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DEVELOPMENT OF KNEE BANDIT USING CALOTROPIS GIGANTEA LEAF EXTRACT ON BAMBOO KNITTED FABRIC

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Abstract: *Calotropis* commonly called milk weed is a large shrub belongs to *Apocynaceae* family, species *Calotropis gigantea* which can yield a durable fibre commercially known as "bowstrings of India". It is grown in water scary areas which do not require fertilizer andcultivation. The object of creating a knee bandit out of bamboo knit fabric and *Calotropis gaigantea* leaf extract is to investigate the possibilities of employing natural materials to create useful and environmentally responsible medical devices. The plant *Calotropis Gaigantea* is well-known for its therapeutic qualities. It has been utilized historically for its analgesic and anti-inflammatory benefits. Knitted bamboo cloth is a great starting point for making a knee bandit because of its antibacterial, breathable, and comfortable qualities. In this study, bioactive components from CALOTROPIS GIGATEA leaves are extracted and then integrated using environmentally friendly methods into bamboo knitted fabric. This plant, particularly its latex, is known for its medicinal properties, including wound healing and potential anti-inflammatory effects. The study investigates the use of leaf extract from this plant Bamboo is a sustainable and renewable resource, making it an environmentally friendly base for the bandage. Its properties, like good moisture absorption and breathability, are also beneficial for a knee bandage. The research aims to create a knee bandage that combines the wound-healing capabilities of *Calotropis gigantea* with the sustainability and functional properties of bamboo fabric.

By using *Calotropis gigantea* leaf extract's unique bioactive qualities to bamboo knit fabric, the current work aims to create a functional knee bandit. *Calotropis gigantea* was chosen as a sustainable substitute for synthetic treatments frequently found in therapeutic fabrics because of its anti-inflammatory, analgesic, and antibacterial qualities. Because bamboo cloth is naturally soft, breathable, and antibacterial, it was selected as the perfect substrate for wearable health applications.

Keywords: Calotropis Leaves, Calotropis Extract, Bamboo Knitted Fabric, Essential oil

I. INTRODUCTION

Calotropis gigantea, commonly known as giant milkweed or crown flower, is a widely used medicinal plant with a rich history of use in traditional Indian systems of medicine like Ayurveda. It's recognized for its diverse pharmacological activities, including antioxidant, antimicrobial, antipyretic, and wound-healing properties. The plant also exhibits analgesic, anti-inflammatory, and insecticidal effects. Research has identified various phytochemicals in *Calotropis gigantea*, such as flavonoids, terpenoids, and phenolics, which contribute to its medicinal properties. The knee pain and discomfort, often associated with conditions like arthritis, sports injuries, and muscle strains, have become prevalent health concerns worldwide. Traditional methods of managing knee pain usually involve the use of medications, physical therapy, and knee braces. However, these solutions often come with side effects or do not provide adequate relief for long-term use. In recent years, there has been a growing interest in natural, sustainable alternatives to conventional pain management, particularly in the form of wearable therapeutic products. *Calotropis Gaigantea, also called the giant milkweed, is a plant with a long history of medicinal use. Its leaves contain bioactive compounds known for their anti-inflammatory, analgesic, and antimicrobial properties, making them suitable for treating pain and swelling. When they are incorporated into fabric, these properties can provide localized therapeutic effects, offering a natural alternative to chemical-based treatments.*

The creation of a knee bandit using *Calotropis Gaigantea* leaf extract on bamboo knitted fabric is an inventive way to address knee discomfort in an eco-friendly and natural way. Bamboo knit fabric is a popular material for making wearables that are both pleasant and functional because of its softness, breathability, and moisture-wicking capabilities. Bamboo fabric's antibacterial qualities improve the product's longevity and hygiene even more and its environmentally friendly qualities meet the growing need for sustainable solutions.



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This knee bandit improves skin health, comfort, and hygiene in addition to providing pain and inflammation treatment by combining bamboo fabric with *Calotropis Gaigantea* leaf extract. By offering a long-term and comprehensive approach to pain management, this blend of natural materials has the potential to revolutionize how people treat kneerelated conditions. The knee bandit is a potential addition to the wearable healthcare space since it seeks to deliver a therapeutic experience that combines conventional knowledge with contemporary textile technology.

