Jurnal Penyelidikan dan Pendidikan Kejuruteraan. Jilid 2, 2005

A Novel Mosquitoes Repellent Soap Based on *Azadirachta indica* and *Eucalyptus citriodora* Oil

KHAIRUL, F.K., HARBANT, S., HUNTER, M. AND AHMAD, M.N.

School of Material Engineering

Bioprocess Engineering and Environmental Engineering Program,

Kolej Universiti Kejuruteraan Utara Malaysia, 01000 Kangar, Perlis.

ABSTRACT

The use of *Azadirachta indica* and *Eucalyptus citriodora* oil is a two stage repellent system for the soap, where *E. citriodora* offers short term repellency and the *A. indica* component offers longer term efficacy effects. Both materials (*A. indica* and *E. citriodora*) are from natural sources and locally available. This is the first time the two natural agents have been combined into a single product, thus providing synergy and longer term residual efficacy than present herbs and *E. citriodora* oil used in similar types of products in the market. This is cost effective product to combat mosquitoes as well as personal soap for everyday use.

INTRODUCTION

Mosquitoes in rural areas are a major human problem. The majorities of products in both the domestic and international market require spraying or roll on as application medium. Thus time/ efficacy effect is very limited and requires a conscious effort from the consumer to use the repellent. The use of soap as a medium of application fits in with everyday consumer habits and allows for all day residual efficacy.

Female mosquitoes draw blood from people and animals because they need the protein found in blood to help develop their eggs. Mosquitoes are attracted to people by skin odors and carbon dioxide from breath (Clements, 1963; Curtis, 1986). The active ingredients *A. indica,* commonly known as neem and *E. citriodora* oil employed in the production of this soap repellent, use two different methods to make the person's skin unattractive for feeding. Both active raw materials were processed from natural sources, cultivated locally in Perlis. *A. indica is* a highly effective, medium to broad spectrum insect repellant. This substance has been widely used for centuries - not killing the pest instantaneously but incapacitating them (National Research Council, 1992). *E. citriodora* oils provide protection similar to repellents with low concentrations of DEET (N,N-diethyl-m-toluamide). Besides that, this oil also have aroma that can repel mosquito and wards off the biting mosquito (Chopra *et al.*,1986).

This product is natural and available from renewable resources and contains no synthetic compounds like DEET, which is often criticized for being toxic (Smith, 2002). This soap can also be applied to pets for safe and effective protection.

MATERIAL AND METHOD

Extraction

Two parts of *A. indica* have been used i.e. oil, from the seed produced by cold pressing process or cold water extraction from the leaves. Both parts contain same active ingredient but the amount is less in leaves when compared with oil fromthe seeds. *E. citriodora* essential oils are produced from steam distillation.

Soap making process

Formulation of this soap repellent consists of 72.5% virgin coconut oil, 25% Sodium Hydroxide (NaOH), 2% *A. indica* extracts and 0.5% *E. citriodora* essential oil. Melt virgin coconut oils and heat slowly until temperature increases to 110°C, emulsify the oils with NaOH and stir continuously for about 30 minutes and then add *A. indica* extracts. When the viscosity of the solution begins to increase, the temperature is decreased to 40°C and *E. citriodora* oil is added. After a day or two, the soap is taken out of the mould when it turns hard. It is then cut into suitable sizes and allowed to age for about three weeks before using it.

Efficacy test

Efficacy test were conducted according to Malaysia Standard (MS 1497: 2000): Methods of Biological Evaluation of the Efficacy of Repellent – Bioassay Method For Mosquito Repellent on Human Skin with slightly modification. A fresh batch of 25 sucrose-fed female adult mosquito of *Culex quinquefasciatus* aged 5-7 days (starved overnight) are introduced into a box. The volunteer is treated with test sample on one arm whilst the other arm is left untreated. Both hands are covered with thick rubber gloves up to wrists to confine the bites to only the expose area. Both hands are each then inserted through the circular opening into the screen cage containing mosquitoes and were exposed simultaneously for period up to 3 minutes and the number of mosquitoes landing and/or biting is recorded. The assessment period will be 1, 2, 4, 6 and 8 hours post application of the test sample. A minimum of three human baits is required for each test sample and experiment is triplicates. The effectiveness of a repellent *was* assessed by determining the percentage reduction of mosquito biting and/or landing on treated arm when compare with the untreated arm.

