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Development Of Insects Repellent Fabric Using Natural Herbal Extract (Traidax Procumbense)

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Abstract
The aim of project work is to produce Multifunctional finish fabric by using natural herbal tridax procumbense for curtain fabric. The leaf portion of the plant having the various properties like antimicrobial, mosquito repellents etc, the extraction of plant leaf was applied over the fabric with the help of coating technique.
The antimicrobial activities are tested against three organisms namely E.coli, Klebsiella pneumonia, bacillus subtilis .Mosquito repellent tested with the help of two different larvaes namely Ade saegypti, Cuiex quinauefasciatus. The physical properties like strength drape tested, tensile strength, flexural rigidity. The fastness properties like rubbing, washing tests conducted. This project is an attempt to produce multifunctional textile materials by natural herbals.

Keywords
Enzymatic desizing, Alkaline enzyme scouring, Peroxide Bleaching, Antimicrobial activity, Tridaxprocumbens, Extraction of tridax procumbens juice, Application on fabric, Disease& Control, Taxonomy and Characterization

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I. Introduction

Cotton is a soft, fluffy staple fiber that grows in a boll, or protective capsule, around the seeds of cotton plants of the genus Gossypium. The fiber is almost pure cellulose. Under natural conditions, the cotton bolls will tend to increase the dispersion of the seeds.

The plant is a shrub native to tropical and subtropical regions around the world, including the Americas, Africa, and India. The greatest diversity of wild cotton species is found in Mexico, followed by Australia and Africa. Cotton was independently domesticated in the Old and New Worlds. The English name derives from the Arabic (al) quṭn قُطْن, which began to be used circa 1400 AD. The Spanish word, "algodón", is likewise derived from the Arabic. (2)

World Health Organization (WHO) has estimated that more than 80% of the world's population relies on traditional medicine for their primary healthcare needs.By definition, 'traditional' use of herbal medicines implies substantial historical use, and this is certainly true for many products that are available as 'traditional herbal medicines'(8). In many developing countries, a large proportion of the population relies on traditional practitioners and their armamentarium of medicinal plants in order to meet health care needs (6)

Although modern medicine may exist side-by-side with such traditional practice, herbal medicines have often maintained their popularity for historical and cultural reasons. Such products have become more widely available commercially, especially in developed countries. In this modern setting, ingredients are sometimes marketed for uses that were never contemplated in the traditional healing systems from which they emerged.(8)

The phytochemical screening revealed the presence of alkaloids, carotenoids, flavonoids (catechins and flavones) and tannins. It is richly endowed and saponins. The proximate profile shows that the plant is rich in sodium, potassium and calcium. Leaf of Tridax mainly contains croud proteins 26%, crude fiber 17% soluble carbohydrates 39% calcium oxide 5%, Luteolin, glucoluteolin, quercetin and isoquercetin have been reported from its flowers. (4)

Traditionally, Tridax procumbens has been in use in India for wound healing, as anticoagulant, antifungal and insect repellent. It is also used in diarrhoea and dysentery. Its leaf extracts were known to treat infectious skin diseases in folk medicines. It is a well-known ayurvedic medicine for liver disorders or hepato-protective nature besides gastritis and heart burnThe collected herbs were shadow dried with in a temperature range 37-40ºC. The moisture content of herb collected was reduced to less than 14% with proper drying since most of the herbs have moisture content of 60-80% and cannot be stored without drying. Proper drying has to be carried out otherwise important compounds may get contaminate (7)

II. Materials And Methodology

(A) Materials

Cotton fabric (100% scoured and bleached cotton). Tridax procumbens

Cotton Fabric

scoured and bleached 100% cotton fabric (136 ends/inch,60 picks/inch) was used for the application . The leaves of Tridax procumbens were used for antimicrobial and mosquito repellent finish.

Tridax procumbens

The collected herbs were shadow dried with in a temperature range 37-40ºC. The moisture content of herb collected was reduced to less than 14% with proper drying since most of the herbs have moisture content of 60-80% and cannot be stored without drying. Proper drying has to be carried out otherwise important compounds may get contaminated.

