from the slightly greater Tween 80 coefficient value of 88.81, followed by 80.01 and 12.29.

Increasing the amount of surfactant can reduce the size of emulsion droplets (Dantas *et al.*, 2021) The smaller the droplet size, the clearer the emulsion formed so that the transmittance value is higher. The higher the HLB value of the mixture, the clearer the emulsion formed so that it has a high transmittance value. A high transmittance value indicates that the clarity of the emulsion formed is close to water clarity so that it is possible that the emulsion formed is nanometer in size. According Wardhani (2016) transmittance values of more than 75% indicate the size of the droplets formed by oil in water getting smaller to form nanoemulsions when meeting with gastrointestinal fluid.

Emulsification Time. This test is carried out to obtain a picture of the time needed for SNEDDS to form nanoemulsion when it encounters gastrointestinal fluid. Based on the test results in table 7, F (6) has the fastest emulsification time in AGF which is 6.53 seconds ± 0.35. Of the three formulas (F4-F6) the emulsification time is less than 1 minute. This shows that the system made is SNEDDS grade A.

The results of the emulsification time test in AGF in table 5 were analyzed using Design Expert 7.1.5 software to see the effect of each component on the emulsification time. The D-Optimal design equation obtained from the results of the optimization calculation with Design Expert 7.1.5 is the following linear equation Y = 6.42A + 12.52 B + 0 AB. Y = response transmittance value, A = Tween 80, B = PEG 400, A * B = tween 80 interaction and PEG 400.

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Table 5. Results of Emulsification Time Test for SNEDDS Formula of Faloak Bark Extract (*Sterculia quardrifida* R. Br)

Formula	Lucidity	Emulsification Time (seconds)
F4	80,03 ±0,06	12,63 ±0,21
F5	87,49 ± 0,49	9,23 ±0,42
F6	88,81 ± 0,01	6,53 ±0,35

Note : Total volume = 7.0 mL; VCO volume = 1.0 mL; extract amount = 50 mg (Source: Primary research data)

The effect of each component and its interaction on the emulsification time value of the SNEEDS Formula of Faloak bark extract can be known from the coefficient values in the equation. Positive notation (+) in the equation shows that Tween 80, PEG 400, and a mixture of tween 80 and PEG 400 increase the emulsification time. PEG 400 can increase the time of emulsification with greater ability followed by Tween 80, seen from the slightly larger PEG 400 coefficient value of 12.52 and tween 80 of 6.494. So the greater the concentration of tween 80 the faster the time to form nanoemulsion when it encounters gastrointestinal fluid.

Nanoemulsion stability in AGF and AIF media

Nanoemulsion stability testing in AGF and AIF media was carried out to determine the stability of nanoemulsion in AGF and AIF media. Emulsions are said to be stable if phase separation does not occur or no sediment or mist has formed for a certain time. The results of SNEDDS stability testing of Faloak bark extract in AGF media showed that one formula, F4, formed a turbid solution at 3 hours of storage and 2 formulas namely F5 & F6 SNEDDS that were made can form clear nanoemulsions and no deposits formed for more than 3 hours of storage. The time of 3 hours is assumed as the time of drug transit during the stomach.

SNEDDS of Faloak bark extract in AIF media also showed unstable emulsions. At the beginning of making AIF media, the appearance of the media made is murky, this can be caused by the storage of media-making material that is not tightly closed so that some of the powder has been moist because it absorbs moisture from the air. After adding the SNEDDS formula F 4 to F6 the phase color is seen in storage for 1 hour for F4 emulsions and after 2 hours for F5 and 6. emulsions. The 4 hour time is assumed to be the length of time the drug is in the intestine. The test results can be assumed that formulas F4 through F6 have not been able to maintain Faloak extract in droplets until they are ready to be absorbed.

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Optimization of SNEDDS Formula for Extracts of Faloak Bark (*Sterculia quardrifida* R.Br)

The optimization the SNEDDS bark extract formula is determined using Design Expert 7.1.5 Mixture method software, namely D-Optimal design. The response variables used are the transmittance parameters and emulsification time in AGF.

