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DEVELOPMENT OF MOSQUITO REPELLENT FABRIC USING BAMBOO SHOOT AND NEEM EXTRACT

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ABSTRACT

From centuries man has always concerned about his protection which then leads to number of developments in every field with regards to textile. Global warming is the cause of the distribution of mosquitoes which has expanded from tropical regions to northern latitudes and that leads to a spread in sources of viral infection from mosquitoes. Hence, personal protective measures must be taken to protect human from mosquito bites. The major tool in mosquito control operation was the application of synthetic insecticides. But this has not been very successful because it has harmful effect on human health i.e. unpleasant smell; oily feeling to some users and potential toxicity. Using natural plant products is a simple and sustainable method of mosquito control. Repellents of plant origin do not pose hazards of toxicity to human and domestic animals and are easily biodegradable. Enhancing the health and hygiene qualities of consumer product make it necessary to find a new ways of applications on textiles with medicinal plants. Bamboo shoot (slices) and Neem (leaf) methanol extract was used for mosquito repellent finish on woven cotton. Fabric was desised and mersarised (using NaOH). For mosquito repellent finishing both the extracts are used on the fabric through piece dye method. Treated samples were tested against mosquitoes for evaluating their efficacy and durability and compared using charts to get the most efficient mosquito repellent fabric

KEYWORDS: Neem, Bambooshoot, Methanol extract, Textile, Mosquito

INTRODUCTION

Mosquitoes are a serious threat to public health transmitting several dangerous diseases for over two million people in the tropics. There has been a large increase in the insecticide resistance of this vector and has become a global problem. Insecticides residues in the environment, as a result of chemical insecticide usage, have turned the researcher's attention towards natural products.[1]

Control of mosquitoes is something of utmost importance in the present day with rising number of mosquito borne illnesses. Mosquitoes need to be exterminated using the right tools and with a little bit of effort. These blood thirsty beasts don't care about boundaries and they can bite you if your neighbourhoods are allowing its breeding.[4]

Deforestation and industrialized farming are also two of the factors causing an alarming increase in the range mosquitoes.[2]

In the past years, the plant kingdom has been of great interest as a potential source of insecticidal products. Many species in the plant kingdom synthesize a variety of secondary metabolites which play a vital role in defence of plants against insects/mosquitoes. Plants may be alternative source for mosquito repellent agents since they constitute a rich source of bioactive chemicals.[3]

Plant products can be used, either as an insecticide for killing larvae or adult mosquitoes or as repellents for protection against mosquito bites, depending on the type of activity they possess.

1. OBJECTIVE

To produce a mosquito repellent fabric by treating it with Neem extract and Marigold extract separately and compare the repellence.

2. LITERATURE REVIEW

- **Definition of mosquito repellent**

A mosquito repellent is a substance applied to skin, clothing, or other surfaces which discourages insects (and arthropods in general) from landing or climbing on that surface. There is also mosquito repellent products available based on sound production, particularly ultrasound (inaudibly high frequency sounds) (Gulrajani et al., 2007).

- **Mosquito repellent chemicals**

Mosquito repellents primarily are categorized into two groups: repellent insecticides and contact insecticides (cause death of the insects). Mosquito repellents are also divided into two groups, namely chemical repellants and natural repellants. Peoples initially applied mosquito repellents on their skin directly as lotion and were effective only for few hours, besides most of them can be harmful, since they are coming in direct contact with body (Oshaghi et al., 2003).

- **DDT (Dichlorodiphenyltrichloroethane)**

First synthesized in 1874 by a chemist named Zeidler. It affects the nervous system by interfering with normal nerve impulses. Initially it was used by the military in World War II for public health purposes. People excessively exposed to DDT while working with the chemical or accidental exposure report a prickling sensation of the mouth, nausea, dizziness, confusion, headache etc. Therefore due to this developed countries do not use DDT (Pani, 2008).

- **DEET (N, N-diethyl-m-toluamide)**

DEET is commonly used insect repellent for several types of biting and sucking insects, including mosquitoes. It can be applied on human skin as a lotion or on clothes. Normally this pesticide does not kill the insects but repels from treated area. Because DEET is used directly on human skin, scientists have thoroughly studied its toxicity (Pani, 2008).

