International Journal of Scientific Research in Engineering and Management (IJSREM)
Volume: 09 Issue: 06 | June - 2025 SJIF Rating: 8.586 ISSN: 2582-3930

Formulation and Evaluation of Polyherbal Handwash of Terminalia catappa and Elettaria cardamomum

Sahil Deshmukh, Trupti Shirbhate, Vaishnavi Nawghare, Rashmi Sonkusare

1. Abstract:

The rising preference for natural personal care products has encouraged the use of herbal ingredients in hygiene formulations. This study explores the development of an herbal handwash using extract of Desi almond (Terminalia catappa), cardamom (Elettaria cardamomum), aloe vera (Aloe barbadensis), and reetha (Sapindus mukorossi). Desi almond provides essential nutrients that help nourish and hydrate the skin, while cardamom exhibits antimicrobial and refreshing properties. Aloe vera contributes soothing and moisturizing effects, whereas reetha, rich in natural saponins, acts as a mild foaming and cleansing agent. The formulation was analysed using cup-plate method for determining its antimicrobial properties and effectiveness against pathogens. The evaluation of polyherbal handwash was carried out for its pH, cleansing efficiency, and skin-friendliness. Findings suggest that the herbal handwash effectively cleanses without causing dryness or irritation, making it a suitable alternative to chemical-based handwashes. The study underscores the potential of plant-based ingredients in creating sustainable and skin-friendly hygiene products.

Keywords: Herbal handwash, Terminalia catappa, Elettaria cardamomum, Aloe barbadensis, Sapindus mukorossi, antimicrobial, skincare.

2. Introduction-

The skin is the most exposed part of our body and requires protection against skin pathogenicity. Hospital-based infections have proven to be a serious problem in the field of hospital care, which has resulted in extended hospitalizations and substantial morbidity and mortality[1]. The hands of healthcare workers (HCWs) are the main route of transmission of multi-resistant pathogens and infections in patients. Therefore, the antiseptics are used for maintaining hygiene[2]. Many chemical preservatives are available in the market as alcohol-
based disinfectants, chlorhexidine products, and more[3]. They have some adverse effects as their frequent use can lead to skin irritation and also resistance among pathogens[4].Skin infections can be caused by various pathogens, including bacteria like Staphylococcus and Streptococcus, viruses like herpes simplex, fungi like Trichophyton and Candida, and parasites like lice and scabies[5].

Terminalia Catappa Linn. (Indian Almond Tree) leaves have antioxidants, foaming, and antibacterial properties, which help to heal leprosy. It also contains phytochemicals such as tannins, kaempferol and quercetin[6].

Elettaria cardamomum, commonly known as green cardamomum, is an important ingredient of herbal hand washing with antibiotics, antioxidants and skin-free properties. Essential oils such as ±terpinol, 1.8-sinol (eucalyptol), and linalool contribute to their potent antibacterial and anti- mycotic effects and become effective when removing harmful microorganisms. Additionally, its flavonoids, including quercetin and kaempferol, offer antioxidant benefits that protect the skin from environmental damage and oxidative stress. The presence of tannins acts as a natural astringent, contributing to the cleaning and tightness of the skin, while saponins support foam and cleansing effects. Cardamom also contains alkaloids that improve antibacterial activity and ensure thorough hand hygiene. Furthermore, the natural scent provides a refreshing sensory experience, and its moisturizing properties contribute to preventing dryness and irritation. Overall, Elettaria cardamomum plant make a valuable addition to herbal hand washing, ensuring both cleanliness and skin nourishment[7].

Aloe barbadensis, commonly known as aloe vera, is a beneficial ingredient in herbal handwash due to its ability to cleanse, hydrate, and protect the skin. It contains polysaccharides that help retain moisture, preventing dryness and irritation from frequent washing. Its natural antimicrobial properties aid in eliminating bacteria and fungi, ensuring effective hand hygiene. Additionally, aloe vera has anti-inflammatory compounds that soothe redness and irritation,

making it ideal for sensitive skin. It also promotes skin repair and regeneration, thanks to its rich blend of vitamins, amino acids, and antioxidants. The presence of saponins contributes to its cleansing and foaming action, while anthraquinones like aloin and emodin enhance its antimicrobial benefits. With its ability to nourish and refresh the skin, aloe vera is a key component in herbal handwash formulations, providing both cleanliness and skin care benefits[8].