After drying the grinding was carried out to break down the leaves of the plant into very small units ranging from coarse fragments to fine powder. Extraction refers to separating the desired material by physical or chemical means with the aid of a solvent.

Antimicrobial active substances were extracted from the plant by methanolic extraction method. The powdered plant material; was extracted with methanol by adding 20g of herbal powder in 100ml of methanol for 24 h to separate the alkaloids.

2(B) Methodology

Desizing

Desizing is the process of removing the size material from the warp yarns in woven fabrics. Sizing agents are selected on the basis of type of fabric, environmental friendliness, ease of removal, cost considerations, effluent treatment, etc.

Enzymatic desizing

Enzymatic desizing is the classical desizing process of degrading starch size on cotton fabrics using enzymes. Enzymes are complex organic, soluble bio- catalysts, formed by living organisms that catalyze chemical reaction in biological processes. Enzymes are quite specific in their action on a particular substance. A small quantity of enzyme is able to decompose a large quantity of the substance it acts upon.

Enzymes are usually named by the kind of substance degraded in the reaction it catalyzes. Amylases is the enzyme that hydrolyses and reduces the molecular weight of amylose and amylopectin molecules in starch, rendering it water that is soluble enough to be washed off by the fabric. Effective enzymatic desizing requires strict control of pH, temperature, water hardness, electrolyte addition and choice of surfactant.

Advantages of Enzymatic Desizing

- No damage to the fibre
- No usage of aggressive chemicals
- Wide variety of application processes, and
- High biodegradability

2(C) Scouring

Definition:

The term ‘scouring’ applies to the removal of impurities such as oils, was, gums, soluble impurities and sold dirt commonly found in textile material and produce a hydrophilic and clean cloth.

Objectives of Scouring:

1. To remove natural as well as added impurities of essentially hydrophobic character as completely as possible
2. To increase absorbency of textile material
3. To leave the fabric in a highly hydrophilic condition without undergoing chemical or physical damage significantly.

Alkaline enzyme scouring

Desized fabrics were scoured through harnessing alkaline pectinase enzyme in 0.05 M phosphate buffer containing 0.5 g/l nonionic wetting agent at pH 8.5 and temperature 55°C using a material to a liquor ratio of 1:50. The whole operation of this bioscouring was carried out using a mechanical washing machine.

Four concentrations of alkaline pectinase were used in the treatments viz, 0.5 g/l, 1 g/l, 2 g/l and 3 g/l.

After the treatments the temperature was raised to 100°C for 10 minutes to stop the enzyme action. The fabrics were then washed with hot water and cold water and finally dried at ambient conditions.

2(D) Bleaching

Chemical processes used to remove impurities and eliminate any undesired color from various materials to give them a white color or prepare them for dyeing (textiles, wood pulp, wax, and so on).

Bleaching is most widely used in the textile industry. Preliminary removal of impurities involves treatment of the material with chloramines, weak acid or alkaline solutions, and enzyme preparations, and also boiling in alkaline solution. Oxidizing agents (sodium or calcium hypochlorite or reducing agents are used in the actual bleaching process.

Bleaching is done in a bleaching plant equipped with continuous-operation steaming units and with scouring machines, in which the textiles are processed with solutions of alkalis, acids, and oxidizing agents. The textiles are washed with water between bleaching operations and upon completion of the process. Organic compounds are also used in bleaching.

Peroxide Bleaching:

The bleaching process was performed using the exhaustion method through in situ formation of per acetic acid. In this technique, bioscoured cotton and bioscoured cotton/polyester blend fabrics were treated with an aqueous solution containing different concentrations of tetraacetylethylenediamin (TAED) (5 g/l, 10 g/l, 15 g/l and 20 g/l) and hydrogen peroxide (H2O2) (3 g/l, 5 g/l, 7 g/l and 9 g/l). Sodium silicate (2 g/l) and Egyptol® (0.5 g/l) were added to the solution.

A material to a liquor ratio of 1:50 was used and the pH of the bath was adjusted at 8 by drop – wise addition of an aqueous solution of sodium hydroxide (2g/l) with continuous stirring. The bleached sample was washed several times with hot water then cold water and finally dried at ambient conditions.