- **Mosquito repellent plants**

Medicinal plants have been used in almost all cultures and communities for thousands of years. Castor (Ricinus communis), Pyrethrum (chrysanthemum cinerariaefolium), Patchouli, Cymbopogon (lemon grass), Neem, Tulsi (basil), Pudina (mint), Long (clove), Lavender, Marigold are plants that can be used as mosquito repellent. Of this Neem, Pudina, Marigold and Tulsi are majorly available in all parts of India (Karolia and Mendapara, 2005).

In today's era of modernization of the textile industry, we are going through advancements of technology in every field of this industry. The world where this would lead us would be astonishingly Hitech and materialistic. To ensure our security and safety from the future hazards, we need to equally develop the technology for our protection (Kumaravel et al., 2009).

Value addition in clothing has changed the global textile scenario. A novel and holistic approach of the 21st century has been the use of microencapsulation in textile finishing. Creative designers of the 21st century want to diversify their vision from visual aesthetics to performance value like sense of smell, colour change technology, phase change materials and bactericides. Market for fragrant clothing has also been expanded and due to increase in awareness about health and hygiene people increasingly want their clothing to be hygienically fresh (Karolia and Mendapara, 2005).

A mosquito repellent textile is one such textile product came out recently. It protects the human beings from the bite of mosquitoes and thereby promising safety from the diseases like malarial fever. To impart this character, a finish of the mosquito repelling agent is given to the textile material. Thorough research and development has facilitated the applicability of certain chemicals of the textile products, which sustain this character for a reasonable period (Pani, 2008).

Mosquito – borne diseases such as malaria, dengue fever and yellow fever, have plagued civilization for thousands of years. There are various kinds of mosquitoes, each of which has a different habitat, behaviour and preferred source of blood. About ten of these species are so numerous and such vicious biters of man and animals, that an organized mosquito control is necessary because mosquitoes are not only a nuisance as biting insects, but are also involved periodically in transmitting disease to humans and animals (Gulrajani et al., 2007).

The repellent properties of plants to mosquitoes and other pest insects were well known before the advent of synthetic chemicals. However, the most commonly used insect repellents are synthetic chemicals that mostly have contained DEET (N, Ndiethyl-3-methylbenzamide) in their formulations. Although DEET is an effective repellent against a broad spectrum of insects, however there are disadvantages associated with the use of DEET, which stem principally from its activity as a solvent of paints, varnishes, and some plastic and synthetic fabrics. There have also been concerns over toxicity of DEET (Oshaghi et al., 2003).

A variety of botanical substances have been evaluated for their repellence against mosquitoes. Thousands of plants have been tested as potential sources of insect repellents. None of the plant-derived chemicals tested to date demonstrate the broad effectiveness and duration of DEET, but a few show repellent activities. Plants whose essential oils have been reported to have repellent activity include citronella, cedar, verbena, pennyroyal, geranium,

lavender, pine, cajuput, cinnamon, rosemary, basil, thyme, allspice, garlic, and peppermint. Unlike synthetic insect repellents, plant-derived repellents have been relatively poorly studied. When tested, most of these essential oils tend to give short-lasting protection, usually less than 2 hours (Fradin, 1998). Therefore, on the basis of these findings, the present study focuses on the investigation of mosquito repellence properties of Neem and Marigold plants.

Some of the herbal compounds obtained from plants are well known from time immemorial as antibacterial and antifungal products. These plants and tree products are applied directly on skin or wounds as paste either for skin care or wound healing (Sayed and Jawale, 2006).

The natural products are abundantly available in nature and are widely distributed. They are cheap and not processed and can be used as raw materials for required applications. Apart from dyeing these medicinal products possess distinct odour for identification. These plant products are non-irritant to skin and non-toxic. Many of these materials are skin care products. The stem, bark, leaf, root and tuber of the plants and trees can be used for special application. Lemon grass is a medicinal plant whose leaves are widely used for many applications (Premalatha and Nagarajan, 2007).

