
Effect of Thickener and Emulsifier on Formulation

Mosquitoes belonged to the family of nematocerid flies which was the Culicidae (from the Latin culex, genitive culicis, meaning "midge" or "gnat"). Female mosquito was responsible to carry the vector that leads to the disease spread. There were 3000 species of mosquitoes but there were 3 mainly mosquitoes that responsible for the spread of diseases into a human. Firstly, the voracious Asian tiger which members of Aedes mosquitoes carry yellow fever, dengue, and encephalitis. Next, malaria disease was carried by Anopheles mosquitoes. They also transmit filariasis (also called elephantiasis) and encephalitis. Lastly, Culex mosquitoes carry encephalitis, filariasis, and the West Nile virus.

Recently, there were many cases related to mosquito diseases that have spread globally. The Americas have experienced a massive outbreak of Zika virus (ZIKV) which has now hit at least 49 states at the beginning 2013-2014. Although most cases have taken place in South America and the Caribbean, imported and autochthonous cases have taken place in the United States. Vectors of ZIKV were known as Aedes aegypti and Aedes albopictus mosquitoes. Most of the peoples have not known about the potential for temperate Aedes mosquitoes to transmit ZIKV. Aedes vexans has a worldwide dispersion, highly abundant in particular localities, aggressively bites humans, and a competent vector of several arboviruses (Gendernalik, 2017).

Zika was a viral illness spread by the sting of two species of infected mosquitoes and was an emerging disease in the western hemisphere. People who were bitten by a Zika virus-infected mosquito often show only minor symptoms, if any. Major concerns of Zika, however, include the virus' documented impact on pregnancies and sexual transmission of the virus. The other common mosquito disease which distributed worldwide now was malaria. Based on an article from The Herald, the country (Zimbabwe) has recorded a significant increase in malaria cases compared to the same period in the last two years according to the Ministry of Health. Dr. Mberkunashe said 119 593 cases were recorded in the first 11 weeks of this year compared to 73 019 and 82 328 cases for the same periods in 2016 and 2015 (Mawonde, 2017).

In May 2015, first reports of locally-transmitted infection of Zika received by The World Health Organization (WHO) from Brazil. Then, WHO received reports that mothers who've exposed to Zika during pregnancy lead to microcephaly in babies in October 2015. Starting from February 2016, local transmission of Zika infection had been reported from more than 20 countries including Americas and an explosion number of thousands of cases was in Cabo Verde in western Africa. (Kindhauser et al., 2016). Other than that, based on researchers by Kindhauser et al. (2016), serological (antibody detection) tests for Zika cross-react with antibodies stimulated by other viral infections, the presence of Zika virus was ideally confirmed by the

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detection of viral nucleic acids by polymerase chain reaction (PCR) testing or by virus isolation. *Plectranthus amboinicus* (Lour.) Spreng was a perennial herbaceous plant belonging to the family Lamiaceae, which occurs in the tropics and warm areas of Africa, Asia and Australia (Arumugam et al., 2016). A large genus of *Plectranthus* from Lamiaceae family has 300 different species and can be found in Tropical Africa, Asia and Australia (Lukhoba et al., 2006). This plant also commonly known as Indian borage, and it was a fleshy, succulent herb famous for its distinct oregano-like flavor and odor (Arumugam et al., 2016). IBO can be used as a food flavoring, food additive and natural nontoxic preservative (botanical fungicide) substituting for chemical fungicides.

2.2.2 Advantages

Plectranthus Amboinicus was one plant that has been practiced widely as a traditional medical specialty to treat diseases such as a cough, fever, and others. It was utilized in folk medicine to handle conditions like cold, asthma, constipation, headache, cough, fever and skin diseases (Arumugam et al., 2016). Founded on the researcher, Patel et.al (2010), he claims that "the results show that ethanolic and aqueous extracts of *Plectranthus amboinicus* had significant antioxidant activity". Other than that, (Manjamalai et al., 2012) found that the essential oil of *Plectranthus Amboinicus* showed a substantial anti-inflammatory and anti-microbial action. Apart from its medicinal properties it also possesses antifungal, antiochratoxigenic and antioxidant activity to protect food commodities from microbes (Murthy et.al, 2008). Furthermore, *Plectranthus* species were frequently used as medicines and were used to treat a range of ailments, skin infections, digestive system problem, and respiratory problems (Lukhoba et al., 2006). The aromatic leaves of *Plectranthus amboinicus* (Lour.) Spreng can be used to make a syrup and researcher proved that it can be utilized to treat coughs and also has been used to treat a cattle (Rice et.al, 2011). *Plectranthus amboinicus* was used for the treatment of skin ulcerations caused by *Leishmania braziliensis* at Brazil and the juice of these plant was used to treat skin allergies in India. It also been used as a poultice for centipedes and scorpion bites in Malay and to treat burns also (Lukhoba et.al, 2005). Gurgel et.al (2009) cited that "we reported that the hydroalcoholic of *P. amboinicus* possesses promising anti-inflammatory and antitumor effects ". It can seem that *Plectranthus amboinicus* have many benefits to treat many diseases.

