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Research Article

Surface Tension Action of *Clitoria ternatea* Infused Surfactant

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Abstract: This study aimed to produce a soap or surfactant made from Blue ternate or *Clitoria ternatea* flower and to measure and determine if it would affect the surface tension action of water when it is added to it, the researcher aimed to answer the following problems: (1) What is the Surface Tension Action of *Clitoria ternatea* in terms of Wettability, Dispersion Size and Capillarity? (2) Which concentration of *Clitoria ternatea* in soap would give optimum result in surface tension action? Treatment 0 (without *Clitoria ternatea*), Treatment 1 (25 g of *Clitoria ternatea* to a 100 ml of Coconut Oil), Treatment 2 (50 g of *Clitoria ternatea* to a 100 ml of Coconut Oil) or Treatment 3 (75 g of *Clitoria ternatea* to a 100 ml of Coconut Oil). (3) Is there a significant difference on surface tension action among varying concentration in soap?

Petals of the flower were grinded to infuse in oil via heating process, the researcher made 4 treatments with 2 trials each and each trials have 5 replicates. To analyze the results the researcher uses ImageJ application to measure its wettability, a capillary tube to measure its capillarity and a droplet measurement in cloth to measure its dispersion size. The major findings and conclusions of this study were: (1) Treatment 0 to Treatment 1 shows that it still has a high surface tension action, which means that the intermolecular forces in water is strong thus it has also a low cleaning action. Meanwhile Treatment 2 shows a low surface tension action and lastly Treatment was supposedly should have the lowest surface tension action, but in the data, it shows that it has a high surface tension action. By this we can conclude that as the level of concentration of *Clitoria ternatea* increases, the lower surface tension action it can exhibit. (2) Treatment 2 gives the optimum result in surface tension action, in which it has a low surface tension action. Treatment 2 contains 50 grams of *Clitoria ternatea* on a 100 ml of coconut oil, and by this we can conclude that there is an error in the experiment because supposedly treatment 3 should give the optimum result. (3) The computed F value was 0.976652 less than the computed F critical value which is 2.764199. Hence there is no significant difference in surface tension action among the varying concentrations of the soap. In general, the study is somewhat successful but it can be improved with the use of more advance application such as pendant drop analysis, and by extracting the oil of the flower by steam or fractional distillation.

Keywords: Surface tension action, *Clitoria ternatea*, surfactant.

Introduction

The coronavirus COVID-19 disease is the biggest crisis the world is currently facing, with its emergence since December 2019, the virus is still spreading in most part of the globe and sadly here in the Philippines the curve has not flatten yet. The world has now achieved a drastic death of 2.95 million as of March 13, 2021 and a worldwide case of 137 million, this pandemic does not only take lives of a million people but also drastically changed the lives of many. But like of any other pandemic and epidemic, this situation will not be forever, by practicing minimal health standard, social distancing and discipline the curve may flatten, yet with all these precautions we have a very strong agent against this pandemic and that is a SOAP.

According to World Health Organization (2020) the new coronavirus is a respiratory virus that spreads mainly by droplets generated by infected peoples' coughs or sneeze, as well as droplets of saliva or nasal discharge that sticks to surfaces and just like the other coronaviruses it can last up to days on surfaces depending on the environmental condition. To protect everyone, it is advised to frequently wash hands with alcohol with at least 60-70% concentration but it is best to wash our hands with soap, any type of soap even just a regular beauty soap.

The soap disrupts the lipid membrane that coats the viruses in which makes the virus useless or harmless. According to New York Times (2020) Soap is made up of pin-shaped molecules with a hydrophilic head that readily binds with water and a hydrophobic tail that avoids water in favor of forming bonds with oils and fats. When suspended in water, these molecules alternately float around as solitary groups, interact with other molecules in the solution, and form micelles, which are small bubbles with heads pointed outward and tails tucked within. When washing hands with soap and water, the soap molecules envelop any microorganisms on the skin. The hydrophobic tails of free-floating soap molecules try to avoid water by wedging themselves into the lipid envelopes of viruses and destroying them apart.

