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Formulation and Evaluation of Herbal Mosquito Repellent Incense Stick

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Abstract: ***Currently, there are a number of environmental and health concerns with the use of chemicals made specifically to repel mosquitoes. The goal of this study was to create a safer, chemically free, much less expensive, and easily manufactured mosquito repellent. Living things called vectors can spread contagious diseases from animals to humans or between humans. The most well-known disease vector is the mosquito. The goal of this study was to ascertain the effectiveness of Azadirachta indica, a plant from the Maliaceae family that is used to make a safe and reliable herbal mosquito repellent stick, as a natural insect repellent. In today's world, there is a growing need for natural mosquito repellents that are affordable, dependable, non-toxic, environmentally safe, and biodegradable.***
Keywords: Mosquito repellent, Incense stick, Essential Oil.

I. INTRODUCTION

Each year, more than 7 lakh people die as a result of vectorborne diseases, which make up more than 17% of all infectious diseases.[1]The most common disease carrier is the mosquito.These mosquitoes are responsible for spreading a wide range of illnesses, including Chikungunya, Dengue fever, Malaria, Lymphatic filariasis, Rift valley fever, Yellow fever, and Zika.In 2017, India reported 1, 57,220 cases ofdengue and 250 deaths from mosquitoborne illness.The data revealed that there were 62,268 instances of chikungunya in the nation, with Karnataka reporting the highest number of cases at 31,644 cases.[2]The culicidae family of mosquitoes contains more than 300 different species.Malaria, dengue fever, and yellow fever are only a few of the illnesses spread by mosquitoes [3,4] The majority of the world's population still uses synthetic chemical larvicides to keep mosquitoes under control, but many of these chemicals are poisonous to people, animals, and plants, and resistance to them can make control difficult.In order to inhibit mosquito larvae or act as repellants for the same, researchers are now utilising natural compounds.The main pesticides used against mosquitoes in the Americas are pyrethroids and organophosphates, according to a recent WHO pesticide study.DEET (N, N diethyl-m-toluamide), a commonly used chemical-
based insect repellent for mosquitoes, is a licenced pesticide but may cause skin and eye irritation, sleeplessness, and other adverse effects.Other synthetic pyrethroids used to kill adult mosquitoes in mosquito control programmes include permethrin, resmethrin, and sumithrin.There are numerous plant extracts that are known to repel insects.
Essential oils among plant products are gaining attention as a potential source for mosquito control.
as a result of their insecticidal or repellent qualities.[5]It falls under the genera For the majority of disease pathogens like malaria, dengue fever, myiasis, yellow fever, encephalitis, etc., Anopheles, Aedes, and Culex are recognised to be vectors. Malaria is caused by a protozoan parasite that is carried by the female Anopheles mosquito. Plasmodium falciparum, Plasmodium vivax, Plasmodium ovale, and Plasmodium malariae are the four different kinds of protozoa that cause malaria. According to a WHO report from 2012, it was the main cause of early mortality and contributed to more than 500,000 fatalities. The American Association of Mosquito Control reports that as of 2018, the death toll had risen to 100,000.
Chills and a high temperature are the symptoms[6,7,8]. Mosquito-borne illnesses are a significant threat to human health, and their management is become more challenging as a result of mosquitoes' high rate of reproduction and emergence of chemical resistance. synthetic insecticides and repellents been widely used to reduce mosquito populations by either killing adult mosquitoes, keeping them from biting people, or eliminating mosquito eggs at vector breeding grounds. However, its negative effects on non-target populations and the emergence of resistance spurred researchers to look for other, straightforward, and long-lasting mosquito control strategies[9].