Sapindus mukorossi, commonly known as soapnuts, is an important ingredient in multi-head cleaning due to its natural cleaning, antibiotics and skin-friendly properties. It contains saponins that act as natural surfactants, creating a gentle foam that effectively eliminates dirt, oils and microorganisms without causing dryness or irritation. Its antibacterial and antifungal properties help to remove harmful bacteria, making it a strong but mild alternative to synthetic detergents. Additionally, Sapindus Mukorossi contains flavonoids and phenolic compounds that provide antioxidant and anti-inflammatory benefits that soothe the skin and prevent irritation. The presence of triterpenoids further improves their antibiotics and cleaning effects, ensuring a deep, effective hand hygiene. Soapnut is a sustainable option for vegetable hand washing formulations, offering sustainable options for vegetables and healthy hands[9].

2.1 Benefits:

1. Skin-Friendly & Gentle – Prevents irritation and dryness, making it suitable for frequent use and all skin types.
2. Eco-Friendly & Biodegradable – Made from natural ingredients, reducing environmental pollution.
3. Cost-Effective – Uses easily available herbal components, making it affordable.
4. Additional Skin Benefits – Provides moisturization, soothing effects, and antioxidant protection with ingredients like aloe vera and turmeric.
5. Safe & Chemical-Free – Free from harsh synthetic chemicals, reducing the risk of skin damage and allergies.
6. Holistic Approach – Cleanses while nourishing and protecting the skin, offering a natural alternative to conventional handwashes[10].

3. AIM & OBJECTIVE

Aim: Formulation and Evaluation of Polyherbal Handwash of Terminalia catappa and Elettaria cardamomum.

Objectives:

1. Antibacterial and Antifungal Protection: Combats harmful bacteria and fungi.
2. Skin Hydration and Nourishment: Aloe vera and Terminalia catappa soothe and hydrate the skin.
3. Gentle Cleaning: Soapnut provides natural foaming and gentle cleansing without drying the skin.
4. Antioxidant Protection: Protects skin from free radicals and environmental damage.
5. Eco-Friendly: All-natural, chemical-free, and biodegradable ingredients.
6. Cultural and Medicinal Benefits: Leveraging traditional herbal healing properties for skin care.

4. Plan of work-

1. Collection and Authentication of herbs

2. Preparation of plant extract
3. Formulation of polyherbal handwash
4. Evaluation of polyherbal handwash:

- pH
- Viscosity
- Spreadability
- Antimicrobial assay

5. LITERATURE REVIEW-

1. Satish K. Sharma et.al (2020)

The aim of this study was to develop a herbal handwash with leave extracts of Terminalia Catappa, Curcuma Longa fruit and Garcinia Indica bark. Antibiotic activity against skin pathogens was assessed using disc diffusion process and results were compared with marketed products. Its regular use can lead to skin irritation. Therefore, herbal hand wash was formulated using herbal extracts of T. catappa, C. Longa, G. Indica. The current results shows that ingredients of T. Catappa, C. longa and their combination compositions can develop better preservative hand wash than commercial formulations. Therefore, new ways to combat antibiotic drug resistance in pathogenic organisms and healthier living by germ-free aseptic hands can be found[11].

2. P. Venkatalakshmi et.al (2016)

Terminalia catappa L. is a huge spreading tree that grows along the shore in tropical regions. It is a member of the Combretaceae family. Folklore medicine has utilized many portions of this tree, and studies have shown that it has antibacterial, antifungal, anti-inflammatory, antioxidant, anti-tumour, anti-HIV, hepato-protective, and anti-diabetic qualities. The review's pharmacological effects offer scientific support for the plant's many traditional applications and folklore assertions. Numerous components of this plant have been reported to exhibit a wide range of biological activity. Therefore, the research community, which is searching for the creation of a safe, natural, plant-based medication source for a variety of human ailments, will benefit from this compilation of data about the pharmacological activities and medicinal effects of this plant. From this possible plant source, further thorough research can help create herbal medication that has been scientifically confirmed[6].

3. Sultana J. Pomy et.al (2022)

Investigating the nutritional qualities of individual cardamom husks and seeds was the goal of the current study. According to proximate analysis, cardamom seeds have 14.9% moisture, 11.8% crude fibre, 4.6% ash, 3.6% fat, 10.5% protein, and 56.04% carbohydrates, while the
husk has 11.6% moisture. 32.21% carbohydrates, 2.2% fat, 5.2% protein, 15.4% ash, and 31.8% crude fibre. Determination of water-soluble vitamins and minerals provided the information that, carbohydrate seed contains 0.2% vitamin C, 2.46% calcium, 2.48% magnesium, 13.1% phosphorus and 13.1% potassium. The antimicrobial evaluation also

revealed that the drying method's ZOI had the best value against Staphylococcus aureus. Therefore, it can be said that the cabinet drying technique of cardamom seed shown superior efficacy even though it had the lowest quantity of seed extract yield (12.90%)[7].