2(E) Tridax Procumbens

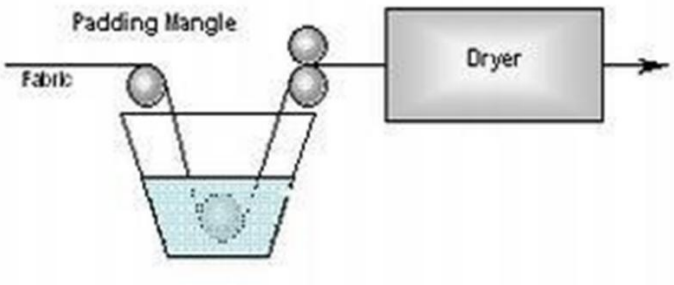
Tridax procumbens is a species of flowering plant in the daisy family. It is best known as a widespread weed and pest plant. It is native to the tropical Americas but it has been introduced to tropical, subtropical, and mild temperate regions worldwide

Tridax procumbens is known for several potential therapeutic activities like antiviral, anti oxidant antibiotic efficacies, wound healing activity, insecticidal and anti-inflammatory activity. Some reports from tribal areas in India state that the leaf juice can be used to cure fresh wounds, to stop bleeding, as a hair tonic. Despite these known benefits, it is still listed in the United States as a Noxious Weed and regulated under the Federal Noxious Weed Act.

Traditionally, Tridax procumbens has been in use in India for wound healing, as anticoagulant, antifungal and insect repellent. It is also used in diarrhoea and dysentery. Its leaf extracts were known to treat infectious skin diseases in folk medicines. It is a well-known ayurvedic medicine for liver disorders or hepato-protective nature besides gastritis and heart burn.

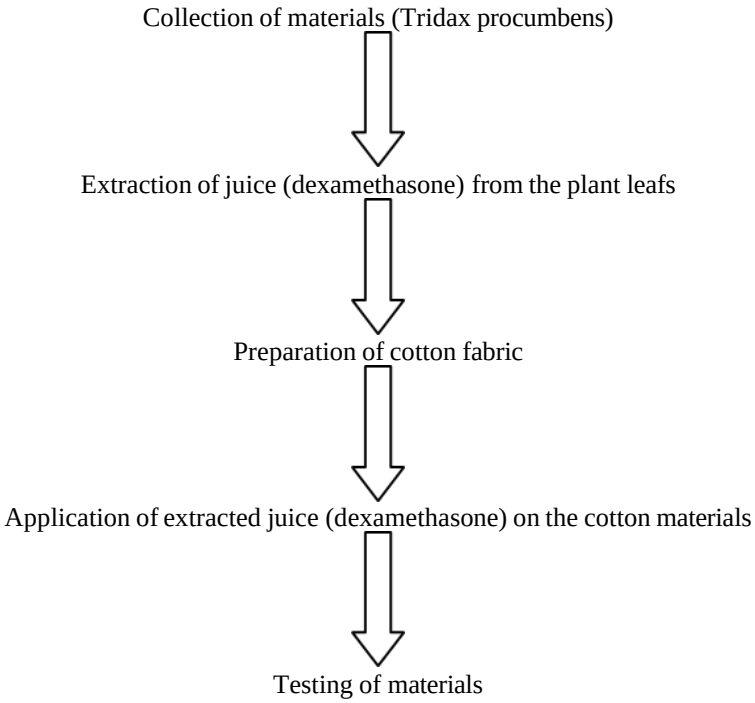
The study had found anti-cancer properties of Tridax procumbens against human prostate epithelial cancer cell line. A study was carried out to verify the claims wherein tribal inhabitants of Udaipur district, Rajasthan were using the plant for treatment of diabetes. It was concluded that the results were comparable to that of reference standard Glibenclamide and the Tridax procumbens flower extract showed antidiabetic properties.