OBJECTIVES

- To design and develop knee bandit that provide effective support and stability to the knee joint
- To reduce knee joint pain
- To improve knee join mobility
- To evaluate the antimicrobial and anti-inflimmatory properties of the *Calotropis gigantea* leaf extract



II. METHODS/METHODOLOGY



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COLLECTION OF RAW MATERIALS MILKWEED LEAF

The *Calotropis* leaves is collected from the Agriculture field. The leaf is gently wash to remove the milk produced then it is dried use in dry cloth In traditional medicine, *calotropis* leaves are used to treat a variety of conditions, such as respiratory disorders, skin conditions, and pain management. It helps to control the Knee pain



Figure:01Calotropis Gigantea leaf



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ESSENTIAL OIL

Essential oils are widely used in aromatherapy, cosmetics, and natural healing because of their many advantages. These oils preserve the natural fragrance and therapeutic qualities of the plants and are used extensively in aromatherapy, skincare, medicine, and even household cleaning. The oil helps to control the joint pain and good fragrance.



Figure:02 Euclyptus oil

BAMBOO KNITTED FABRIC

Bamboo knitted fabric is a soft, breathable, and eco-friendly textile made by knitting fibers derived from bamboo pulp, known for its high absorbency, natural sheen, and hypoallergenic properties. The fabric which I have used is of 180 GSM in developed sample 185.63 GSM



Plate :01Bamboo Knitted Fabric

PREPARATION OF RAW MATERIALS

Dry leaves Fine Powder

DRY LEAVES:

After wash the leaves remove dirt .Spread the leaves on a dry cloth in a shaded area with good air circulation. Avoid direct sunlight and dried in room temperature 33° Celsius .It may take 7-10 days depending on the Weather conditions.The leaves should be brittle and crisp, breaking easily when crushed.The material is regularly checked and rotated to ensure uniform drying. Once the *Calotropis gigantea* plant parts are completely dry and brittle, they are ground into a fine powder protect them from moisture, light, and air. Properly dried *Calotropis gigantea* retains its therapeutic properties and is ready for further processing into extracts .



Plate:02 Calotropis Leaf



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FINE POWDER

To make powder from *Calotropis gigantea*, wash the leaves, dry them in a shaded place, and then grind them into a fine powder using a grinding machine. After grinding, the powder sieve through a fine to remove any large, unground particles and to standardize the particle size. The resulting fine powder is then stored in airtight containers to protect it from moisture, light, and contamination, ensuring its stability and effectiveness for later use.



Pleate:03 CLOTROPIS POWDER

EXTRACTION

After grinding 20 grams of *Calotropis* leaf powder with water in a proportion of 1:30, about 600 milliliters of water is obtained. The process of extracting is done by heating the water and allowing the mixture to be simmered in a low intensity for 20 to 30 minutes to absorb the healthy chemicals from the leaves of *Calotropis*. Clear herbal extract is yielded by shaking and fully draining off the liquid upon completion of extraction to eliminate all solid impurities.



Plate:04 Extraction

APPLICATION OF EXTRACTION BAMBOO KNITTED FABRIC

Procedure for applying Calotropis extract using the padding mangle method

Heat at 50-60°C for 2-3 hours for better extraction.Filter the extract using muslin cloth or filter paper to remove solid residues.The First step in preparing the padding bath is to thoroughly mix the extracted liquid Calotropis with a suitable binding agent, such as alum in order to enhance the extract on the fabric surface. The fabric is immersed in the extraction of Calotropis, then squeezing it between two rollers to control the amount of liquid absorbed and removed.