But the annihilating capacity of the soap does not only rely on its power to disintegrate lipid membrane of microorganism but also in its cleaning action or surface tension action in water. Water has a property called surface tension and this tension causes water to form a bead on the surface of things like ceramic, table top and glass. This property should be broken or lessen in order to clean or disinfect, and to achieve this there is a need to use surfactant. Soap lowers the surface tension of water but with the trend of plants nowadays especially herbal plant, a theory about blue ternate as a main ingredient in soap that would greatly lower the surface tension of water may be arrived at. *Clitoria ternatea* Linn. is an attractive perennial climber with conspicuous blue or white flowers. It belongs to the family Fabaceae and commonly known as "butterfly pea" and "blue ternate". It is traditionally used to treat various ailments in some part of Asian old healing practice.

The plant is native to south-east Asia and distributed in tropical Asia including India, the Philippines and Madagascar. Some herbal plants are used as additives or ingredients to soap in order to add anti-microbial or cleaning action. According to Pandaya *et al.*, (2017) nowadays herbal disinfections are being introduced in market as a substitute and environment-friendly solution. Many ethanopharmacologists, botanists, microbiologists and natural product chemist are searching for phytochemicals (allelochemicals) to develop new antimicrobials. These compounds can be used as disinfectants, antiseptics, dentifrices and chemotherapeutic agents. Natural saponification agent is regarded as a good source of disinfectants formulation. It is in this light that the researchers attempted to discover the cleaning ability of blue ternate and its usability as a hygiene tool.

Methodology

This study used an experimental method of research to produce a soap mainly made of *Clitoria ternatea*, in order to measure its surface tension action or cleaning action. The researchers prepared four treatments to determine the best concentration of blue ternate extract, with two (2) trials for each treatment. To measure the surface tension action of the blue ternate the researcher will use ImageJ an application used to display, annotate, edit, calibrate, measure, analyze, process, print, and save raster (row and column) image data. The soap-making process was conducted at the natural science laboratory and took (2) weeks for the soap be cured. The surface tension action testing took two days for the researchers to accomplish.

Preparation and Collection

Before air-drying the petals, the researchers thoroughly washed them to ensure that no dirt will remain. The flowers were air-dried at room temperature for two (2) days. The dried leaves were blended to bits using a blending machine and is ready to be infused to a carrier oil (coconut oil).

Blue Ternate Soap Production

The researchers mixed the blue ternate bits to the carrier oil which is a coconut oil, then heat in low fire for about 1 hour for the flower components be infused in the oil, then cooled it for 1 hour. The oil then added to sodium hydroxide and water mixture. Coagulation of the mixture happened after an hour of slowly blending it to a stand mixer. The researcher keeps it in the stand mixer until it turns into a paste-like texture which indicates that is ready to be cured. The mixture was transferred into a separate container. The researchers allowed the product to cure at room temperature for two weeks. The researchers prepared four treatments with two trials for each treatment. 0 contain no *Clitoria ternatea* to a 100 ml of coconut oil, treatment 1 contains 25g of *Clitoria ternatea* to a 100 ml of oil, treatment 2 contains 50g of *Clitoria ternatea* to a 100 ml of oil and treatment 3 contains 75 g of *Clitoria ternatea* to a 100 ml of oil.

Surface Tension Measurement

a) Capillarity: The *Clitoria ternatea* (5 grams) soaps will be diluted to 50 ml of water with the same lathering action, once diluted the researcher will measure its capillarity by measuring the liquid that rises on the glass tubing. Glass tubing will be put in inside the container (beaker), then using a ruler, the researcher will measure the capillary action.

b) Wettability: The *Clitoria ternatea* soaps (5 grams) will be diluted to 50 ml of water with the same lathering action, once diluted the researcher will take 5 replicates to each treatment, and the researcher will take picture of it for it to be analyzed. The pictures will be analyzed using ImageJ application, and it will take 2 days for the researcher to measure the surface tension action of *Clitoria ternatea* extract.

c) Dispersion Size: Lastly for the dispersion size, same procedure. The *Clitoria ternatea* soaps (5 grams) will be diluted to 50 ml of water with the same lathering action, once diluted the researcher will take 5 replicates or droplets. The droplets are dropped on a cloth to measure the surface it will wet. Droplets was drawn using a dropper.

Statistical Tool

Inferential statistics was used in this study specifically Two-way ANOVA. Two-way ANOVA was used to determine the significant difference between the surface tension action of *Clitoria ternatea* in varying concentration.