The fabric samples were treated with herbal extracts using citric acid as cross- linking agent. Methanolic extracts of tridax daisey is applied onto the fabric by pad- dry-cure method with M:L ratio of 1:20 at 50ºC using 8% citric acid concentration. After padding for 30 min, the samples were taken and dried at 100-120ºC for 5 min and cured at 180ºC for 3 min.



Cotton fabric passes through guide roller to the bath containing tridax juice (dexamethasone) with the help of immersion roller the fabric is dipped into the solution and get penetrated by tridax juice (dexamethasone) into fabric yarn structure than pass to the squeeze roller, which squeeze the fabric to remove the excess solution in the fabric.

Then the squeezed fabric is passed through the curing chamber to cure the fabric at a temperature of 100-120^{o}C for 3 min.



2(F) Disease

Anopheles albimanus mosquito feeding on a human arm – this mosquito is a vector of malaria, and mosquito control is a very effective way of reducing the incidence of malaria.

Mosquito-borne diseaseand Life-threatening disease

Mosquitoes can act as vectors for many disease-causing viruses and parasites. Infected mosquitoes carry these organisms from person to person without exhibiting symptoms themselves. Mosquito-borne diseases include:

Viral diseases, such as yellow fever, dengue fever and chikungunya, transmitted mostly by Aedes aegypti. Dengue fever is the most common cause of fever in travelers returning from the Caribbean, Central America, and South Central Asia. This disease is spread through the bites of infected mosquitoes and cannot be spread person to person

Control

Many methods are used for mosquito control. Depending on the situation, the most important usually include:

- source reduction (e.g., removing stagnant water)
- biocontrol (e.g. importing natural predators such as dragonflies)
- trapping, and/or insecticides to kill larvae or adults
- exclusion (mosquito nets and window screening)
- Prevention of mosquito bites, with insecticides, nets, and repellents.

2(G) Aedes aegypti

The yellow fever mosquito, Aedes aegypti is a mosquito that can spread the dengue fever, chikungunya and yellow fever viruses, and other diseases. The mosquito can be recognized by white markings on legs and a marking in the form of a lyre on the thorax. The mosquito originated in Africabut is now found in tropical and subtropical regions throughout the world.

2(H) Spread of disease and prevention

Aedes aegypti is a vector for transmitting several tropical fevers. Only the female bites for blood which

she needs to mature her eggs. To find a host, Aedes aegypti are attracted to chemical compounds that are emitted by mammals. These compounds include ammonia, carbon dioxide, lactic acid, and octenol.

Scientists at the Agricultural Research Service have studied the specific chemical structure of octenol in order to better understand why this chemical attracts the mosquito to its host. They found that the mosquito has a preference for "right-handed" (dextrorotatory) octenol molecules.

Aedes aegypti can also contribute to spread reticulum cell sarcoma among Syrian hamsters. The CDC traveller's page on preventing dengue fever suggests using mosquito repellents that contain DEET (N, N-diethylmetatoluamide, 20% to 30% concentration, but not more). It also suggests the following:

1. Although aedes aegypti mosquitoes most commonly bite at dusk and dawn, indoors, in shady areas, or when the weather is cloudy, "they can bite and spread infection all year long and at any time of day."
2. The mosquito's preferred breeding areas are in areas of stagnant water, such as flower vases, uncovered barrels, buckets, and discarded tires, but the most dangerous areas are wet shower floors and toilet tanks, as they allow the mosquitoes to breed in the residence.
3. Research has shown that certain chemicals emanating from bacteria in water containers stimulate the female mosquitoes to lay their eggs. They are particularly motivated to lay eggs in water containers that have the correct amounts of specific fatty acids associated with bacteria involved in the degradation of leaves and other organic matter in water. The chemicals associated with the microbial stew are far more stimulating to discerning female mosquitoes than plain or filtered water in which the bacteria once lived.
4. Wear long-sleeved clothing and long trousers when outdoors during the day and evening.
5. Spray permethrin or DEET repellents on clothing, as mosquitoes may bite through thin clothing.
6. Use mosquito netting over the bed if the bedroom is not air conditioned or screened. For additional protection, treat the mosquito netting with the insecticide permethrin.