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Figure. mosquito

The term "mosquito" means "little fly." The mosquito's body is segmented, with three pairs of long, hair-like legs, one set of wings, and lengthy mouth parts. For the mosquito to produce eggs, proteins and iron were also necessary [10,11]. The mosquito's salvia is what causes the itchy sensation after a bite. Numerous diseases, including dengue, malaria, yellow fever, and others, are spread by mosquitoes to humans [12].
Kingdom: Animalia
Phylum: Arthropoda
Class: Insecta
Order: Diptera
Family: Culicidae [13].
The use of mosquito repellents will stop mosquitoes from biting . The market's abundance of synthetic insect repellents is leading to increasing negative side effects, such as breathing issues, discomfort, and coughing [14,15]. In order to lessen the negative effects of the marketed product, herbal ingredients are utilised in the production of mosquito repellents. The herbs camphor, benzoin, lemon balm, garlic powder, lavender, holy basil, and cinnamon oil have a mosquito-repelling effect.Neem is a plant with numerous medicinal bpeopleenefits, including antifungal, antibacterial, antiviral, and anti-diabetic properties.Neem offers defence against mosquito bites as well [15,16,17].

II. MOSQUITO REPELLENT

"Bug spray" is another name for mosquito repellent. To prevent mosquito bites on the skin, repellents are applied to the skin's surface [18]. Using a fan with more airflow and wearing light-colored clothing will help you stay away from mosquitoes. Van mounted foggers and hand foggers are employed to control adult mosquitoes [19,20].Since ancient times, numerous plant oils, smokes, tars, and other chemicals have been utilised as insect repellents to chase away or kill insects. Before World War II, there were only four effective repellents available: citronella oil, which was occasionally used as a hair treatment for head lice, dimethyl phthalate, which was discovered in 1929, Indalone, which was patented in 1937, and neem oil, which was discovered in 1931 and 1939 saw the launch of Rutgers 612 [21].

A. Types of Mosquito Repellent

Different categories are used to categorise mosquito repellents. They fall into the chemical or herbal repellent categories, depending on where they come from. They can also be divided into groups based on their behaviour. Repellent insecticides are pesticides that deter insects and other pests rather than killing or poisoning them. Insecticides are substances that include neurotoxins that cause disruption during contact.When in contact with mosquito and insect neural systems, they become unconscious [22].

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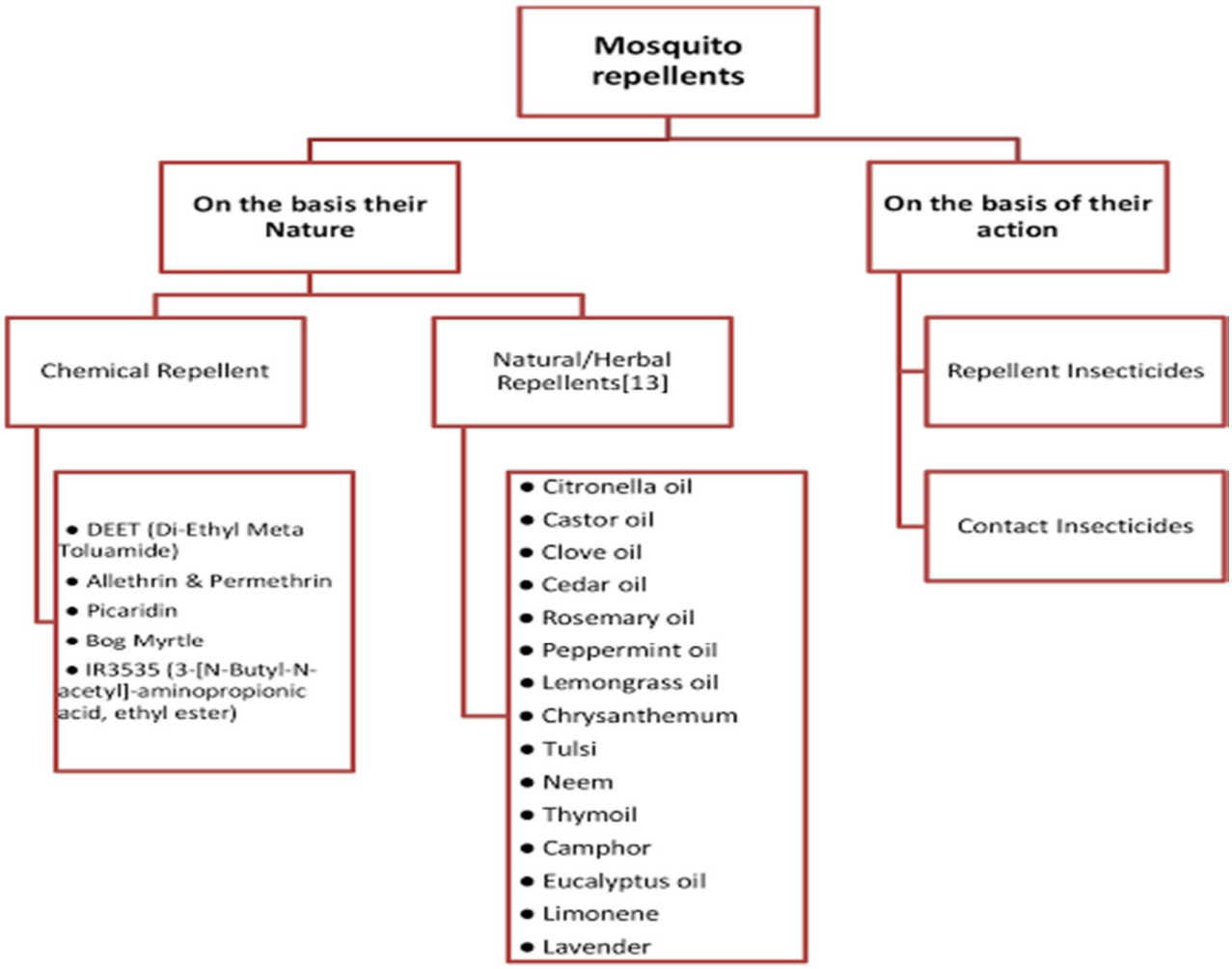