4. A T. Tyowua et.al (2019)

The aim of the study was to explore the potential of Aloe vera extract as a natural alternative to synthetic antimicrobial agents like triclosan in hand-washing liquid soaps. Aloe vera, known for its antibacterial and antifungal properties, was incorporated into soap formulations made from a blend of castor, coconut, and olive oils. The antimicrobial effectiveness of the resulting soap was tested against common skin pathogens, including *Staphylococcus aureus*, *Pseudomonas aeruginosa*, and *Aspergillus flavus*. The findings showed that Aloe vera-enriched soaps exhibited similar antimicrobial activity to triclosan-based commercial soaps while offering additional skin benefits such as moisturization. These soaps also demonstrated good cleaning properties, producing abundant foam and effectively removing dirt and microbes. The study suggests that Aloe vera can serve as a safe and effective alternative to synthetic antimicrobial agents in cosmetic formulations, aligning with the growing demand for safer, natural ingredients in personal care products[8].

5. Aruna J. Kora et.al (2020)

The biosurfactants derived from plants are less toxic, renewable, biocompatible, biodegradable, and less costly than chemical surfactants. The pericarps of soapnut fruits, which are known to have a wide range of biological qualities, are used to make the aqueous extract used in this paper. Fourier transform infrared spectroscopy (FTIR) and a zeta analyzer were used to characterize the extract in order to determine its surface charge and functional groups, respectively. The extract had a negative charge of -8.9 mV and was rich in flavonoids, triterpenoids, and saponins. At the chosen concentrations, the extract had no antibacterial effect on Gram-negative bacteria. However, at 43.75 mg of crude saponins, it showed a strong inhibitory effect on Gram-positive bacteria, specifically Bacillus subtilis and Micrococcus luteus, with inhibition zones of 4.0 mm and 12.5 mm, respectively. As an alternative to artificial surfactants, the green extract utilized in this study finds usage in the food and cosmetic sectors as a natural, antibacterial, and antioxidant biosurfactant[9].

6. Description of herbs-

1. Terminalia catappa (Desi almond/Indian almond)

Southeast Asia is the natural home of Terminalia catappa Linn. (Combretaceae). The Latin word "terminalis," which describes the leaves that swarm at the tips of the shoots, is where the generic name comes from. It is a big tree that thrives in tropical and subtropical regions. Different levels of action against Pseudomonas aeruginosa, Pseudomonas testosteroni, Pseudomonas pseudoalcaligenes, Staphylococcus aureus, and Staphylococcus epidermidis are demonstrated by the aqueous and methanolic extracts of T. catappa leaves[12]. When it comes to suppressing the examined microbial strains, the methanolic extract is noticeably more effective than the aqueous extract[13].

- Biological source: Terminalia catappa Linn
- Family: Combretaceae
- Parts used: Leaves
- Uses: Antimicrobial and antioxidant

Fig.1: Terminalia catappa

2. Elettaria cardamomum (Green cardamom)

The well-known spice Elettaria cardamomum, sometimes referred to as green cardamom, has important therapeutic uses. Its antibacterial activity is one of its many bioactive qualities that has drawn a lot of attention lately. Cardamom's essential oils and phytochemicals have high antiviral, antifungal, and antibacterial properties, which makes it a promising natural component for personal hygiene products. Extracts from Elettaria cardamomum can be used in handwash formulations as a plant-based, efficient substitute for artificial antimicrobials. By preventing the growth of dangerous bacteria and being kind to the skin, substances like cineole, terpinene, and flavonoids improve the effectiveness of handwashing solutions. In addition to promoting good hand hygiene, this natural antibacterial activity lowers the risk of illnesses in a sustainable and environmentally beneficial way[14].