Natural herbal products are attractive alternative to synthetic agents for imparting antimicrobial properties to textiles since there is a tremendous source of medicinal plants with bioactive agents in India. Neem extract is one such type of product which is extracted from seed, bark or leaves of Neem tree (Azadarichta indica) belonging to Mahgony family and found abundantly in the Indian subcontinent. It has an excellent potential as antimicrobial agent (V. Krishnaveni, 2011).

Natural products are safe for human when compared to the synthetic compounds. Therefore, it is the hour to launch extensive search to explore eco-friendly biological materials for control of insect pests. According to studies, plants are considered to be the primary source of natural bio-acting agents because of their numerous active compounds including simple phenols, phenolic acids, quinones, flavonoids, flavones, flavonols, tannins, coumarins, terpenoids, essential oils, alkaloids, lactins and polypeptides (Murugesh and Ravindra, 2015).

Botanicals insecticides are candidates to replace the conventional insecticides mostly by the organic farmers. The neem tree (Azadirachta indica. Juss) (Meliaceae) has got great interest in this regard. Neem was considered safe to the humans and animals due to relative low

toxicity. Several reports have described the antifeedant, repellent and growthmodifying neem properties on the insects, which were essentially due to the terpenoid azadirachtin from the neem fruit (Boeke et al., 2004).

On the other hand the bamboo shoots have excellent anti-microbial and insect repellent qualities and can be extracted to make capsules, tablets etc. It is used as a medicine in the form of anti-oxidant, anti-free-radical, anti-aging and anti-cancer activity in Southeast Asia (Debangana Choudhury,Jatindra K Sahu, GD sharma, April 2012; Debangana Choudhury,Jatindra K Sahu, GD sharma, April 2012).

3. RESEARCH METHODOLOGY

I have used qualitative research process for the fulfilment of the research proposal while collecting and analysing the data with a different methods.

It is an exploratory research. As I have taken the reference from different journals and articles and also have collected the data on first hand.

4. PLAN OF WORK

1. Selection of research topic (developing a mosquito repellent fabric).
2. Review of literature and journals.
3. Identification of research gap and problem.
4. Finding solution for the problem i.e. objective.
5. Preparation of samples

5.1.Preparation of bamboo shoot extract.

5.2.Preparation of neem extracts.

5.3.Treatment of cotton with bamboo shoot extracts.

5.4.Treatment of cotton fabric with neem extracts.

6. Repellence test of fabrics

6.1.Cage preparation

6.2.Mosquito collection.

6.3.Observation.

7. Comparative analysis of all samples (bamboo shoot treated, neem treated and non-treated samples).

7.1.Statistical analysis.

8. Conclusion.

5. Experimentation

5.1.Materials

The raw material has been selected based on the traditional knowledge and experience. Traditionally used repellent agents have been blended with some new ingredients. The most important traditional and popular ways of repelling mosquitoes was by using Neem leaves. Use of bamboo shoot extraction on the other hand is an old traditional practice of repelling mosquitoes in North Eastern states of India, especially in Arunachal Pradesh.

Fig. 1: Neem leaf and extract

Fig. 2: Bamboo shoot

In this addition to above mentioned traditional and Natural herbal insecticides following medicinal herbs have been selected as raw material for preparing novel herbal mosquito repellent fabrics. Methanol and sodium hydroxide is taken from the college laboratory, NIFT Bhubaneswar.

5.2. Methods

5.2.1. Preparation of Bamboo shoot extract

Take bamboo shoot ➔ wash properly ➔ slice it properly

➔ Add water ➔ keep it for 24 hours ➔ filter the paste with filter paper

Bamboo shoot is collected from the local market of Guwahati, Assam. Wash it properly using warm water. Slice it properly in smallest pieces possible. Take 20-30 gm of sliced bamboo shoot and add 50-70 ml of water to it. Keep the extract covered with a lead or plastic for 24-28 hours. Filter the extract using filter paper.

5.2.2. Preparation of neem extract

Take neem leaf ➔ wash properly ➔ make proper paste ➔ Add methanol ➔ keep it for 24 hours ➔ filter the paste with filter paper

Neem leaf is collected from the Neem tree available in the college campus of NIFT, Bhubaneswar. Wash the leaves properly using warm water. Grind the leaves using grinder and make a proper paste.take 20-30 gm of pasted Neem leaf and add 5-8 ml of methanol to it. Keep the extract covered in an air tight container for 24-28 hours. Filter the extract using filter paper.