Figure: types of mosquito repellant

B. Plant Based Repellent

In comparison to synthetic chemicals, natural products have shown to be a rich source of molecules for the creation of therapeutic agents due to their higher structural variety. The discovery of innovative pharmaceuticals will continue to rely heavily on natural products, which have historically been major sources of bioactive chemicals [23].Since ancient times, people have employed plant-based repellents on themselves to protect themselves against various Anopheles species. Traditional plant knowledge that can be used to create new natural repellents as an alternative to chemical repellents is very useful.In various studies conducted around the world, it has been discovered that plant extracts or essential oils can deter malaria vectors. This thorough analysis sought to determine whether plant-based insect repellents were effective against Anopheles mosquitoes. Environmentally safe repellents against Anopheles species could be made using the essential oils and extracts of some plants. Plant oils, which are generally safe, inexpensive, and accessible in many parts of the world, may one day be used as effective substitutes for manufactured repellents [24].

III. CLASSIFICATION OF MOSQUITO REPELLENT:

A. Physical Method of Mosquito Repellent

The physical techniques used to repel mosquitoes serve as a barrier that prevents mosquito bites. Emptying the stagnant water into old tyres, buckets, plastic covers, rain gutters, and other containers is an activity connected to physical mosquito repellent strategies. It is quite appealing. should regularly, at least once per week, replace the water in bird baths, fountains, pools, rain barrels, etc. to prevent mosquitoes from finding the ideal location to deposit their eggs. Additionally, it is advised that you dress in long sleeves, particularly at dawn and night. To further stop mosquitoes from getting into the house, one must fix the screens on the windows and doors. This group comprises coils, mosquito nets, and other commercially available repellents [25].

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B. Mechanical methods of Mosquito repellent:

It was well known that yellow light attracted fewer mosquitoes than white light, and that this characteristic could be leveraged to create a mechanical insect repellent. The Electric Mosquito Zapper, Mosquito Magnets, and other techniques fall under the mechanical category of mosquito repellents. an Electrical The Mosquito Zapper traps mosquitoes with ultraviolet light and then kills them when they come into touch with a fatal electric charge [26]..

C. Chemical method of Mosquito repellent:

Chemical repellents assist prevent and contain insect-borne illness epidemics including measles, Lyme disease, dengue fever, bubonic plague, West Nile fever, etc. by providing the most effective personal insect-seeking protection [27].