- Biological source: Elettaria cardamomum
- Family: Zingiberaceae
- Parts used: Seeds
- Uses: Antimicrobial

Fig.2: Elettaria cardamomum

3. Aloe vera

Aloe vera, or Aloe barbadensis, is well known for its calming, hydrating, and antibacterial qualities. It is a useful component in handwash formulations because of its bioactive components, which include anthraquinones and saponins, which have antibacterial and antifungal properties. Aloe vera has been proven in studies to be efficient against

Staphylococcus aureus and Escherichia coli. It keeps the skin moisturized and free of irritation while improving cleanliness when used in handwash. Its natural makeup ensures efficient washing and skin protection while providing a mild, environmentally responsible substitute for synthetic antibacterial agents[15].

- Biological source: Aloe barbadensis
- Family: Asphodelaceae
- Parts used: Gel
- Uses: Wound healing, skin soothing, and moisturizing

Fig.3: Aloe vera

4. Sapindus mukorossi (Reetha)

The Sapindus mukorossi tree, sometimes referred to as soapnut or reetha, is indigenous to the Indian subcontinent and other Asian regions. Because the fruit's pericarp is abundant in saponins, which are natural surfactants, it has long been used as an alternative to soap. Sapindus mukorossi has significant antibacterial action in addition to its cleaning qualities, which makes it a useful component of handwash formulations. Research indicates that it is efficient against Salmonella typhimurium, Staphylococcus aureus, and Escherichia coli. Its natural foaming and antibacterial properties make it an environmentally beneficial substitute for synthetic detergents in handwash formulas. It is perfect for sustainable hygiene products since it guarantees thorough washing while being gentle to the skin.

- Biological source: Sapindus mukorossi
- Family: Sapindaceae
- Parts used: Seedpod
- Uses: Cleansing

Fig. 4: Reetha

7. MATERIALS AND METHOD-

7.1 Materials:

All the herbal drugs were procured from local market. The polyherbal handwash was formulated using following natural ingredients, which are tabulated in Table 1.

Table 1: Ingredients, biological Sources, and Their Uses

Sr.no	Ingredients	Biological source/family	Uses
1	Terminalia catappa	Combretaceae	Antimicrobial and antioxidant
2	Elettaria cardamomum	Zingiberaceae	Antimicrobial
3	Aloe vera	Asphodelaceae	Wound healing, skin soothing, and moisturizing
4	Sapindus mukorossi	Sapindaceae	Cleansing and foaming
5	Sodium lauryl sulfate (SLS)	-	Cleansing and foaming

7.2 Method of Preparation:

- **Preparation of Plant Extracts:**

The plant matter was gathered straight from the source. Each plant material (plant leaves) weighed 10 g (dry weight) and was added separately to a 100 ml methanol solution. After heating the combination to 60°C in water, it was incubated for one hour. After filtering, the combination was utilized as a methanolic (plant leaves) was put one at a time to a 100 ml methanol solution. After heating the combination to 60°C in water, it was incubated for one hour. For later usage, the mixture was filtered and turned into a methanolic extract.

- **Preparation of Hand-wash:**

The herbal handwash was prepared by mixing 8 ml of methanolic plant extracts with distilled water as quantity sufficient. To achieve the final volume of 20 ml. 5 g of Sapindus mukorossi was added. The solution was thoroughly mixed at room temperature to ensure uniformity, and its antibacterial effectiveness against microorganisms was assessed

Table 2: Formulation of Polyherbal handwash

Ingredients	F1	F2	F3

Terminalia Catappa	4 ml	2 ml	2 ml
Elettaria cardamomum	2 ml	4 ml	2 ml
Aloe barbadensis	2 ml	2 ml	4 ml
Sapindus mukorossi	-	5 g	5g
SLS	3 g	-	-
Water	Q.S	Q.S	Q.S

7.3 Evaluation Parameters-

The prepared herbal handwash was evaluated by following parameters.

A. Physical evaluation of Handwash: The handwash was greenish in colour and translucent in appearance

a. **pH:** The pH of handwash was measured using digital pH meter.

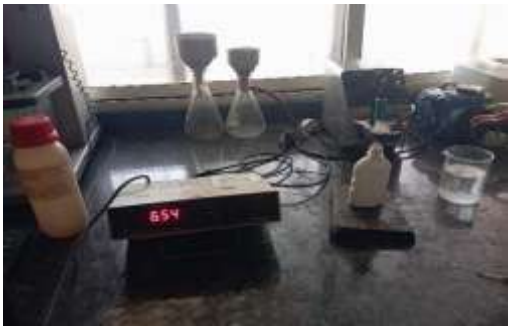

Fig. 5 pH

b. **Viscosity:** The handwash was poured in a beaker and viscometers tip was dipped into the beaker and measured using digital Brookfield viscometer.

