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# Development of Liquid Soap Containing Methanolic Extract of Cork Tree Stamen

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## ABSTRACT

Cork tree (*Sonneratia caseolaris* (L.) Engl., family Sonneratiaceae) found in estuarine and tidal creek landscape and mangrove area. Cork tree extract has antioxidant and antimicrobial activity. The aim of this research was to develop liquid soap base containing cork tree extract prepared by beaker method using Cocamide DEA and Cocamidopropyl betaine as foam booster, Texapon N70 and Empigen OB as surface active agent and Eumulgin E033 as viscosity inducing agent as well as solubilizer. The most appropriate formula consisted of Cocamide DEA 2 %w/w, Cocamidopropyl betaine 5 % w/w, propylene glycol 2%w/w, Empigen OB 20%, Eumulgin E033 3 %w/w, N-methyl pyrrolidone 5 %w/w and cork tree extract 1 %w/w. Liquid soap represented the rheological behavior as newtonian flow. The antimicrobial activity of liquid soap containing NMP against S. aureus was shown in this research.

**Keywords:** Cork tree, NMP, Cocamide DEA, Texapon N70, Empigen OB, Eumulgin E033

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## INTRODUCTION

Cork tree (*Sonneratia caseolaris* (L.) Engl., family Sonneratiaceae) is one of the lead plants of the mangrove forest [1]. Cork tree is typically found in riverside area. Many parts of this tree have been used as source of food or traditional drug [2]. Cork tree fruit extracts could be used for treatment of bleeding, hemorrhages, piles and sprain poultices [3]. Phenolic compounds such as gallic acid and flavonoids (luteolin and luteolin-7-O-glucoside) are the main substances which their amount are varied in each part of this plant [4]. Previous researches reported that cork tree extract has antioxidant activities when examined by DPPH assay. Two flavonoids (luteolin and luteolin-7-O-glucoside) were found to be antioxidants [5]. The antimicrobial activity of cork tree flower has been reported previously [6]. This study aimed to prepare the liquid soap containing cork tree extract. The physical properties such as pH, viscosity, rheological study, surface tension, foaming capacity and antibacterial activity were determined.

## MATERAILS AND METHODS

### Materials

Cocamide DEA (EMPILAN 2502, lot. MIW0011909), Cocamidopropyl betaine (EMPIGEN BS/FA, lot. BLW0002489), propylene glycol and Vantocil TG (lot. 1457), Texapon N70 and Empigen OB (lot. MIW0008709), Eumulgin E033 (lot. S791970018), Kotilen L/1 (lot. 1/2147037), Amaranth S (lot. 8RC164306), Reinolderm (lot. 37602) were purchased from The East Asiatic (Thailand) Public Company Limited, Bangkok, Thailand. NMP (N-Methyl-2-pyrrolidinon, 99%, extra pure, lot. A0277037) was purchased from ACROS ORGANICS, Thailand. Tryptic Soy Broth, was purchased from Becton, Dickinson and Company, USA.

### Methods

### Preparation of cork tree stamen extract

Stamen of cork tree was collected from the mangrove forest located in Samuthsongkram, Thailand, in October 2008. Voucher specimens were deposited in department of Pharmacognosy, Silpakorn University in Nakhon Pathom, Thailand, with voucher reference numbers sc 01. The collected plant was dried with hot air oven at 60°C for 72h. Cork tree stamen of 100 g was macerated separately in 400 mL methanol and was macerated at room temperature 24 hrs and then filtrated. The filtrate was evaporated until dry under vacuum.

### Preparation of liquid soap containing cork tree extract

To investigate the optimal developing liquid soap, various concentrations of Cocamide DEA, Cocamidopropyl betain, Texapon N70, propylene glycol, Vantocil TG, Empigen OB,

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Eumulgin E033 were used. Distilled water was boiled until 70 °C and then Cocamide DEA, Cocamidopropyl betain, Texapon N70, propylene glycol, Empigen OB, Eumulgin E033 and Reinoderm were added into water according formula (Table 1). The liquid soap was slowly mixed until homogeneous. Then, the cork tree extract was added and mixed homogeneously into the liquid soap.