D. Natural method of Mosquito repellent:

Natural Mosquito RepellentsNatural substances that have been shown to have insecticidal or repellent properties have been crucial i n halting the spread of vector-
borne diseases to both humans and communities.Since the beginning of human culture, humans and mosquitoes have coexisted in cl ose proximity, and we have exploited natural resources to protect ourselves against mosquito bites and diseases spread by vectors.T hese natural insect repellents have been created and promoted since antiquity and have contributed to the development of personal s afety techniques [28].

***E.** Synthetic method of Mosquito repellent:*

Synthetic repellents for mosquitoesDespite being used as mosquito repellents for a long time,substances derived from plants still ha ve some drawbacks.Plant
based insect repellents have a lower environmental impact than synthetic repellents becausebeen put to fairly bad test.In contrast, it s eems that the effectiveness of these natural repellents wears off quickly and for a shorter period of time.
These substances offer only transient protection and require frequent reapplication.
Hefty odour, skin irritation, and potential health hazards are a few downsides. Additionally, they inweren't frequently examined for t oxicity.The price of these repellents is frequently prohibitive, which is most important [29].

IV. INCENSE

When burned, incense is an aromatic biological material that emits fragrant smoke. The phrase can refer to either the substance or the scent [30]. Incense is used for ceremonial, therapeutic, meditation, and aesthetic purposes. Insect repellent or as a basic deodorant are other uses for it.[31,32,33,34]..Aromatic plant components, frequently coupled with essential oils, make up incense [35]. Incense takes on several forms depending on the underlying culture, and these forms have evolved due to technological advancements and an increase in usage [36].



Figure. Incense

The market for incense and incense sticks has expanded globally in recent years. USA, Brazil, China, and India are the top exporters and consumers of incense and incense sticks, respectively [37]The smudge is typically composed of aromatic ingredients. a flammable binding in combination content [38]. Various materials are available. which have been in use since the dawn of time, either together or separately for incense. fragrant woods are one form of material. Essential oils, plants, and resins [39].

A. Classification of incense sticks on the basis of burning:

The burning incense might be divided into two general categories based on its size and shape. Incense is burned in two different ways: directly and indirectly[.40-42]

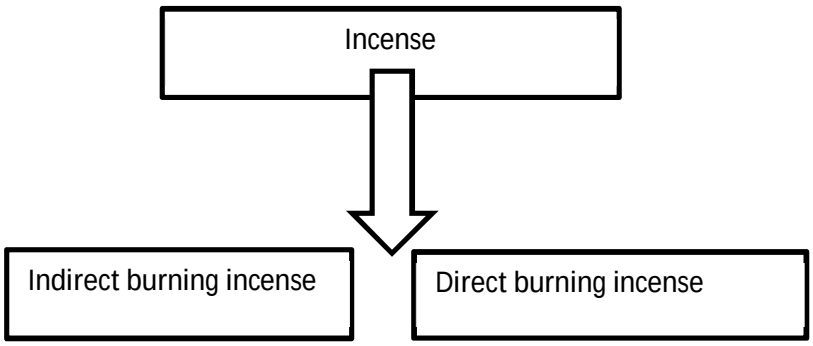


Figure: Classification of insence sticks on the basis of burning

1) Indirect Incense Burning Sticks

"Non-flammable incense" is a concoction of scented substances, such as resins [43]. They carry out. not include flammable materials that require various burning fuels. This Various types of fragrance can exist. duration of material's surface burning. The more delicate scent ingredients tend to burn more quickly due to the increased surface region than heavier or coarser scents having more compact surface areas[44]

2) Direct Incense Burning Sticks

As it is directly lit by fire, direct burning incense is often referred to as "combustible incense" [45]. Without the addition of outside heat or a flame source, the incense burner's gleaming embers will continue to smoulder [46]. Incense used for direct burning is either expelled, crushed into a structure, squeezed, or covered in a supporting substance [37, 47]. An aromatic finely ground (or liquid) fragrance substance is used to create this sort of scent, along with an odourless adhesive, on a moldable substrate [48, 49].