Plate:05 After treated fabric

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FRAGRANCE FINISHING

Fragrance finishing in fabric refers to the process of applying scents to textiles, often to enhance user experience, create a luxury feel, or add functionality like odor control. This process is widely used in fashion, home textiles, sportswear, and even medical textiles.Use eucalyptus essential oil .Ensure the oil is pure and suitable for textile application.Padding is most common: pass the fabric through the solution and squeeze out excess using padding mangle

DRYING

• Drying significantly influences *Calotropis gigantea* extracts, primarily by removing moisture, which prevents microbial degradation and prolongs shelf life, while also potentially affecting the concentration and stability of phytochemicals. The infused fabric is now dried in Shadow temperature at 30-40°C for 3-4hours.

• Drying removes water, a crucial factor for microbial growth and degradation of phytochemicals within the extract. This process increases the shelf life of the extract by slowing or preventing microbial growth and certain biochemical reactions that might alter its characteristics.

III. TESTING & EVALUATION

LIQUID HOLDING CAPACITY

A Liquid Holding Capacity test is necessary to analyze properties such as water retention textile industries. It measures the ability of a material to retain liquid, typically water.

SOFTNESS

Softness tests quantify subjective perceptions of softness by assessing a material's resistance to deformation under pressure. They frequently use tools such as texture analyzers or specialist softness testers.

ABSORBENCY

- Absorbency testing assesses a material's ability to absorb and retain liquids.
- The time it takes for a fabric to become completely wet.
- How much liquid a fabric can hold.
- How quickly a liquid moves through the fabric.

ANTI MICROBIAL TEST

An antimicrobial test, also known as antimicrobial susceptibility testing is a laboratory procedure that determines which antimicrobial agents like antibiotics are effective against a specific microorganism causing an infection, guiding treatment decisions.

The majority of infectious diseases are bacterial in origin. With the discovery of laboratory methods to grow these microorganisms using an appropriate growth medium known as "culture," determining the sensitivity and resistance of specific pathogens to a wide range of antimicrobial agents is necessary so clinicians can immediately institute proper treatment regimens.

Antimicrobial susceptibility testing is a laboratory procedure performed by medical technologists to identify which antimicrobial regimen is effective for individual patients. On a larger scale, the testing aids in evaluating treatment services provided by hospitals, clinics, and national programs to control and prevent infectious diseases.

MOISTURE CONTENT

A moisture content test measures the amount of water present in a sample, typically expressed as a percentage of the sample's weight. This test is used in various industries like food, agriculture, and construction to ensure product quality, determine suitable processing conditions, and monitor material properties. The moisture content of soil also referred to as water content, is an indicator of the amount of water present in soil. Moisture content is the ratio of the mass of water contained in the pore spaces of soil to the solid mass of particles in that material, expressed as a percentage. A standard temperature is used to determine the mass of the sample.

PH VALUE

A pH value test establishes whether a solution is basic or acidic. A pH of 7 indicates neutrality, a number below 7 indicates acidity, and a value above 7 indicates alkalinity. It quantifies the concentration of hydrogen ions (H+) in a substance. The method used to determine a substance's acidity or alkalinity is called pH testing. Because it requires quantifying a single ion species across a wide range of concentrations, expressing a solution's acidity presents difficulties.



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SKIN IRRITATION

Tests for skin irritation determine whether a chemical or other substance has the potential to irritate the skin. These experiments can be carried out in vivo (using animals, though many areas are gradually ceasing to use animal testing) or in vitro (using models of human skin that have been recreated). Examples of in vitro techniques that predict skin irritation using models of the human epidermis include the Epidermal and Skin-ethic tests.

ANTI BACTERIAL

Antibacterial tests, also known as antibiotic susceptibility tests or antimicrobial susceptibility tests, determine which antibiotics will be most effective in treating a bacterial infection. These tests help identify the specific antibiotics a bacteria is sensitive to or resistant to, guiding the choice of treatment for patients. Susceptibility testing for antimicrobial is necessary for patients who raise suspicion of infection based on history and physical exam. Antibacterial agents are then used to detect sensitivity or resistance from bacteria.

ANTI FUNGAL

The term "ANTI FUNGALtest" describes testing methods intended to assess how well antifungal medications work against fungal infections. When resistance to standard antifungals is suspected, these tests are extremely important for diagnosing and treating fungal infections. Finding the minimum inhibitory concentration (MIC) or minimum effective concentration (MEC) of an antifungal medication required to inhibit or eradicate a certain fungus species is the aim of these studies.