2.2.3 Bioactive compound

The bioactive compound was a type of chemical found in small amounts in plants and certain foods (such as fruits, vegetables, nuts, oils, and whole grains). Bioactive compounds have actions in the body that may promote good health. Previous studied shows in the prevention of cancer, heart disease, and other diseases (National Cancer Institute). Examples of bioactive compounds that have in *Plectranthus Amboinicus* were such as carvacrol, thymol, Cis

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–Caryophyllene, t-Caryophyllene, and p-Cymene. Besides, Arumugam et al. (2016) state that the major components from aerial parts (stem and leaves) of *P.amboinicus* that collected at Thailand were Linalool (50.3%), Carvacrol (14.3%), Geranyl acetate (11.7%) and Nerol acetate (11.6%) with transcription factor inhibition activity. Furthermore, the constituent of carvacrol, with other components such as p-cymene, b-caryophyllene, and a-terpinolene were the bioactive compounds that could be the reason for the antifungal activity (Murthy et al., 2009). In Cuba, a leaf was boil and given to patients suffering from a chronic cough or tuberculosis and eventually, scientific studies proved that *P. amboinicus* having anti-*Mycobacterium tuberculosis* activity. Additionally, the unsterilized ethanolic leaf extract of *P. amboinicus* showed antibacterial activity against diabetic wound pathogens, *S. aureus*, *P. mirabilis*, *E. coli*, *K. pneumonia* and *P. aeruginosa* (Arumugam et al., 2016). Hence, it can be seen that the bioactive compound of this plant was very useful for medical benefit.

2.3 Extraction of essential oil

There were many extractions was used widely now to extract the bioactive compound from the herbal plant. The desired bioactive compound was very important for medicinal purposes. Several of them were set up to hold various types of important functions in the living plants such as attraction, protection or signaling. Definition of bioactive compounds in plants was a secondary plant metabolites that showing pharmacological or toxicological effects in man and animals (Azmir et al., 2013) Types of extraction that widely used to extract essential oil of herbal plant were such as hydrodistillation (Chen et.al, 2014), ultrasonic extraction (Wang and Lee, 2016), ultrasound, microwave, Soxhlet extraction, and cold maceration (Wu et al, 2015).

2.4 Lotion Formulation

Extraction of essential oils of the herbal plant can be used to produce lotion, cream by adding it with a certain amount of it. The bioactive compound of *Plectranthus Amboinicus* such as thymol and carvacrol were important to promote as an anti-mosquito to the skin. Many diseases have been proved that because of mosquito bites such as zika, dengue, encephalitis and yellow fever. Some mosquitoes were vectors for diseases. This implies they can transport diseases from one human or animal to another. Typically, the diseases were caused by tiny parasites or viruses. For instance, a mosquito that bites an infected human or creature can pick up a virus along with the blood meal and spread to other peoples by their bites.

The highest amount of carvacrol and thymol as a bioactive compound in essential oils of *Plectranthus Amboinicus* can cause the mosquito-borne disease cases reduced. The small amount of essential oil extract of *Plectranthus Amboinicus* was used in the lotion formulation as an active ingredient in order to promote the lotion as an insect repellent lotion. Basic components to form a lotion or cream were thickener, emulsifier, humectant, diluent, emollient and others. The aim of this work to optimize the anti-mosquito lotion formulation using leaves

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Plectranthus Amboinicus essential oil extract by varying the emulsifier, thickener, and essential oil.

Table 2.4.1 shows the various types of thickener used in industry today. Based on the table, the suitable thickener should be used in lotion formulation was synthetic thickener such as carbopol. Based on table 2.4.5, the suitable emulsifier used in this formulation was oil in water emulsifier such as glyceryl monostearate. Oil in water emulsifier was suitable for lotion formulation because of the texture of the lotion was more too non-oily mixture and function of emulsifier were supported the oil drops packed in water, used for moisturizing effects. Selection of emulsifier was based on the calculation of HLB (hydrophilic-lipophilic balance).

Lipid Thickeners

Lipid thickeners primarily consisted of liquidified materials. They deliver their natural thickness to the formula. Normally, these materials can be liquefied by heat and solids at room temperature. They were mostly used in creams and lotions. Some frequent types include Carnauba Wax, Stearyl Alcohol, Cetyl Alcohol, and Stearic acid.