V. ADVANTAGES:

1) It is chemical free as compared to synthetic repellents.
2) Prevent causation of diseases like malaria , dengue , fever etc.
3) Do not cause any skin irritation.
4) Easily available.
5) Cost effective.
6) Pleasant.
7) Environmental-friendly.
8) Repel other bugs.
9) Peace of mind.
10) No allergic reaction.

Ingredients list

Sr.No.	Name of ingredient	Figure	Main use
1.	Neem powder		Antibacterial, Antifungal, Antiviral, Antidiabetics, Mosquito repellant.

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2.	Rose water		Antibacterial, Antifungal, Antiseptic, Antidepressants, Anti- inflammatory.
3.	Camphor powder		Insect repellant, Bug repellant.
4.	Clove powder		Anti- inflammatory, Antibacterial, Antiviral, Antioxidant, Pain killer.
5.	Cow dung powder		Antibacterial, Antifungal, Fertilizer, Antimicrobial.
6.	Tragacanth gum powder		Natural gum, Thickening agent

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A. Neem Powder

◇kingdom: plantae
◇Clade:Tracheophytes
◇Clade:Angiosperms
◇Clade:Eudicots
◇Clade:Rosids
◇Order:Sapindales
◇Family:Meliaceae
◇Genus:Azadirachta
◇Species:A. indica
◇Binomial name:Azadirachta indica
◇Synonyms:
•Antelaea azadirachta (L.) Adelb.
•Antelaea canescens Cels ex Heynh.
•Antelaea javanica Gaertn.
•Azadirachta indica subsp. vartakii Kothari, Londhe & N.P.Singh
•Melia azadirachta L.
•Melia fraxinifolia Salisb.
•Melia hasskarlii K.Koch
•Melia indica (A.Juss.) Brandis
•Melia japonica Hassk.
•Melia parviflora Moon
• Melia pinnata stocks

A fast-growing, evergreen tree with a height range of 15 to 20 metres, Azadirachta indica. The neem branches are widely dispersed. The crown is somewhat circular or spherical and fairly dense.The stem and petiole meet at the point where the white, fragrant blossoms appear. The size of a single blossom is 5–6 mm long and 8–11 mm broad. A smooth, olive-like drupe is the neem fruit. The fruit's thin skin turns yellow when it is ripe. Yellowish-white describes the bittersweet pulp.[50] The fruit's white, hard inner shell protects one, occasionally two or three, elongated seeds with a brown seed coatAll tree parts, including the seeds, leaves, blossoms, and bark, are utilised to make a variety of medicinal medicines. Products made from neem contain medical qualities that are proven to be anti-fertility, anti-fungal, anti-diabetic, antibacterial, and antiviral.[51]

Neem seed extract contains limonoids, some of which have been shown to have insecticide and pesticide activities. Azadirachtin is the primary limonoid found in neem seed extract.Other compounds found in Neem seed extract include azadiradione, fraxinellone, nimbin, salannin, salannol, vepinin, and vilasinin. Tannins, flavonoids, and derivatives of sesquiterpenes are what give neem oil its [52].

1) Uses and benefit of Neem

1.Treats Acne: Neem has an anti-inflammatory property which helps reduces acne. Azadirachta Indica also helps reduce skin blemishes.
2.Nourishes Skin:Neem is a rich source of Vitamin E which help repair damaged skin cells.
3.Treats Fungal InfectionsNeem has scientifically proven antifungal property which helps treat fungal infections.
4.Useful in Detoxification:Neem can prove useful in detoxification both internally and externally. Consumption of neem leaves or powder stimulates kidneys and liver increasing the metabolism and eliminating the toxins out of the body. Externally, neem scrubs or paste can be used to remove germs, bacteria, dirt, etc from your skin preventing rashes and skin diseases.
5.Increases Immunity: Neem is known for its antimicrobial and antibacterial effects. These properties play a huge role in boosting immunity.
6.Insect & Mosquito Repellent: You can burn a few neem leaves to ward off the insects. This is also effective against different types of mosquitoes . From all the home remedies for malaria , neem is the best for treating the early symptoms of malaria.
7.Prevents Gastrointestinal Diseases: Neem's anti-inflammatory properties help reduce inflammation of the gastrointestinal tract which helps reduce a series of diseases like constipation, stomach ulcer, flatulence, etc.