Results and Discussion

The researchers prepared four treatments with two trials for each and each trials has five replicates. To simplify the data the researchers arrived at the average or mean of the replicates for each trial or treatment.

Wettability: The wettability measurement for each treatment varies. Treatment 0A has a wettability measurement of 51.92 while 0B has a wettability measurement of 33.08, treatment 0s has a high surface tension considering it has no *Clitoria ternatea* in it. 1A on the other hand has a wettability measurement of 29.86, while 1B has a measurement of 29. 24, though treatment 1s was lower compared to treatment 0s the researcher still considered it a high. Now for treatment 2A it has a wettability measurement of 24.00 while 2B has a measurement of 20.20 which is the lowest on all of the treatments. Treatment 2s has the lowest measurement for wettability, which indicates that it broken the surface tension of water. Lastly, treatment 3A has a measurement of 25.24, and 35.96 for treatment 3B, hypothetically treatment 3s should have the lowest wettability measurement since it has a greater amount of *Clitoria ternatea* in it.

Dispersion Size: Upon measuring the dispersed water droplets on the cloth, here are the results: Treatment 0A has a dispersion size of 9.80 mm the same with 0B. Dispersion for these treatments was low due to the fact it has no *Clitoria ternatea*. Meanwhile, treatment 1A has a measurement of

11.20 while 1B has 11.00, which are higher since it has a flower in it. Treatment 2A has also 11.20mm dispersion size while 2B has 11.00 which is consistent low surface tension action along with the result for its wettability. Lastly, 3A has a dispersion size of 10.80 and 10.60 for 3B. Again, this is because to the possible error in the experiment.

Capillarity: The results are greatly much similar. For 0A it has 2mm for capillarity, the same with 0B, 1A, and 1B and though this is very low capillarity action, the researcher still considered it as high considering the result of the other treatments. Treatment 2A and 2B has a 1mm capillary action, which is low. Lastly for 3A, it has a 0mm and a 1mm for 3B.

Note: *For wettability, the higher contact angle the higher surface tension. Meanwhile in dispersion size, the larger the size the lower surface tension and lastly higher capillarity means higher surface tension.*

Which concentration of *Clitoria ternatea* in soap would give optimum result in surface tension action? Treatment 2 gives the optimum result in surface tension action. Treatment 2 has a 50g *Clitoria ternatea* into a 100ml of oil. To be specific, Treatment 2A shows the following results, wettability measurement of 24.00, dispersion size of 11.20mm and a 1.00 mm measurement for its capillarity action, which indicates that it has a low surface tension action. For treatment 2B, the data set indicates that it has also a lower surface tension action, it has a wettability measurement of 20.20, a dispersion size of 11.00 and a capillarity action of 1.00 mm, this data indicates that 2B has a low surface tension action. There is a significant difference among the different concentrations of *Clitoria ternatea* in soap.

The researcher used Two-way ANOVA to determine if there is a significant difference. Treatments from 0A to 3B, and F computed value is 0.976652 which is lower compared to the F critical value that is 2.764199. With this computation, it shows that there is no significant difference among the varying concentrations since the F Value is less than the F Critical Value. Given also the result of Treatment 3 which might be cause of error in the experiment, there is no solid difference between all the concentrations of *Clitoria ternatea*.

Conclusion

As the level of concentration of *Clitoria ternatea* increases, the lower surface tension action it can exhibit, but unfortunately it has discrepancy in the last treatment which we can conclude that there is an error in the experiment. The researchers recommend to do a fractional distillation or any distillation that would extract the oil from the flower, by that the claim of lowering the surface tension would be stronger.

Given that the treatment 2 gives the optimum results, we can say that there is an error in conducting treatment 3 and adding the flower to a simple homemade/basic soap would give it efficient cleaning action, since adding this flower somewhat lowers the surface tension of water when it is combined. The researchers recommend to compare the *Clitoria ternatea* soap to a branded and commercial soap available in the market, with that we can see if there is a significant difference between the two. The researchers also recommend to study the other parts of the plant like the roots and fruit, as well as to study the anthocyanin compound of the flower which gives the blue color of the flower.

Conflicts of interest: There is no conflict of interest of any kind.

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