Table 6 results from the optimization of the SNEDDS formula of Faloak Bark Extract (*Sterculia quardrifida* R. Br). The optimum formula is determined based on the greatest desirability approach, which means there is a closeness between the results of the formula test with the expected value to be able to meet the requirements. The range of values in desirability is 0 to 1. One is the highest value which means getting closer to 1 then the possibility of getting the expected response value is greater. The optimization results obtained a desirability value of 0.71.

Table 6. Parameter parameters for SNEDDS formula optimization

Respon	*Goal*	Minimum Point	Maximal Point	*Importance*
Tween 80 (%)	*In range*	90	95	3
PEG 400 (%)	*In range*	5	10	3
Lucidity (%)	*Maximaze*	75	99	5
Emulsification time in AGF (seconds)	*Minimize*	6,2	12,8	4

The desirability value is influenced by the target or goal to be achieved to obtain the optimum formula. Determination of the goal value based on the response to be achieved and the importance to emphasize to each expected lower or upper value of each response, so that a formula that has the test response value as expected can be produced.

The goal criteria for the number of Tween 80 and PEG 400 are in range according to the upper and lower limits obtained. Maximize clarity due to good nanoemulsion is what results in a clear visual appearance with a transmittance value close to 100% (Dantas *et al.*, 2021). Minimize emulsification time because the smaller the emulsification time the faster the time to form nanoemulsion when it encounters gastrointestinal fluid. The optimization results using Design Expert 7.1.5 Mixture method software is D-Optimal design, so the formula 6 (F6) is chosen, which is the ratio of oil and surfactant + cosurfactant 1: 7, with the ratio of surfactant and cosurfactant 95%: 5% so the oil ratio : Surfactants: cosurfactants are 1 ml: 6.65 ml: 0.35 ml.

To prove and verify the truth of the data predicted through Design expert® software is valid or not by performing the test procedures previously performed. The statistical approach of one-sample test (comparison single sample test) with Open Stat software is used to test the suitability between the sample average (predictive value) with the verification value whose results can be seen in Table 7.

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Table 7. Test Results Comparation Single Sample Test Analyzes

Respon	Prediction Value	Verification Value	P value	Conclusion
Lucidity (%)	88,81 ± 0,01	87,69± 0,85	0.150	No differance
Emulsification time	6,53 ± 0,35	6,57 ± 0,15	0.690	No differance

Based on data analysis shows that between the predicted value and the verification value on the clarity of the response (transmittance) and the time of emulsification does not differ because the value of p> 0.05, so Design Expert® 7.0.1.5 can predict the clarity of the response (transmittance) and the emulsification time of the SNEDDS Extract formula Faloak bark

The Result of Antioxidant Activity Test of Ethanol Extract from Faloak (*Sterculia quardrifida* R. Br) Bark, SNEDDS F (4) and vitamin C control

Based on research data in table 8 percent reduction of ethanol extract. The optimum formula of Faloak bark microemulsion (*Sterculia quardrifida* R. Br) to the 5 series of treatment concentrations gives different average DPPH radical reduction values. Can be seen the relationship between the concentration of ethanol extract of Faloak bark and percent reduction, increasing the concentration of ethanol extract of Faloak bark (*Sterculia quardrifida* R. Br) then followed by the increasing percentage of reduction of DPPH radical with regression y = 0.5071 + 2, 8862x with a correlation coefficient (r) of 0.9775. After inputting the linear equation, the average value of IC_{50} is obtained. The IC_{50} value of the ethanol extract of Faloak bark (*Sterculia quardrifida* R. Br) was 38.511 ± 2.159 ppm. This means that the ethanol extract of Faloak bark (*Sterculia quardrifida* R. Br) has very strong antioxidant activity because the IC_{50} value is between> 50 µg / mL(Edhisambada, 2011). This is comparable to research conducted by Amin *et.al*., (2016) Ethanol extract of Faloak bark has antioxidant activity with IC_{50} of 4,8101 ppm.