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8.Treats Wounds: Neem leaves have an antiseptic property which is why it is used to heal wounds.
9.Reduces Dandruff: Neem is extensively used in shampoos and conditioners. Azadirachta Indica has antifungal and antibacterial properties which help eliminate dandruff and strengths your hair.
10.Reduces Joint Pain: Application of neem oil or extract on the affected area can help reduce pain and discomfort. Hence it is widely used for treating arthritis.
11.Exfoliates skin: Neem is an excellent exfoliant. It helps remove dead cells from the surface of the skin which will help prevent the growth.

2) Rose Water

◇Kingdom:Plantae
◇Clade:Tracheophytes
◇Clade:Angiosperms
◇Clade:Eudicots
◇Clade:Rosids
◇Order:Rosales
◇Family:Rosaceae
◇Subfamily:Rosoideae
◇Tribe:Roseae
◇Genus:Rosa L.
◇Division: Tracheophyta
◇Synonyms:
•Hulthemia Dumort
•.×Hulthemosa Juz. (Hulthemia × Ro
◇Binomial name : Syzygium aromaticum

3) Camphor Powder

◇Kingdom:Plantae
◇Clade:Tracheophytes
◇Clade:Angiosperms
◇Clade:Magnoliids
◇Order:Laurales
◇Family:Lauraceae
◇Genus:Camphora
◇Species:C. officinarum
◇Binomial name: Camphora officinarum
◇Synonym: Laurus camphora L.
◇Persea camphora (L.) Spreng.
◇Cinnamomum camphora (L.) J.Presl.
◇Camphora officinalis Steud.
◇Camphora camphora (L.) H. karst.

Alcanfor, Camphora, Camphre, Camphre de Laurier, Camphre Gomme, Camphrier, Cemphire, dl-Camphor, dl-Camphre, Formosa Camphor, Gum Camphor, Kampfer, Karpoora, Karpuram, Laurel Camphor, Spirit of Camphor, 2-Bornanone, 2-Camphanone, 1,7,7-Trimethylbicyclo[2.2.1]heptan-2-one.
The moniker "camphor tree," "camphorwood," or "camphor laurel" are all used to refer to the evergreen tree species Camphora officinarum.[53 ,54]
The tree C. camphora yields a white, crystalline material known as camphor. For many years, people have used camphor as a spice in food, an ingredient in incense, and a medicinal. It also serves as an insect deterrent and a flea-killing agent.
Ingredients in chemicals

All plant parts of the species contain volatile chemical compounds, and the essential oils are steam distilled from the wood and leaves. There are six distinct chemical subtypes of camphor laurel, known as chemotypes: camphor, linalool, 1,8-cineole, nerolidol, safrole, and borneol. When harvesting by odour in China, field workers avoid combining chemotypes.[55 56] China produces bogus "eucalyptus oil" from the cineole component of camphor laurel.[57]

4) Clove Powder

◇Kingdom:Plantae
◇Clade:Tracheophytes
◇Clade:Angiosperms
◇Clade:Eudicots
◇Clade:Rosids
◇Order:Myrtales
◇Family:Myrtaceae
◇Genus:Syzygium
◇Species:S. aromaticum
◇Binomial name : Syzygium aromaticum
◇Synonym:
Caryophyllus aromaticus L.
Eugenia aromatica (L.) Baill.
Eugenia caryophyllata Thunb.
Eugenia caryophyllus.
Studies on whether it works to lower fevers, keep mosquitoes away, and stop premature ejaculation have come up empty.[58][59] Whether cloves or clove oil lower blood sugar levels is still a matter of debate.[59] It's possible to utilise the essential oil in aromatherapy.[58]