**Table 1: The formula of liquid soap (F1-F17)**

| Formulation | F1 | F2 | F3 | F4 | F5 | F6 | F7 | F8 | F9 | F10 | F11 | F12 | F13 | F14 | F15 | F16 | F17 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| cocamide DEA | 2 | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| cocamidopropyl betaine | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| Texapon N70 | 2 | 2 | 3 | 4 | 5 | 4 | 4 | 4 | 4 | - | - | - | - | - | - | - | - |
| Empigen OB | - | - | - | - | - | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 |
| propylene glycol | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| Eumulgin E033 | - | - | - | - | - | - | 1 | 1.5 | 0.5 | 1 | 0.5 | 1 | 1.5 | 1.5 | 1.5 | 1.5 | 1.5 |
| Reinolderm | - | - | - | - | - | - | - | - | - | - | 5 | 5 | 5 | 5 | 5 | 5 | 5 |
| NMP | - | - | - | - | - | - | - | - | - | - | - | - | - | 10 | 15 | 20 | 40 |
| water | 92 | 91 | 91 | 90 | 89 | 80 | 79 | 78.5 | 79.5 | 83 | 78.5 | 78 | 77.5 | 67.5 | 62.5 | 57.5 | 37.5 |
| total weight | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 |

**Study of physical properties and antimicrobial activity**

The prepared systems were determined their viscosity and rheological behavior using Brookfield DV-III Ultra programmable rheometer (Brookfield Engineering Laboratories. Inc., USA) (n=3). Foaming capacity was also tested (n=3). Surface tension and pH were determined using the First Ten Angstroms (FTA 1000 USA) and pH meter (Professional Meter Sartorius), respectively, (n=3). Antimicrobial activity of liquid soaps containing NMP against Staphylococcus aureus was investigated using an agar-cup diffusion method by measuring diameters (mm) of clear zones of growth inhibition. The tests were performed in triplicate.

## RESULTS AND DISCUSSION

Physical properties of prepared liquid soap were presented in Table 2. Foaming capacity, pH and surface tension of the liquid soap were increased as the amount of cocamide DEA was increased because cocamide DEA was foam booster [7]; moreover, liquid soap was also transparent soap and represented the rheological behavior as pseudoplastic flow in F1 and newtonian flow in F2. Texapon N70, anionic surfactant, was used to increase foaming capacity for F3 to F5 at the amount of 3, 4, 5 %w/w and the result showed that foming capacity, pH and surface tension were increased. Liquid soap was also transparent soap and represented the rheological behavior as pseudoplastic flow in F3 and newtonian flow in F4 and F5. The F6, F7, F8 were developed from F4 by addition of Empigen OB that used as amphoteric surface active agent. Eumulgin E033 was added in formulation (F7 and F8) because F4 showed the low viscosity. The viscosity of F7 and F8 were higher than that of F6, significantly. The foaming capacity of F7 was lower than F6 significantly because Eumulgin E033 was added into F7;

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**Table 2: Physical properties of liquid soaps.**

