

Recycling of Wastepaper to Eco-Friendly Mosquito Repellent Sticks by Using Neem and Papaya Leaves

Asavari Bhosalea, Manish S. Warudea, Aishwarya S. Patila and Tushar A. Shindec*

A R. C. Patel Institute of Pharmaceutical Education & Research, Shirpur
C*SVKMS, NMIMS, MPSTME, Centre For Textile Functions, Shirpur Campus

Abstract-Waste is the term used to describe undesired resources created from domestic, commercial, industrial, and institutional activities. It can be classified based on its origin and composition, such as organic matter, paper, glass, metals, and plastics. In there are so many educational institutions, workplaces, and packing industries generate large amounts of paper waste, contributing significantly to municipal solid waste. Paper pulp can be produced from wood, plant materials, and recycled paper. Neem (*Azadirachta indica*) and papaya (*Carica papaya*) are valuable plants having excessive medicinal and insecticidal properties. In Papaya leaf extract contains cyanogenic glycosides, papain, and alkaloids which is effective against insect or pests. Camphor, a natural tree-derived compound, is widely used in mosquito repellents due to its strong odour and has long-lasting repellent action.

Keywords: Repellent, Neem, Papaya, Extract, mosquito.

I. INTRODUCTION

In recent years, a lot of companies have implemented sustainability principles that apply to their operations due to laws, regulations, and concerns about environmental impacts. The National Solid Waste Policy (NSWP) is defined by the law and its successor Decree 7404. This has led to an increase in scholarly research in the literature [1,2]. Economic, environmental, and social growth are all taken into consideration by the Triple Bottom Line (TBL), a three-pillared notion of sustainability. It includes things like better resource management, better waste reduction, reduced emissions, less environmental impact, enhanced social investments, and better resource utilization [3,4]. Together, paper and cardboard make up a sizable portion of waste roughly 10% of all municipal solid waste.

Importance and benefits of recycling and utilize paper waste:

Paper can be used to create new products and recycled. Most of the clean paper is designed to be reused. Paper recycling is the process of turning wasted paper into new products, such as packaging, paper bags, cardboard boxes, toilet paper, and greeting cards. The main elements, cellulose fibers, are combined with different chemicals to give it its properties. The cellulose is bleached by adding more chemicals to it. Cellulose, one of the most important organic materials, is a naturally occurring biopolymer that may be created and biosynthesized from a range of sources, such as wood, bacteria, fungi, and plants [5]. Concern over polymer-based products is growing, which will not only limit their potential in the future but also lead to a significant increase in demand for paper and paperboard.

This is primarily because these products are inaccessible. In addition to saving a great deal of extra money, newsprint paper is an essential application for recycled paper in writing, printing, and product assembly. With reused paper, almost 35% of the raw

materials required to create paper in a nation like India are satisfied [6]. As is already common knowledge, paper its waste is recyclable up to seven times. Recycling discarded paper that is still usable is so crucial [7]. Paper is made from the cellulose pulp Fibers that are obtained from pulping wood. It was created in China at first, then in Europe, and now all over the world. Wood remains the most prevalent source of fibers used in the paper industry, but the processes and chemicals used to produce it have changed over time [8]. Even after digitization, offices, periodicals, and newspapers still use paper-based products. Additionally, it represents 31% of the global packaging market [9].

The pulp and paper industry (PPI) makes a substantial contribution to the global economy despite its poor utilization margins, which are caused by well-known challenges with pricing and satisfying consumer needs. Furthermore, this industry is constantly under pressure to reduce emissions that pollute the air and water [10]. Paper recycling is becoming a more viable option for the paper industry's sustainable growth from an environmental standpoint. Apart from stratifying the requirement for resistance, durability, and flexibility against both internal and external stressor, these materials should also be environmentally friendly and produce the least amount of pollution when being built and used [11].

Ingredients:

Sr.no	Name	Quantity
1	Waste paper	50 gm
2	Camphor	3 gm
3	Neem extract	25 gm
4	Papaya extract	25 gm
5	Leamon grass oil	3 Drops
6	Clove oil	3 Drops
7	Orange oil	3 Drops

Importance of mosquito repellents by using neem leaf and Papaya leaf

Azadirachta indica, the scientific name for neem, is a tree that is indigenous to the Indian subcontinent. It is well-known for its many health advantages and has been utilized in traditional medicine for generations. Neem has strong insect-repelling qualities because of its constituents, which include salannin, nimbin, and azadirachtin. Traditional medical systems have long utilized herbal remedies known for their insect-repellent properties, which are attributed to phytochemicals such as flavonoids, terpenoids, alkaloids, essential oils, glycosides, tannins, and saponins. Papaya (*Carica papaya*) is one such plant, with studies demonstrating that its leaves, bark, roots, and seeds possess effective larvicidal and mosquito-repellent properties, while papaya leaf juice is also known to increase platelet counts in dengue patients.