Naturally derived thickeners

The component of natural thickener was polymers that function by absorbing water to swell up and gain the viscosity. Cellulose derivatives like Hydroxyethylcellulose were commonly used in liquid cleansing products such as body wash or shampoo. Guar gum was another example of a naturally derived thickener. Others include Locust Bean Gum, Xanthan Gum, and Gelatin. Any formula that contains a high level of water can be used these thickeners. However, they can be not stable, cause clear formulas to become cloudy, and feel sticky on the skin.

Mineral thickeners

Mineral thickeners naturally happened as mined ingredients that can absorb water or oils and encourage viscosity. They give a different kind of viscosity than the natural gums. Example of thickener was Silica, Bentonite, and Magnesium Aluminum Silicate. These thickeners can be used to thicken oils as well as water-based formulations.

Synthetic thickeners

Carbomer (carbopol) was the most common example. It was a water-swellaable acrylic acid polymer that can be used to form crystal clear gels. They have a desirable feel which makes them superior to other thickening agents that leave a sticky feel. Carbomer thickeners also have the ability to suspend materials in solution so you can have low viscosity formulas with large

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particles suspended. These thickeners also help to stabilize emulsions and frequently used in lotion and cream products.

Component & example

Function

Range wt (%) Patent No: US 6,348,501 B1

Diluent

Distilled water

Water and water-like ingredients were the foundation of our lotion making activities. Without water, a mixture cannot be classified as a true lotion. Combinations of various water materials can make wonderful lotions and creams. 80-85

Emulsifiers

- Glyceryl Stearate SE
- Glyceryl Oleate
- Shea Butter Glycerides

Emulsifiers have the wonderful ability to bond water and oil together. Without an emulsifier, our oil and water blends can separate much like a vinaigrette. Regular shaking or high-speed mixers only temporarily make the mixture to appear emulsified 1-5

Thickener

- Sorbitol
- Xanthum Gam
- Synthetic wax
- Beeswax

It enhances the consistency, volume, and viscosity of cosmetic products, thereby providing

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more stability and better performance. While some thickeners have also emulsifying or gelling properties, the majority of thickeners have the ability to retain water on the skin and act therefore as moisturizers. Thickeners can be completely natural like waxes but also synthetic or semi-synthetic. They were derived from various sources and consist of very different molecular structures including polysaccharides, proteins, alcohols, silicones or waxes. 1-2

Emollients

- glycerin

Emollients include a large variety of compounds with softening and smoothing properties. As compared to plant oils, specialty emollients were resistant to oxidation and can therefore not spoil and need no antioxidants for preservation. In addition, most specialty emollients show very good spreadability on the skin and provide a satiny, smooth and non-greasy feel to the skin. Typically, they were non-comedogenic, non-allergic and non-irritant.

Essential oils

Plant extracts were to help skin repair itself. Many plants offer healing, soothing and beneficial properties to the skin. Sometimes the difference between a good lotion and a great one was the extract used. Small amounts were generally used, up to 2%. 0.5-2 (Making Cosmetic and The Saga, retrieved by May 2017)

2.6 Analysis

2.6.1 pH of skin ranges from 5 and 6, and 5.5 was considered to be average pH of the skin. Therefore, the formulations intended for application to the skin should have pH closer to this range (Akhtar, 2008). The pH value can be measured by using pH meter or pH strips.

2.6.2 Stability Test The centrifugal tests were performed at 25°C and at 5000 rpm by placing the 10g of the sample in centrifugal tubes. In this study centrifugation test was performed at different time intervals for primary emulsions kept at different storage conditions for up to a period of 28 days. In the case of primary emulsion, no phase separation after centrifugation was seen in any of the samples kept at different storage conditions up to 14 days but slight phase separation on centrifugation was seen from 21st day up to 28th day of observation in the samples kept at 40°C and 40°C+ 75% relative humidity and no more phase separation was observed till the end of study period..

2.6.3 Rheology Test

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Physical stability was assessed through rheological determinations performed to examine the viscosity of the lotion composition. Rheological parameters were determined at 25 C, using a CP 41 spindle and 1.0 ml of each sample. Rheogram curves constructed with ascendant and descendant segments were obtained with rotation speeds increasing progressively (1–4 rpm) and gradually decreasing (4–1 rpm). With the results obtained, values for consistency index (related to the system viscosity) and flow index (related to the system pseudoplasticity) were mathematically calculated by the Ostwald law: $\tau = k \dot{\gamma}^n$ where τ is the shear stress, the consistency index, the shear rate, is the flow index. Data were statistically analyzed using Kruskal–Wallis, a non-parametric test.

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