| Formula | pH | | viscosity (cPs) | | foaming capacity (mL) | | surface tension (mN/m) | |
|---|---|---|---|---|---|---|---|---|
| | Average | S.D. | Average | S.D. | Average | S.D. | Average | S.D. |
| 1 | 9.46 | 0.01 | 303.33 | 7.11 | 16.9 | 4.24 | 27.8 | 0.2 |
| 2 | 9.54 | 0 | 188.9 | 9.13 | 25.27 | 6.53 | 28.41 | 0.41 |
| 3 | 9.51 | 0.01 | 25.98 | 0.23 | 23.7 | 6.71 | 28.41 | 0.4 |
| 4 | 9.56 | 0.01 | 12.64 | 1.09 | 19.8 | 0.35 | 28.82 | 0.21 |
| 5 | 9.6 | 0 | 3.75 | 0.04 | 32.77 | 2.97 | 29.81 | 0.58 |
| 6 | 9.81 | 0.02 | 26.43 | 0.43 | 37.97 | 2.7 | 28.85 | 0.39 |
| 7 | 9.23 | 0.01 | 49962.7 | 2761.02 | 30.7 | 3.04 | 28.56 | 0.04 |
| 8 | 9.31 | 0.01 | 27580.3 | 1832.13 | 38.77 | 5.26 | 28.1 | 0.22 |
| 9 | 9.37 | 0.01 | 9944 | 1689.69 | 31.57 | 2.67 | 26.18 | 0.12 |
| 10 | 8.98 | 0.01 | 226.87 | 2.87 | 28.17 | 1.76 | 28.45 | 0.12 |
| 11 | 8.55 | 0.01 | 59.88 | 3.53 | 26.83 | 3.21 | 29.93 | 0.26 |
| 12 | 8.47 | 0.02 | 115.53 | 0.45 | 27.53 | 2.3 | 29.93 | 0.26 |
| 13 | 8.47 | 0.01 | 327.07 | 19.79 | 27.17 | 1.26 | 28.8 | 0.08 |
| 14 | 9.31 | 0.01 | 38.54 | 0.68 | 29.67 | 0.58 | 28.41 | 0.4 |
| 15 | 9.25 | 0.04 | 20.17 | 0.47 | 26 | 1 | 28.41 | 0.41 |
| 16 | 9.59 | 0.07 | 13.59 | 0.09 | 25.33 | 0.58 | 27.8 | 0.2 |
| 17 | 9.61 | 0.02 | 13.39 | 0.08 | 28.33 | 0.58 | 28.82 | 0.21 |

besides, surface tension of F7, 8 were lower than that of F6 significantly because Eumulgin E033 was added into F7. The F6 and F7 represented the rheological behavior as newtonian flow but F8 represented the rheological behavior as pseudoplastic flow. Since F8 had too high viscosity, F9 and F10 were developed by reducing the amount of Eumulgin E033 (F9, F10) and varying the concentration of Texapon N70. It was found that the viscosity was decreased; besides, viscosity of F9 was higher than that of F10 significantly and that Texapon N70 was not added into F10. Additionally, surface tension of F9 was lower than F10 since Texapon N70 was added in F9. F9 represented the rheological behavior as plastic flow and the F10 represented the rheological behavior as newtonian flow. The viscosity decreased when Texapon N70 was not added into the formulation; therefore, the viscosity inducing agent was required for the formula (F11 to F13). From F11 to F13, Eumulgin E033 was varied its concentration and the result showed that the viscosity of F11 to F13 increased when compared with that of F10. Moreover, the surface tension of F13 was lower than that of F11 significantly and the surface tension F13 was lower than that of F12 significantly. The amount of Eumulgin E033 of F13 was higher than F11 and F12. Therefore, the F13 had the least surface tension. The F11 to F13 represented the rheological behavior as newtonian flow. The most appropriate formula without Texapon N70 consisted of Eumulgin E033 at least of 1.5 %w/w. Therefore, Eumulgin E033 was solubilizer and viscosity inducing agent for the developed liquid soap. NMP (N-methyl-2-pyrrolidone) was used as solubilizing agent of cork tree. F14 to F17 were developed from F13. NMP that was added into formulation (F14 to F17) contributed to decrease the viscosity of formulation significantly when compared with F13. The best formulation that could reduce surface tension was F16 (NMP 20 %w/w). Nevertheless, the viscosity of liquid soap was decreased as the amount of

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NMP was increased. Liquid soap formulation containing cork tree extract was developed from F14 (Table 3) that Eumulgin E033 was used as viscosity inducing agent.