Characteristics of camphor

A white, waxy material with a powerful, distinctive scent, camphor is often likened to mothballs. It's a terpenoid, specifically a bicyclic monoterpene ketone, with the chemical formula C₁₀H₁₆O. its highly flammable and can sublime at room temperature. Camphor is used in industry, medicine, and aromatherapy. camphor repels mosquitoes due to its strong, pungent Odor that disrupts their sense of smell, overwhelming their ability to find hosts and causing them to stay away. it acts as a natural insecticide, with its borneol compound being particularly effective at creating an unwelcoming environment for mosquitoes. Its importance lies in providing an affordable, natural alternative to chemical repellents, though it's crucial to use pure camphor and ensure proper ventilation when burning it.

II. MATERIALS AND METHODS

The materials to make the model are Azadirachta indica which is extracted from neem leaves, and wastepaper camphor. The materials used are described below.

Neem leaf

Azadirachta indica, the scientific name for neem, is a tree that is indigenous to the Indian subcontinent. It is well-known for its many health advantages and has been utilized in traditional medicine for generations. Neem has strong insect-repelling qualities because of its constituents, which include salannin, nimbin, and azadirachtin.

Camphor

The strong, pungent fragrance of camphor deters mosquitoes by overloading their sense of smell, making it difficult for them to locate hosts and making them avoid the area. It acts as a natural insecticide, with its borneol compound being particularly effective at creating an unwelcoming environment for mosquitoes. Its importance lies in providing an affordable, natural alternative to chemical repellents, though it's crucial to use pure camphor and ensure proper ventilation when burning it.

Paper waste

Paper is recyclable and can be used to create new products. Paper recycling is the process of turning wasted paper into new products, like greeting cards, packaging, paper bags, cardboard boxes, and toilet paper. Most of the clean paper is designed to be recycled. To give it its qualities and features, cellulose fibers the raw material, are combined with a variety of compounds. To bleach the cellulose, further chemicals are used. Cellulose is a renewable natural biopolymer that may be created and biosynthesized from a range of sources, including wood, bacteria, fungi, and plants. It is one of the most important organic molecules.



Figure 1 Camphor and Wastepaper



Figure 2 Papaya & Neem extract

Equipment: The instruments that were used to create the sample are detailed below :

- Electronic balance: A type of measuring gadget that offers incredibly exact mass or weight measurement is an electronic balance, often known as a digital balance or an electronic weighing scale.
- Grinder: A grinder is a piece of equipment that can be used for a variety of purposes, depending on the



circumstances. For the sample modeling, we shredded papaya leaves, neem, and paper Waste.

C. Beaker: A common piece of glassware used in many scientific experiments is the beaker. Here, we use it to retain and measure samples.

d. PVC mould: Polyvinyl chloride is a popular and versatile type of plastic tubing. a synthetic plastic polymer. PVC is renowned for its chemical resistance, flexibility, durability, low weight, and smooth internal surfaces, among other qualities.