Table 8. Test Results of DPPH Reduction Activities and Antioxidant Activity Test of Ethanol Extract from Faloak (*Sterculia quardrifida* R. Br) Bark, SNEDDS F (4) and vitamin C control

Concentration (ppm)	% damping ± SD Ekstrak Etanol	Concentration (ppm)	% damping ± SD SNEDDS F(4)	Concentration (ppm)	% damping ± SD Vitamin C
30 ppm	39,477 ± 4,630	40 ppm	31,164 ± 2,427	4 ppm	39,170 ± 1,689
40 ppm	49,318	50 ppm	39,810 ±	5 ppm	4,818 ±

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	±0,391			2,364			0,554	
50 ppm	61,384 2,028	±	60 ppm	42,424 5,192	±	6 ppm	56,2 13 2,908	±
60 ppm	73,310 1,70	±	70 ppm	50,986 4,921	±	7 ppm	65,776 2,015	±
70 ppm	80,816 0,850	±	80 ppm	56,769 3,846	±	8 ppm	78,371 4,341	±
IC_{50}	38,511 2,159	±	IC_{50}	70,182 4,893	±	IC_{50}	5,020 0,627	±

Based on the data in table 8 it can be seen that the percent reduction in the formula of SNEDDS ethanol extract of Faloak bark (*Sterculia quardrifida* R. Br) made 5 series of concentrations of 3 replications gives the average reduction value of DPPH radical reduction. Increasing the concentration of optimal formula microemulsion ethanol extract of Faloak bark (*Sterculia quardrifida* R. Br) then followed by the increasing percentage of reduction against DPPH radicals. IC_{50} values for the three replications averaged 70.182 ± 4.893 ppm. This means that the optimal concentration of the microemulsion formula of the ethanol extract of Faloak bark (*Sterculia quardrifida* R. Br) has strong antioxidant activity because IC_{50} values are between 51-100 µg / mL (Salim and Eliyarti, 2019).

Antioxidant activity testing was also carried out on Vitamin C as an ingredient for instrument calibration. Vitamin C solution is made with 5 concentration series, made 3 replications. The yield of DPPH reduction by Vitamin C to the 5 series of treatment concentrations gives an average of the different DPPH radical reduction values. Increasing the concentration of vitamin C is followed by the greater percentage of reduction of DPPH radicals with linear regression y = 2.8324 + 3.0672x with a correlation coefficient (r) 0.9484. After inputting the linear equation, the average value of IC_{50} is obtained. The IC_{50} value of vitamin C was 5.020 ± 0.627 ppm and was classified as very strong. The use of vitamin C as positive control is vitamin C, which contains no synthetic compounds that can interfere with the process of reducing free radicals.

The results of antioxidant activity tests using the DPPH-free radical reduction method, showed IC_{50} values of ethanol extract and vitamin C were very strong, namely 38.511 ± 2.159 ppm and 5.020 ± 0.627 ppm while IC_{50} optimum formula of ethanol extract of Faloak bark (*Sterculia quardrifida* R. br) showed different activities antioxidant where the optimum formula of the ethanol extract of Faloak bark (*Sterculia quardrifida* R. br) has a strong activity that is 70.182 ± 4.893 ppm. The optimum antioxidant activity of the reduced formula can be caused by the reduced activity during the process of making the formula.

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CONCLUSION

Based on the results of the study, it can be concluded that the ethanolic extract of Faloak bark (*Sterculia quadrifida* R. Br) meets the characteristics of the SNEDDS preparation, except that it is unstable in AIF liquid and has strong antioxidant activity.

REFERENCES

Amin, A., Wunas, J. and Anin, Y. M. 2016. Uji Aktivitas Antioksidan Ekstrak Etanol Klika Faloak (Sterculia Quadrifida R.Br) Dengan Metode DPPH (2,2-diphenyl-1-picrylhydrazyl), *Jurnal Fitofarmaka Indonesia*, 2(2), pp. 111–114. doi: 10.33096/jffi.v2i2.180.

Annisa, R., Yuwono, M. and Hendradi, E. 2020. Effect of vegetable oil on self-nanoemulsifying drug delivery system of dayak onion [eleutherine palmifolia (L.) merr.] extract using hydrophilic-lipophilic balance approach: Formulation, characterization, *International Journal of Drug Delivery Technology*, 10(2), pp. 210–216. doi: 10.25258/ijddt.10.2.4.