**Table 3: Formula of liquid soap (F14-F14.3) containing cork tree extract.**

| Formula | F14 | F14.1 | F14.2 | F14.3 |
|---|---|---|---|---|
| cocamide DEA | 2 | 2 | 2 | 2 |
| cocamidopropyl betaine | 2 | 2 | 5 | 5 |
| Empigen OB | 10 | 10 | 20 | 20 |
| propylene glycol | 2 | 2 | 2 | 2 |
| Eumulgin E033 | 1.5 | 1.5 | 1.5 | 3 |
| Reinolderm | 5 | 5 | 5 | 5 |
| NMP | 10 | 5 | 5 | 5 |
| cork tree from stamen | 0 | 1 | 1 | 1 |
| water | 67.5 | 71.5 | 58.5 | 57 |
| total weight | 100 | 100 | 100 | 100 |

**Table 4: Physical properties of liquid soaps (F14 –F14.3)**

| Formula | pH | | viscosity (cPs) | | foaming capacity (mL) | | surface tension (mN/m) | |
|---|---|---|---|---|---|---|---|---|
| | Average | S.D. | Average | S.D. | Average | S.D. | Average | S.D. |
| 14 | 9.31 | 0.01 | 38.54 | 0.68 | 29.67 | 0.58 | 28.41 | 0.4 |
| 14.1 | 6.95 | 0.0115 | 112.55 | 5.64 | 23.83 | 1.61 | 26.68 | 2.79 |
| 14.2 | 7.23 | 0.0058 | 41.06 | 0.22 | 33.67 | 1.53 | 29.01 | 0.17 |
| 14.3 | 7.32 | 0.0115 | 150.47 | 1.71 | 32.83 | 0.76 | 29.22 | 0.23 |

**Table 5: Antimicrobial activity of liquid soap containing NMP (against *S. aureus* (n=3).**

| Formula | Clear Zone (mm.) | | | | |
|---|---|---|---|---|---|
| | 1 | 2 | 3 | Mean | S.D. |
| F.13 | 13.00 | 14.00 | 9.00 | 12.00 | 2.65 |
| F.14 | 16.00 | 14.00 | 14.00 | 14.67 | 1.15 |
| F.15 | 15.00 | 16.00 | 13.00 | 14.67 | 1.53 |
| F.16 | 18.00 | 11.00 | 10.00 | 13.00 | 4.36 |
| F.17 | 19.00 | 22.00 | 17.00 | 19.33 | 2.52 |
| Ampicilin | 40.00 | 35.00 | 37.00 | 37.33 | 2.52 |

The viscosity of F14.1 increased whereas its pH, surface tension, foaming capacity decreased (Table 4). Therefore, the viscosity increased and foaming capacity decreased when the amount of NMP decreased. Moreover, because of the increased cocamidopropyl betaine from 2 % (F14.1) to 5 %w/w (F14.2) and increased Empigen OB from 10 % (F14.1) to 20 %w/w (F14.2), the pH, surface tension, foaming agent of F14.2 were increased but viscosity was decreased. To increase the viscosity, the viscosity inducing agent (Emulgin E033) was added into formulation (F14.3). The viscosity of liquid soap (F14.3) was increased when compared with F14.1 and F14.2. Thus, the most appropriate liquid soap was F14.3. F13 to F17 were investigated for antimicrobial activity against Staphylococcus aureus. The antimicrobial activity

of liquid soap containing NMP against S. aureus is shown in Table 5. The liquid soap exhibited activity against Staphylococcus aureus as amount of NMP was increased.

## CONCLUSION

Liquid soap containing cork tree extract was prepared which the most appropriate formula consisted of 2 %w/w Cocamide, 5 % w/w Cocamidopropyl betaine, 2%w/w propylene glycol, 20% w/w Empigen OB, 3 %w/w Eumulgin E033, 5 %w/w NMP and 1 %w/w cork tree extract. Liquid soap exhibited rheology as newtonian flow with antimicrobial activity against S. aureus.

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