III. Testing Of Material

Antimicrobial finishes

wo different aspects of antimicrobial protection provided by chemical finishes can be distinguished. The first is the protection of the textile user against pathogenic or odour causing microorganisms (hygiene finishes). The second aspect is the protection of the textile itself from damage caused by mould, mildew or rot producing microorganisms. Both aspects will be discussed in this chapter. Protection of textiles from damage caused by insects is covered. The growth of microorganisms on textiles can lead to functional, hygienic and aesthetic difficulties (for example staining).

The most trouble-causing organisms are fungi and bacteria. Under very moist conditions, algae can also grow on textiles but are troublesome only because they act as nutrient sources for fungi and bacteria. Fungi cause multiple problems to textiles including discoloration, coloured stains, and fibre damage.

Bacteria are not as damaging to fibres, but can produce some fibre damage, unpleasant odours and a slick, slimy feel. Often, fungi and bacteria are both present on the fabric in a symbiotic relationship.

Substances added to fibres, such as lubricants, antistats, natural-based auxiliaries (for example size, thickener and hand modifiers) and dirt provide a food source for microorganisms. Synthetic fibres are not totally immune to microorganisms, for example polyurethane fibres and coatings can be damaged.3 Of course, because of evolution, natural fibres are more easily attacked.

Antimicrobial finishes are particularly important for industrial fabrics that are exposed to weather. Fabrics used for awnings, screens, tents, tarpaulins, ropes, and the like, need protection from rotting and mildew. Home furnishings such as carpeting, shower curtains, mattress ticking and upholstery also frequently

receive antimicrobial finishes.

Fabrics and protective clothing used in areas where there might be danger of infection from pathogens can benefit from antimicrobial finishing. These include hospitals, nursing homes, schools, hotels, and crowded public areas. Textiles in museums are often treated with antimicrobial finishes for preservation reasons.

Sized fabrics that are to be stored or shipped under conditions of high temperature (~ 40 °C or 100 ºF) and humidity require an antimicrobial finish to retard or prevent microbial growth fuelled by the presence of warp size. Textiles left wet between processing steps for an extended time often also need an antimicrobial treatment.

The use of antimicrobial finishes to prevent unpleasant odours on intimate apparel, underwear, socks and athletic wear is an important market need. The odours are produced by the bacterial decomposition of sweat and other body fluids, and controlling bacterial growth by hygiene finishes reduces or eliminates the problem. An alternative approach is described on novel anti-odour finishes.

Properties of an effective antimicrobial finish

The growth rate of microbes can be astoundingly rapid. The bacteria populations, for example, will double every 20 to 30 min under ideal conditions (36–40 °C or 77–98 °F, pH 5–9). At this rate, one single bacteria cell can increase to 1 048 576 cells in just 7 hours. Therefore, antimicrobial finishes must be quick acting to be effective. In addition to being fast acting, a number of other important criteria can be listed for antimicrobial finishes.

The antimicrobial must kill or stop the growth of microbes and must maintain this property through multiple cleaning cycles or outdoor exposure. The antimicrobial must be safe for the manufacturer to apply and the consumer to wear. The finish must meet strict government regulations and have a minimal environmental impact.

The antimicrobial finish must be easily applied at the textile mill, should be compatible with other finishing agents, have little if any adverse effects on other fabric properties including wear comfort, and should be of low cost.