5.2.3. Treatment of cotton with extracts

Take white cotton fabric ➔ wash it using soap ➔ dry it ➔ add NaOH ➔ Dry it ➔ Treat with bamboo shoot extract or neem extract ➔ Keep it for 12-18 hours ➔ Wash it ➔ dry

Fig. 3: treatment of cotton with Neem extracts.

Fig. 4: treatment of cotton with Bambooshoot extracts

100 percent woven cotton, white in colour commonly used by consumers for apparels or sometimes home furnishing products is selected for the sampling. The fabric is desized and washed properly using synthetic soap solution for better penetration of the extracts and dry. It is then cut into three equal squares of 8''X8''. The first piece of fabric is kept untreated. The second and the third fabrics are treated with 20-24% o.w.f of NaOH for 15 minutes and dry it. Now the second fabric is treated with 25-30% of Neem extracts and the third fabric is treated with 25-30% of Bamboo shoot extracts and keeps it for 12-18 hours. Steering should be done in proper interval of 15-30 minutes. Wash the fabrics properly using cold water and dry.

5.2.4. Mosquito repellence test

Cage preparation ➔ mosquito collection ➔ inspection ➔ Analysis and comparision

- **Cage preparation**

Make a cuboidal wooden frame of 10''X7''X7''. Attach a white netted fabric on the five sides of the frame using glue. One side of the frame is kept open. The cage is prepared for mosquito repellence testing.

Fig. 5: Mosquito cage for testing.

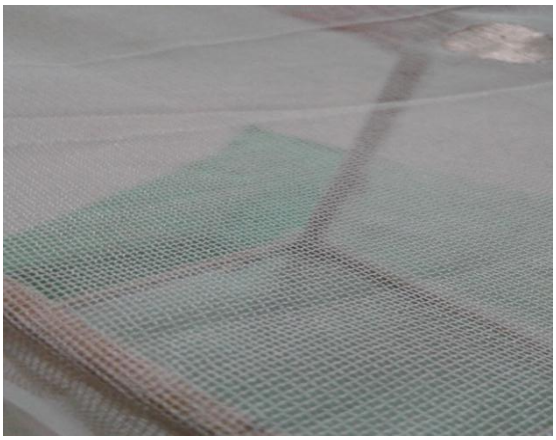

Fig. 6: Netted fabric attached to the cage.

Mosquito collection

Mosquitoes are collected from the drainage area of the college campus NIFT, Bhubaneswar using net. 10-20 mosquitoes are collected and kept in bottle covered with a netted fabric allowing air to pass through.

Fig. 7: Collected mosquitoes in a container

Fig. 8: Zoom view of collected mosquitoes

Inspection

All three samples are being tested for mosquito repellence test one by one. At first the non-treated sample is covered with the cuboidal cage facing the opening downwards. 10 mosquitoes are released in the cage very carefully so that it could not fly away. Now observe the sample for the time interval of: first 5 minutes, 6-25 minutes and 26-30 minutes. Analyse the movement and living status of the mosquitoes in the mentioned time intervals and note it. After the completion of 30 minutes the cage is carefully shifted to the Neem leaf treated sample without allowing the mosquitoes to fly away. Same process of inspection is performed again. The movement is noted down. After the completion of inspection the cage is shifted to bamboo shoot treated fabric. This time another set of 10 mosquitoes are released in the cage. The process is carried out and movement of mosquitoes are been noted.

Fig. 9: Mosquitoes repelling from Neem extracted sample.

Fig. 10: Dead mosquitoes after testing the bamboo shoot extracted sample.

Analysis and comparison

The movements are analysed to find out wheatear the treated fabrics are capable of repelling mosquitoes. The readings are compared by preparing charts to find out which is the most efficient mosquito repellent fabric.