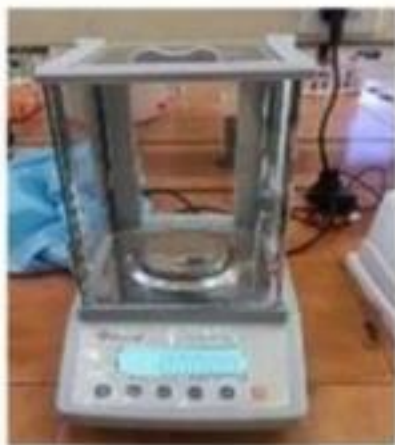


Figure 3 Grinder & Electronic balance

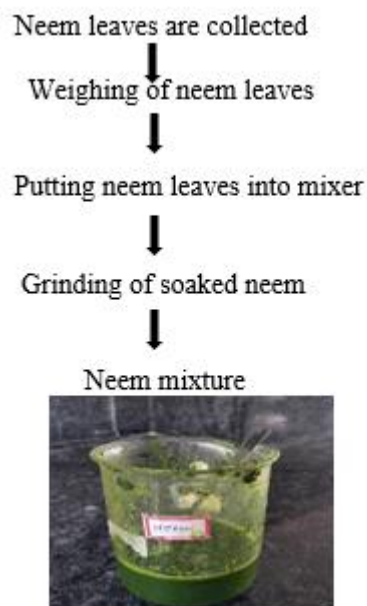
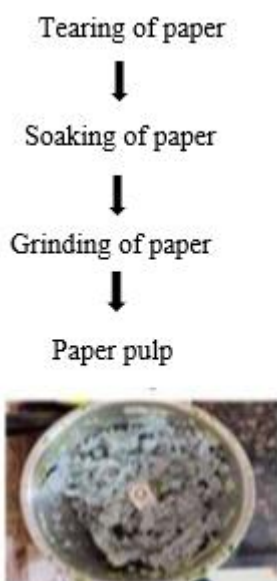


Figure 4 Papaya extract & PVC Mold

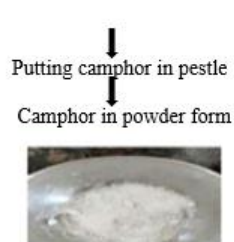
Methodology

Method for preparing paper pulp

- An ample amount of wastepaper, such as newspaper or examination paper, is collected and torn into small pieces.
- G of these pieces are weighed using an electronic balance and soaked in normal water for 3-5 min
- The soaked paper is ground in a mixer to form a slurry with additional water if the slurry is too much thick.
- This paper slurry is now ready to be mixed to materials



Method of preparing powder:



Weighing of camphor

Method for preparing neem mixture

- An ample amount of neem leaves is collected from the tree, and 50 gm are weighed on an electronic balance.
- These leaves are soaked in normal water for 3-5 min, then ground in mixer to form a slurry.
- Which is then ready for mixing.

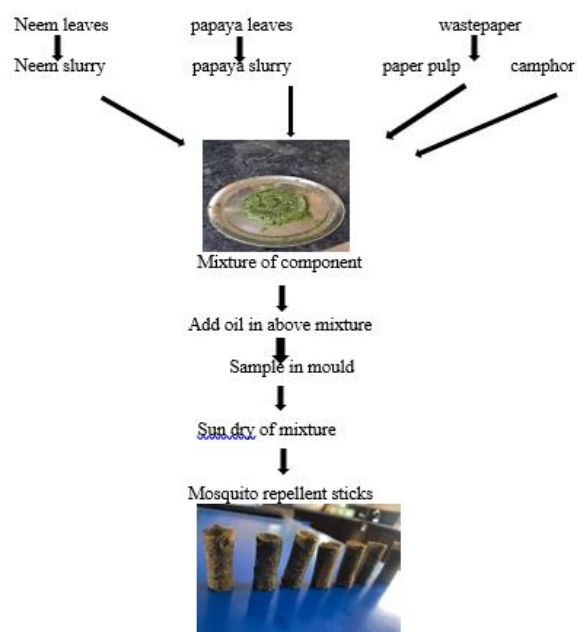
Method for preparing papaya mixture

- An ample amount of papaya leaves is collected from the tree, and 50 gm are weighed on an electronic balance.
- These leaves are soaked in normal water for 3-5 min, then ground in mixer to form a slurry.
- Which is then ready for mixing.



Process of preparing samples containing paper pulp, neem mixture, papaya mixture and camphor

- The powdered camphor is added to the paper pulp and shredded neem; papaya leaves in 2:1:1 ratio.
- This paste is then filled into PVC mould and compacted using a stick to ensure proper compaction and bonding.
- The PVC mould is secured with tape and placed in direct sunlight for 24 hr to dry.
- After drying, the sample is ready for use.



Determination of moisture content

Moisture content is defined as weight of water present in a material, determined by subtracting the dry weight from the weight and then expressed as a proportion of the total weight of the material.

$$MC \% = \frac{\text{Wet weight} - \text{Dry weight}}{\text{Wet weight}} \times 100$$

It is important because during burning a sample exhibit high moisture content, energy is needed to evaporate the water and elevate the temperature of the vapor produced and burning does not take place proper.