RESULT AND DISCUSSION

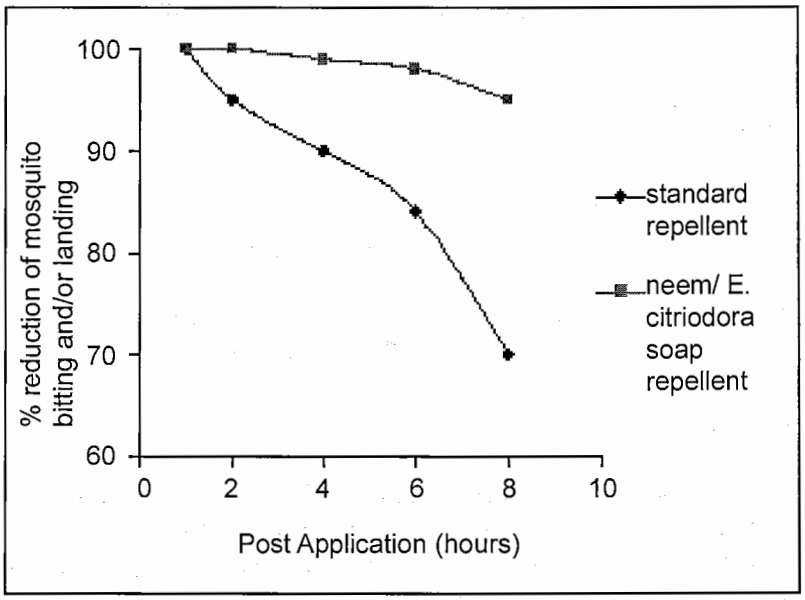

Figure 1: Percentage reduction of mosquito biting and/or landing.

This objective of the study was to determine the efficacy of neem/*E. citriodora* soap repellent over standard repellent (10% DEET w/v). Results indicate that efficacy of this soap repellent is equal in mean percentage reduction versus standard repellent formulation over an 8 hours period (Figure 1). Both products performed equally for the first hours, recording 100% repellency rate. After 2 hours, efficacy of neem/*E. citriodora* soap repellent still remains 100% repellency rate but standard repellent recorded only 95% repellency rate. However, after 4 hours, both products showed a significant difference in percentage of repellency rate, neem/*E. citriodora* soap repellent recorded 99% repellency rate where standard repellent showed only 95% repellency rate. After 6 hours, efficacy of neem/*E. citriodora* soap repellent also showed a significant difference over the standard repellent with 98% and 84% repellency rate respectively. Efficacy of both products showed a significant difference after 8 hours application where neem/*E. citriodora* soap repellent recorded 95% repellency rate and standard repellent recorded 70% repellency rate.

This repellency test tends to support the long residual efficacy of neem/*E. citriodora* soap repellent over DEET as an active ingredient. Although DEET offers strong short-term protection against insect bites, it is often not as effective in the long term as formulas containing less DEET. The reason for this is that DEET will not long adhere to human skin, and will evaporate, rub, or wash off in time. Formulas with lower concentrations often contain lotions or other agents which allow the formula to adhere to skin longer and provide longer-lasting protection. Any lessening of the strength of the protection as a result of the lower concentration may be countered by applying a greater quantity of the substance (Mark & Fradin, 1998).

CONCLUSION

The actual soap making is through long practiced soap manufacturing methods used in the soap making industry today. As far as the writers' are aware, this is the first time the two natural agents that enact efficacy through two different methods, have been combined into a single product, in Malaysia, thus providing synergy and longer term residual efficacy than present herbs and eucalyptus oil used in similar types of products on the marked. Secondly, due to the application media (soap) this product fits into everyday habits of consumers. As this product is natural, consumer market penetration in western countries is possible, subject to approval by relevant regulatory authorities. These developed markets have large consumer segments that prefer natural products and have high percentages of leisure time available that require the use of insect repellents (Department of Health and Human Services, 2005). This product will also have potential in developing markets like Indonesia, Thailand and Vietnam, where a cost effective product is required to combat mosquitoes that also have benefit as a personal soap for everyday use.

ACKNOWLEDGEMENT

The authors would like to thank Dr. Zairi Jaal (UPKV, USM) for supplying mosquito for efficacy test.

REFERENCES

1. National Research Council. (1992). Neem: *A Tree For Solving Global Problems.* National Academy Press, Washington, D.C.

2. Department of Health and Human Services: Centre For Disease Control and Prevention. (2005). What You Need to Know About Mosquito Repellent, from *http://www.cdc.gov/ncidod/dvbid/westnile/mosquitorepellent.html*

3. Malaysia Standards (MS 1497: 2000): *Methods of Biological Evaluation of the Efficacy of Repellent – Bioassay Method For Mosquito Repellent on Human Skin*

4. Smith, C. (2002). The Dangers of DEET. *Duke University Medical Center News.* (919)684-4148. From *www.dukemednews.org*

5. Mark, S. and Fradin, M.D. (1998). Mosquitoes and Mosquito Repellents: A Clinician's Guide. *Annals of Internal Medine*: 128(11):931-940.

6. Clements, A.N. (1963). *The Physiology of Mosquitoes*. Oxford Pergamon Press

7. Cultis, C.F. (1986). Fact and Fiction in Mosquito Attraction and Repulsion. *Parasitologi Today* 2:318-318

8. Chopra. R. N., Nayar. S. L. and Chopra. I. C. (1986). Glossary of Indian Medicinal Plants (Including the Supplement). *Council of Scientific and Industrial Research*, New Delhi.