6. RESULT AND DISCUSSION

All the three samples are been tested for 30 minutes between certain time intervals to check how long its strength of mosquito repellence lasts. The samples are first tested within 5 minutes in its wet condition, when its strength is maximum. Then it is tested after 8 hours, 24 hours, 3 days, 5 days, 1 week, 10 days and 2 weeks respectively in dry condition. When a single mosquito starts sitting on the fabric for more than 10 seconds the sample is no longer considered as mosquito repellent, i.e. the sample has lost its strength of repelling mosquitoes. Hence we stop continuing the observation. The test observations are analysed below:

6.1. Non-treated sample

	Observations of movements of mosquitoes in the cage		
Time interval of testing	till 5 min	5-25 min	26-30 min
Within 5 min (wet sample)	flying	----	----
dry sample	flying	3 sitting in the sample for 7,15,17 sec. respectively	1 sitting in the sample for 12 sec.

6.2.Bamboo shoot treated sample

	Observations of movements of mosquitoes in the cage		
Time interval of testing	till 5 min	5-25 min	26-30 min
Within 5 min (wet sample)	7 died	-----	-----
After 8 hour (dry sample)	Flying	2 died, rest settled in the wall of cage	1 died, rest settled in the wall of cage
After 24 hrs. (dry sample)	Flying	settled in the wall of cage, no flying	settled in the wall of cage, no flying
After 3 days (dry sample)	Flying	settled in the wall of cage, no flying	settled in the wall of cage, no flying
After 5 days (dry sample)	Flying	Flying, 3 settled in the wall of cage	Flying, 4 settled in the wall of cage
After 1 week (dry sample)	Flying	Flying, 2 sit on the sample for 11, 16 sec. respectively	Flying, 1 sits on the sample for 7 sec.

6.3. Neem treated sample

	Observations of movements of mosquitoes in the cage		
Time interval of testing	till 5 min	5-25 min	26-30 min
Within 5 min (wet sample)	3 died	-----	-----
After 8 hour (dry sample)	Flying	2 died, rest settled in the wall of cage	settled in the wall of cage
After 24 hrs. (dry sample)	Flying	2 died, rest settled in the wall of cage	settled in the wall of cage
After 3 days (dry sample)	Flying	settled in the wall of cage	settled in the wall of cage
After 5 days (dry sample)	Flying	settled in the wall of cage, 1 flying	settled in the wall of cage
After 1 week (dry sample)	Flying	settled in the wall of cage, 4 flying	settled in the wall of cage, 3 flying
After 10 days (dry sample)	Flying	Flying, 3 settled in the wall of cage	Flying, 3 settled in the wall of cage
After 2 weeks (dry sample)	Flying	Flying, 3 sit on the sample for 5, 12, 14 sec respectively	Flying, 1 sits on the sample for 16 sec

From the above chart it is analysed that the non-treated sample has no mosquito repellent strength in it, hence it allowed 3 mosquitoes to sit on it.

Secondly, the mosquito repellence strength of bamboo shoot treated sample is excellent in wet condition, whereas the strength does not last long. The dry sample has good mosquito repellence till 3 days after treatment but it starts losing its strength after that and become non-repellent after 1 week.

On the other hand the neem treated sample shows very good mosquito repellence in the first day of treatment both in wet and dry condition. It exhibits good repellence till 5 days after treatment average after 1 week. The strength become poor after 10 days and the sample become non-repellent to mosquitoes after 2 weeks.

7. CONCLUSION

The present study 'Development of mosquito repellent fabric using bamboo shoot and neem' was carried out to see the efficiency and durability of the finish and with its application on cotton. Desizing, merserisation (using NaOH) were done to prepare the fabric for mosquito repellent finish. Bamboo shoot (slices) and Neem (leaf) were selected on basis of mosquito repellency properties. Extraction was done using methanol to get the proper extract of the materials. The fabric was treated with both the extracts separately. The bamboo shoot treated sample has excellent mosquito repellence in wet condition but the strength does not last for more than a week, whereas the neem treated sample exhibits good mosquito repellence in both wet and dry condition and the strength lasts till 2 weeks (without wash). Hence it can be concluded that the Neem treated sample is better mosquito repellent fabric and it can be used for various textile products.

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