5) Cow Dung Powder

Numerous helpful microbes, including Saccharomyces, Lactobacillus, Bacillus, Streptococcus, Candida, and others are abundant in cow dung. Additionally, it includes a variety of dietary ingredients like cellulose, hemicellulose, mucus, lignin, minerals, vitamins, potassium, nitrogen, oxygen, and carbon. Due to the availability of several microorganisms helpful for waste degradation, cow manure is utilised to digest waste produced by cities and hospitals [60] For the creation of papers, fibrous material derived from cow excrement is employed [61]. In recent years, natural mosquito repellents made from cow dung have proven one of the finest substitutes for synthetic repellents [62]. Cow dung toothpaste also enhances oral health and offers defence against oral infections. The use of cow dung provides more economical and environmentally beneficial human activities [63,[64], [65], [66]. Additionally, cow dung has proven to have anti-bacterial and anti-fungal properties [67] Psoriasis and eczema can be effectively treated with it as a skin tonic. Neem leaf powder and cow manure are combined to prevent boils and heat rashes. Both Mycobacterium TB and the malarial parasite have been shown to be killed by cow dung. Corprophilous fungi exhibit the anti-fungal activity[65] [66].

6) Tragacanth Gum Powder

◇Biological source:Astragalus gummifer
◇Family : Fabaceae
◇Kingdom:Plantae
◇Clade:Tracheophytes
◇Clade:Angiosperms
◇Clade:Eudicots
◇Clade:Rosids
◇Order:Fabales
◇Subfamily:Faboideae
◇Genus:Astragalus
◇Species:A. gummifer
◇Binomial name:Astragalus gummifer Labill.

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VI. EXPERIMENTAL WORK

A. *Formula*

Serial no.	Name of ingredients	Quantity taken (gm)
1.	Neem	30gm
2.	Rose water	10ml
3	Camphor	4.5gm
4.	Clove	4.5gm
5.	Cow dung	45gm
6.	Honey	5ml
7.	Water	As per q.s.

B. *Method*

1) In a mixer, all of the dried herbs were ground into a fine powder before being sieved (mesh no. 80).
2) If the powder is not very fine, there will be issues with binding and burning.
3) 20 incense sticks required a total of 100g of powder premix
4) Tables 1 provide of the amount of material taken.
5) The fine powder was diluted with water gradually until it had the consistency of dough
6) It should be well combined and not too watery to avoid difficulties while producing sticks
7) Rolling the dough by hand in tiny batches on unadorned bamboo sticks required dividing the dough into parts.
8) Rose water was used to fragrance the dried incense sticks.
9) Finally, sticks were stored after being packed in an appropriate material, preferably plastic.

VII. EVALUTION PARAMETER OF INCENSE STICK :

A. *Physical Appearance*

Colour:Brownish colour
Odour:

B. *Smock Toxicity Test*

A test of smoke toxicity was carried out in a chamber . next grownup In the 30minutes following their discharge into the chamber, mosquitoes were exposed to the smoke from burning incense sticks. Every 10minutes, the mortality data were recorded. There were 12 mosquitoes employed in all.



Figure: dead mosquito

C. *Feedback from 20 volunteers*

The feedback of mosquito repellant incense sticks were taken from 20 volunteers.

Parameters	Excellent	Good	Average	Poor
1.Product elegance	12	8	--------	-------
2.Mosquito repellancy	15	5	---------	--------
3.Odor of incense stick	12	8	---------	----------
4.Allergy	--------	--------	----------	----------
5.Product sastifaction rating of 1 to 5 score (Average)	3	--------	---------	----------

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VIII. RESULT AND DISCUSSION

Sr no.	Colour	Odour	Mosquito Repellancy	Allergy related issue
1.	Brownish	Rose smell	Excellent	No issue
2.	Brownish	Rose smell	Good	No issue
3.	Brownish	Rose smell	Good	No issue