Antimicrobial activity assessment of curtains; test method 174

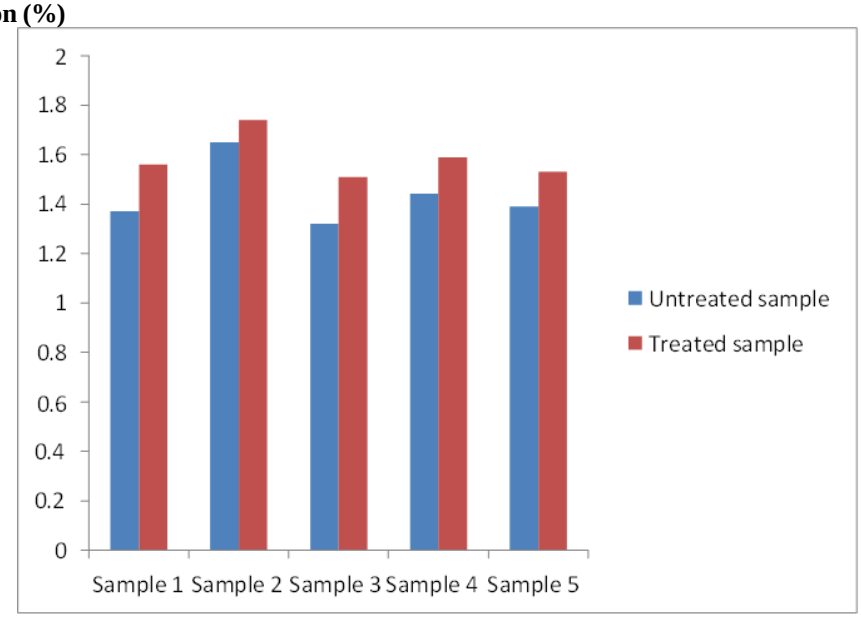
Methods are given for the qualitative and quantitative determination of antibacterial activity and the qualitative evaluation of antifungal properties of carpet samples using procedures and materials similar to those in the above test methods.

IV. Result And Discussion

4(A) Tensile strength (kg/sq.cm)

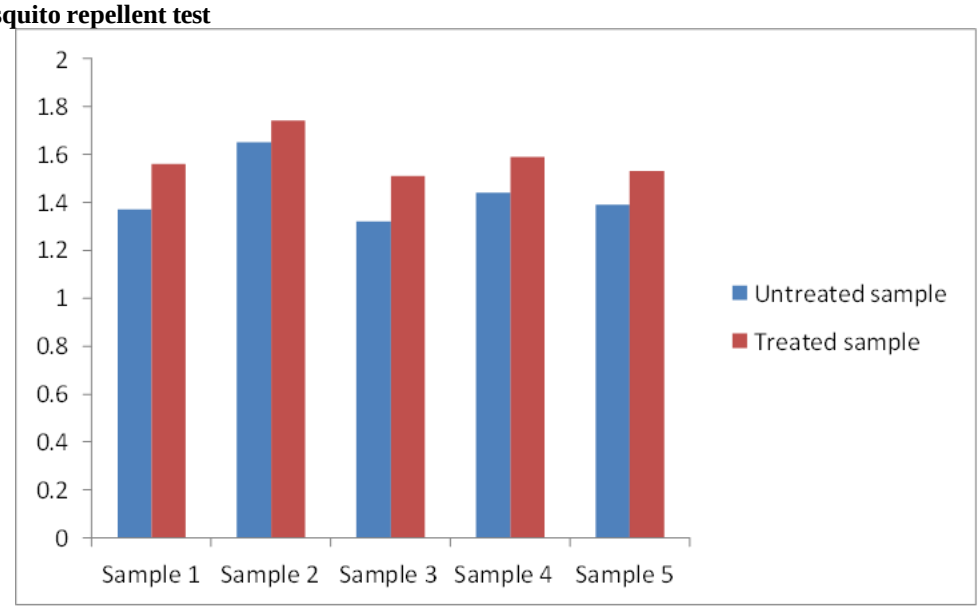
Particulars	Sample 1	Sample 2	Sample 3	Sample 4	Sample 5
Untreated sample	113.69	112.44	114.83	113.11	112.67
Treated sample	114.02	114.88	113.98	114.33	114.56

4(B) Elongation (%)