III. RESULTS AND DISCUSSION

Neem is the ideal plant since it grows quickly, and its seeds and leaves have repellent properties. Neem is a highly effective biopesticide for managing pests due to its non-toxic nature and environmental safety. The most powerful component of neem, azadirachtin, has been found to have specific negative effects on the growth and development of numerous insects, including growth inhibition, oviposition deterrence, and repelling qualities. It is being used extensively in many countries, either by itself or in combination with synthetic pesticides for integrated pest management. It also plays a significant role in mosquito repellent composition.

Mosquito repellent sticks made from natural leaves are intended to protect you and your home free of mosquitoes and diseases. It is safe for your children and canines and can be used in hospitals, rooms, and other locations because it doesn't cause eye irritation or respiratory problems. Mosquito repellent sticks are useful and easy to use. Each stick can cover up to 100 square feet and burn for up to 30 minutes with minimal smoke. Create a perimeter with numerous repellent sticks to keep mosquitoes away from a large area. In enclosed outdoor areas, insect repellent sticks may help keep mosquitoes away. These sticks also reduce smoking, neutralize offensive Odour, and revitalize the air.

Total time requirement for mosquito repellent stick:



Figure 5 Stopwatch

IV. CONCLUSION

The pre-made incense stick was inexpensive, safe, and environmentally friendly. It is suitable for use by people of all ages and is easily transportable. The stick containing camphor had no negative side effects and was effective at keeping mosquitoes away. However, mosquito zappers are safe to use indoors or out and don't produce any harmful smoke or other emissions. There are certain drawbacks to employing mosquitoes. zappers, it is always labour-intensive to use the zapper by hand to eliminate the hovering bug. Another disadvantage of mosquito racquets is that they need a temporary power source to function. These should be kept out of babies' reach because of the possibility of electric shock. Additionally, using too much DEET has been linked to epileptic episodes, headaches, stiff joints, blisters, skin irritation, and memory loss. Furthermore, DEET is believed to be neurotoxic and to cause behavioural and physiological problems, including memory and learning problems as well as reduced motor skills.

However, the natural materials used to make mosquito repellent sticks include wastepaper, papaya and neem leaves, and camphor. These materials are safe for people, animals, etc. The specifically made neem-based insect repellent sticks are better than the store-bought ones, and they perform rather well with no harmful side effects. The sticks were affordable, ecologically friendly,

and safe to use. It is portable and appropriate for use by people of all ages.

REFERENCES

1. C.M. Defalque, F.Marins, A.F. SILVA E. rodriguez, a review of wastepaper recycling network on quantitative network focusing on quantitative method and sustainability, springer Japan KK part of springer nature 2020
2. Elkington J. Cannibals with fork: the triple bottom line of 21st century business. capstone, oxford, UK 1997
3. L,Zihare, D Blumberga, Market opportunities for cellulose product from combined renewable resources, environmental and climate technologies 9(1),33-34
4. H Abushammala, M. A Masood, S. T. Ghulam, J. Mao, on the conversion of paper waste and rejects into high value materials and energy, sustainability 2023,15,6915
5. G.K. Deshwal, N.R. Panjagari, T. Alam, An overview of paper and paper-based food packaging materials: health safety and environmental concerns, J. Food Sci. Technol 2019.56,4391-4403
6. Z.U. Ozola, R. vesere, S. N. Kalnins, D. Blumberga, paper waste recycling, circular economy aspects, Rigas Teh. univ. zinat. Raksti, 23,260-273
7. B. Bahrami, P. Jafari, paper recycling, direction to sustainable landscape, Islamic Azad university 2019
8. S. Chatterjee, S. Bag, D. Biswal, D.S. Paria, Bandyopadhyay, B. Sarkar, A. Mandal, T. K. Dangar, neem-based product as potential ecofriendly mosquito control agents over conventional eco toxic chemical pesticides a review, received 1 Dec. 2022.
9. C. Balamurugan, M. Kadarkarai, M.P ARI, K. Kalimuthu, K.P. Mahesh, P. Chellasamy, D. Devakumar, S. Jayapal, R. Rajapandian, N. Marcello, C. Angelo, B. Giovanni, neem by product in the fight against mosquito borne disease: biotoxicity of neem cake fractions towards the rural malaria vector anopheles Culicifacies, Asian pacific journal of tropical biomedicine 6(6),472-476.
10. H.C. Srivastava, S. K. Sharma, chloroquine resistance plasmodium falciparum in migrant population, Indian J. Malariol 2000;37,39-42, (2023).