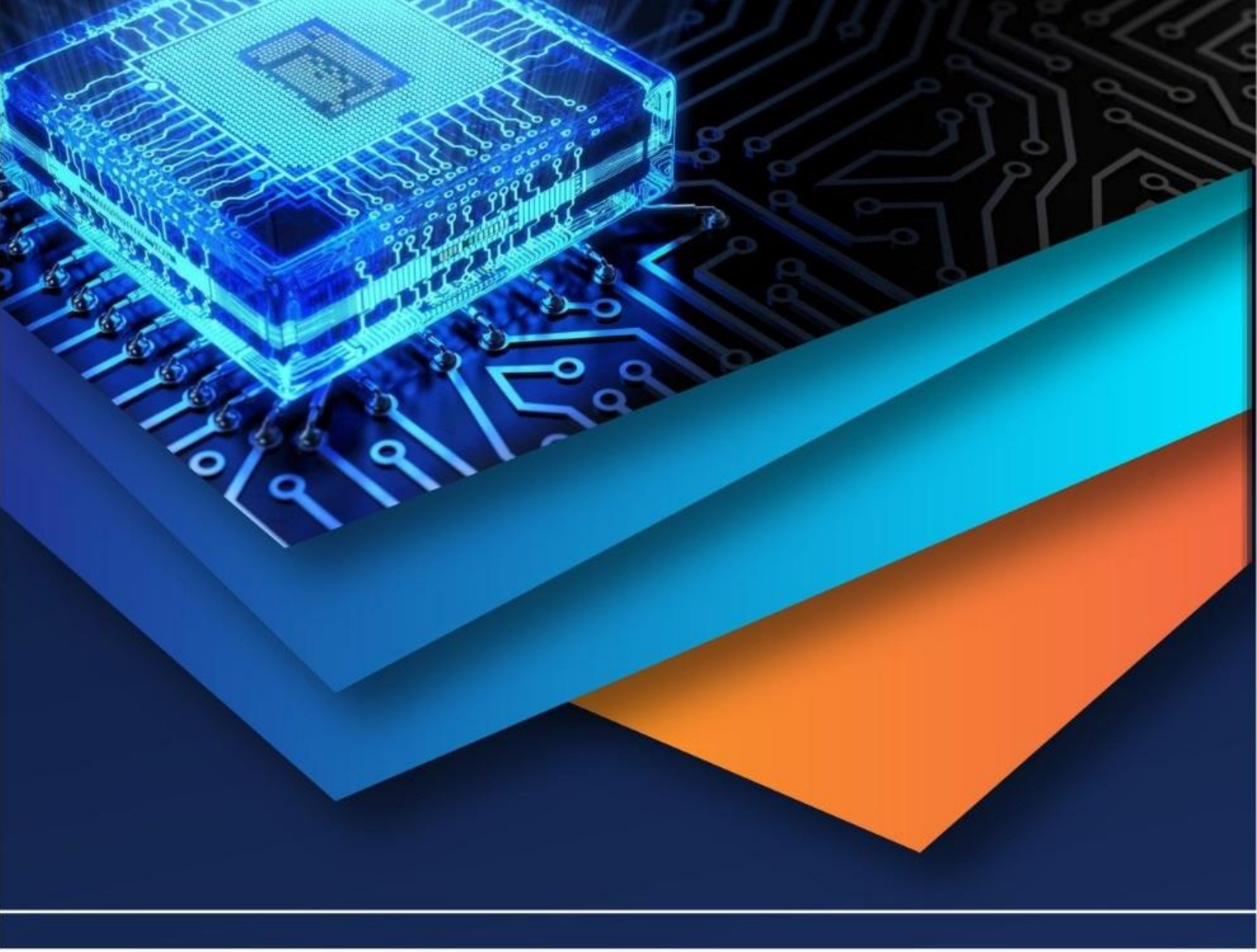
IX. CONCLUSION

The herbal-based mosquito-repelling incense sticks exhibit outstanding mosquito-repelling efficacy and have no negative side effects. The fragrance created by the stick formulations is superior to that of the marketed formulation. The incense sticks were economical, affordable, and safe to use. All age groups may readily utilise it because it is portable. The use of herbals in the creation of mosquito-repelling incense sticks is strongly advised because they produce a nice scent and keep mosquitoes away. The commercially available solution has various side effects, including eye discomfort, coughing, sneezing, and respiratory issues.

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