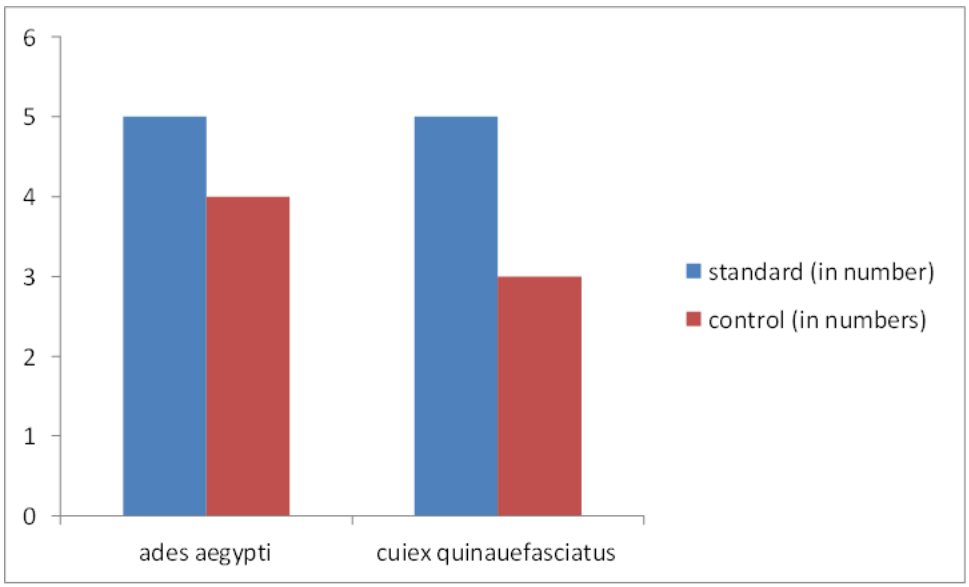


Particulars	Sample 1	Sample 2	Sample 3	Sample 4	Sample 5
Untreated sample	27.17	26.23	28.14	27.22	26.66
Treated sample	27.29	26.56	28.33	27.62	26.32

4(C) Mosquito repellent test



Name of larva	Standard (in numbers)	Control (in numbers)
Ades aegypti	05	04
Cuiex quinauefasciatus	05	03



V. Discussion

The increasing prevalence of vector-borne diseases such as malaria, dengue, chikungunya, and Lyme disease poses a serious threat to public health globally. Traditional insect repellents used in fabrics often rely on synthetic chemicals such as DEET and permethrin, which, while effective, raise concerns about skin irritation, environmental pollution, and long-term health impacts. There is a growing demand for safer, eco-friendly alternatives that provide effective protection without harmful side effects.

Tridax procumbens, a widely available medicinal herb, is known for its insect- repellent, antimicrobial, and wound-healing properties. Extracts from this plant contain bioactive compounds such as flavonoids and

essential oils, which have been scientifically proven to repel insects naturally. Utilizing this herbal extract in textile finishing offers a promising, sustainable alternative to chemical treatments.

This innovation supports public health, environmental conservation, and economic accessibility, especially in rural and low-resource areas where both mosquito-borne diseases and the herb itself are prevalent.

VI. Conclusion

Among the increasing number of arthropod-borne diseases, only few are preventable by vaccines. There is no effective vaccine against Malaria, the only way to avoid it remains avoiding mosquitos'bites. For this reason, personal protective measures against biting arthropods and arthropod borne diseases constitute the first line of defense. A major advance in the protection of high risk personnel (e.g. outdoor workers, travelers, and soldiers) is the development of insects repellent clothing, tents, and netting.

Tridax procumbent Linn is a weed found throughout India, it is native of tropical America and naturalized in tropical Africa, Asia, and Australia. This plant widely distributed and it's each and every part having noble pharmacological activity. The work done till to date on its pharmacological activities like mosquito repellent and anti-bacterial are reporting good.

This plant also used as bio adsorbent for removal of Cr (VI) from the industrial wastewater. This is dispensed for "Bhringraj" by some of the practitioners of Ayurveda. In future, there is huge room for research in direction of more pharmacological activities of plant and to elucidate the mechanism of action of same.

Results also show that, curtain fabric made of cotton/linen shows highest mosquitoes repellent retention capacity and highest resistance against washing compared with 100% cotton. Polyester based curtain fabrics shows lower insect repellent retention capacity compared with cellulosic based fabric. The insect repellent and anti-bacterial treatment of curtain fabrics did not adversely affect the tensile strength, elongation, modulus, flexural rigidity of curtain fabrics.

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