TOXICITY

A toxicity test is a procedure used to evaluate the harmful effects of a substance on living organisms. It involves exposing organisms to a substance and observing the effects, comparing them to a control group that is not exposed. These tests help determine the degree to which a substance negatively impacts biological functions, considering factors like exposure duration, route, and concentration.

IV. RESULT & DISCUSION

SKIN IRRITATION TEST

The developed sample with *calotropis gigantea* extract does not have any irritation and itching detected. Compared to market sample in which itching is found. Therefore, the developed sample passes the test.

ANTIMICROBIAL TEST

The developed sample with *calotropis gigantea* extract have no bacterial activities found. But incase of market sample few bacterial activities are found. Concluding it the developed sample passes the test.

GSM-WEIGHT(G/SQMT) TEST

The GSM of bamboo knitted fabric in developed sample has 185.63(g/sqmt) whereas the fabric of the market sample has less GSM compared to the developed eye mask. So, the developed sample has higher GSM compared to the market sample

PH VALUE TEST

The value of the developed sample is 7.1 which is a base value whereas the market sample is with the PH value of 6.1 which is slightly acidic. Therefore, the developed sample with *calotropis gigantea* extract passes the test.

ABSORBECNY(%)

The developed sample has high absorbency 5.25ml per 100grams compare to market sample 2.31ml per 100grams. Therefore, the developed sample with *calotropis gigantea* extract passes the test.

LIQUID HOLDING CAPACITY (ml)

The developed sample has high liquid holding capacity 5.5% compare to market sample 2%. Therefore, the developed sample with *calotropis gigantea* extract passes the test.

ANTI FUNGAL

The developed sample has found no fungal activities compare to market sample found few fungal activities. Therefore, the developed sample with *calotropis gigantea* extract passes the test.

MOISTURE CONTENT (%)

The developed sample has high moisture content 12.82% compare to market sample 4.32% Moisture content. Therefore, the developed sample with calotropis gigantea extractpasses the test.



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ANTI BACTERIAL

The developed sample has found no bacterial activities compare to market sample founf few bacterial activities and microbes. Therefore, the developed sample with calotropis gigantea extract passes the test.

SOFTNESS

The developed sample with bamboo fabric is very soft feel than the market sample which feels slightly hard as the final test reveals that the developed sample passes the test.

AIR PERMEABILITY

The developed sample has high air permeability 112 cm3/cm2/sec compare to market sample 78cm3/cm2/sec.Therefore, the developed sample with calotropis gigantea extract passes the test.

TOXICITY

The developed sample and market sample has same toxicity level 0.0023%. Therefore, the developed sample with *calotropis gigantea* extract passes the test.

BAR DIAGRAM







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V. SUMMARY AND CONCLUSION

The development of the Knee Bandit demonstrated a successful fusion of traditional herbal therapy and modern textile engineering. The *Calotropis gigantea* leaf extract, when applied to bamboo knitted fabric, retained its bioactive properties and showed potential for relieving knee pain through anti-inflammatory action. The treated fabric also exhibited good antimicrobial activity and wash durability, making it suitable for wearable healthcare applications.

The Knee bandage made from *calotropis gigantea* is eco-friendly product made from bamboo knitted fabric. The knee bandage is, antimicrobial, and soft, providing relief from knee pain. It undergoes various testing to ensure its quality, including, skin irritation, antimicrobial tests, GSM tests, softness tests, anti bacterial tests, absorbency tests, pH value s, toxicity and smoothening effect tests, air permeability tests, liquid holding, and anti-fungal testing.

This innovative product represents a breakthrough in the textile innovation and wellbeing sector, combining scientific innovations with natural resources to create a high-quality, functional, and ecologically sustainable productThe knee bandage made from Calotropis gigantea leaf extract in bamboo knitted fabric is a natural, sustainable, and effective solution for providing comfort, support benefits individuals with knee injuries or condition.

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ANUXURE



Plate:06 Developed Sample