Bali V, Ali M, A. J. 2010. Study of surfactant combinations and development of a novel nanoemulsion for minimising variations in bioavailability of ezetimibe, *Colloids Surf B Biointerfaces*, 76(2), pp. 410–20. doi: 10.1016/j.colsurfb.2009.11.021.

Dantas, A.G.B., de Souza, R.L., de Almeida, A.R., Xavier Júnior, F.H., Pitta, M.G. da R., Rêgo, M.J.B. de M., Oliveira, E.E. 2021. Development, characterization, and immunomodulatory evaluation of carvacrol-loaded nanoemulsion, *Molecules*, 26(13), pp. 1–11. doi: 10.3390/molecules26133899.

Dillak H.I, E.B.E, K. and S, K. 2019. Secondary Metabolites and Anti-oxidant Activity of Ethanolic Extract of Faloak (Sterculia quadrifida), *Biosaintifika*, 11(3), pp. 296–303. doi: http://dx.doi.org/10.15294/biosaintifika.v11i3.20736.

Edhisambada 2011. *Antioksidan dan Radikal Bebas*. Available at:https://edhisambada.wordpress.com/2011/02/22/antioksidan-dan-radikal-bebas/. Tanggal akses : 6 September 2021

Nazzal S, Smalyukh II, Lavrentovich OD, K. M. 2002. Preparation and in vitro characterization of a eutectic based semisolid self-nanoemulsified drug delivery system (SNEDDS) of ubiquinone: mechanism and progress of emulsion formation, *Int J Pharm*, 235(1), pp. 247–65. doi: 10.1016/s0378-517.

Ranta, F., Nawawi, D.S., Pribadi, E.S., Syafii, W. 2012. Aktivitas Anticendawan Zat Ekstraktif Faloak (Sterculia comosa Wallich), *Jurnal Ilmu dan Teknologi Kayu Tropis*, 10(1).

Salim, R. and Eliyarti. 2019. Aktivitas Antioksidan Infusa Daun Kelor (Moringa Oleifera Lam.) Terhadap Warna Daun, *Katalisator*, 4(2), pp. 91–102.

http://doi.org/10.22216/jk.v5i2.5717
Published by LLDIKTI Wilayah X

Jurnal Katalisator Vol 6 No. 2 (2021) 284-296

Singh B, Bandopadhyay S, Kapil R, Singh R, K. O. 2009. Self-emulsifying drug delivery systems (SEDDS): formulation development, characterization, and applications, *her Drug Carrier Syst*, 26(5), pp. 427–521. doi: 10.1615/critrevtherdrugcarriersyst.v26.i5.10.

Sopianti D.D, Herlina, S. H. 2020. Penetapan Kadar Asam Lemak Bebas Pada Minyak Goreng', *Katalisator*, 5(1), pp. 93–99. doi: http://doi.org/10.22216/jk.v5i1.4440.

Tran Th, Guo Y, Song D, Bruno RS, Lu X. 2014. Quercetin-containing self- nanoemulsifying drug delivery system for improving oral bioavailability, *J Pharm Sci*, 103(3), pp. 840–52. doi: 10.1002/jps.23858.

Wahyuningsih, I., Sugiyanto, Yuswanto, A., Martien, R. 2017. The dissolution and diffusion of furosemide on self-nanoemulsifying drug delivery system (SNEDDS), *Indonesian Journal of Pharmacy*, 28(2), pp. 112–118. doi: 10.14499/indonesianjpharm28iss2pp112.

Wahyuningsih, I. and Putranti, W. 2015. Optimasi Perbandingan Tween 80 dan Polietilenglikol 400 Pada Formula Self Nanoemulsifying Drug Delivery System (SNEDDS) Minyak Biji Jinten Hitam', *Pharmacy*, 12(02), pp. 223–241.

Wardhani M.I. 2016. Optimasi formula sediaan SNEDDS dari Ekstrak Kloroform Daun Salam (Syzygium polyanthum) dengan Oleic Acid sebagai Minyak Pembawa. *Tugas Akhir*. Universitas Sebelas Maret.

http://doi.org/10.22216/jk.v5i2.5717
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