Fig. 6 Viscosity

c. **Spreadability:** 0.01 grams of the prepared hand wash were placed between two glass plates, and after one minute, the diameter and Spreadability of the mixture were determined. It was discovered that the Spreadability of the hand was best suited for topical application.

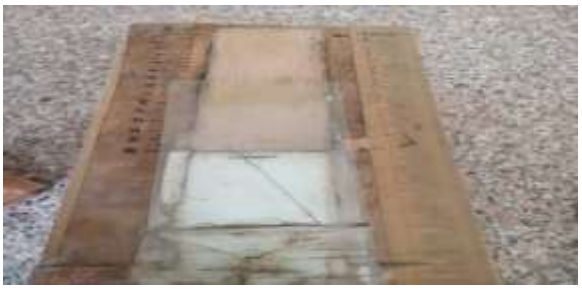

Fig.7 Spreadability

d. **Antimicrobial Assay:** The antibacterial study of the combined plant extracts was evaluated by using cup-plate method**.** Escherichia coli and staphylococcus aureus test culture were used for antimicrobial assay of polyherbal handwash.

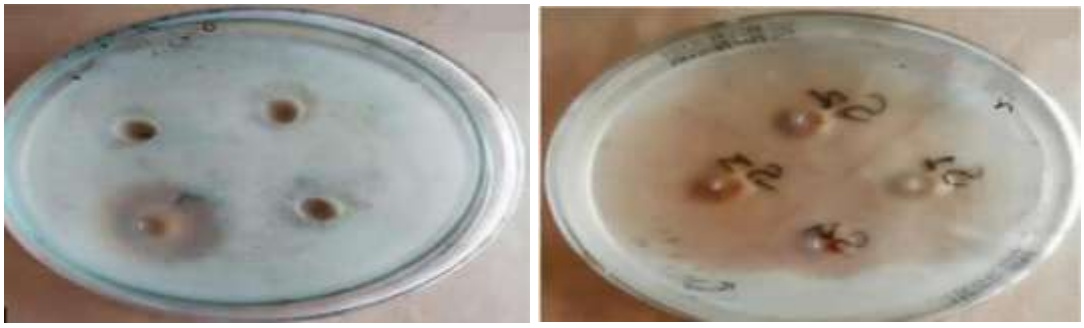

Fig. 8 Zone of inhibition of E. coli and S. aureus

Table 3: Formulations and their zone of inhibition

Formulations	**E. coli**	**S. aureus**
F1	10 mm	12 mm
F2	13 mm	16 mm
F3	15 mm	15 mm
Ciprofloxacin	20 mm	22 mm

8 Result and Discussion-

The findings of the cup plate method demonstrated that the handwash made with methanol extract from a blend of naturally occurring plant materials can be used as an effective alternative to commercially available handwashes.

Table 4: Comparative evaluation of the formulations

Parameters	**F1**	**F2**	**F3**

pH	6.54	6.61	6.76
Viscosity	600cP	877cP	1247cP
Spreadability	12	12.7	13.2

Terminalia catappa, Elettaria cardamomum, Aloe barbadensis, and Sapindus mukorossi are all natural ingredients that work in concert to provide a polyherbal handwash that has antibacterial, skin-soothing, and cleaning qualities. In response to the increased consumer desire for safe and natural personal care products, the combination of these botanicals offers a possible substitute for handwashes made with synthetic chemicals.

The Indian almond tree, Terminalia catappa, is well-known for its antioxidant and antibacterial qualities. Numerous investigations have shown that T. catappa has antibacterial properties against a variety of pathogens, such as Staphylococcus aureus and Escherichia coli[16]. Its capacity to prevent microbial development is facilitated by the presence of bioactive substances such phenolic acids, flavonoids, and tannins. Additionally, T. catappa has anti-inflammatory qualities that may help reduce skin irritation, which makes it advantageous to include in regularly used handwashes[6]. This makes it the perfect component for products meant to safeguard the health of the skin and encourage cleanliness.

In addition to its antibacterial and antifungal properties, cardamom has a nice scent and skin- conditioning properties. It is efficient against diseases like Pseudomonas aeruginosa[17]. Aloe vera is well known for its calming, moisturizing, and antibacterial qualities, which assist to moisturize the skin and stop bacteria from growing[18]. Soapnut is perfect for delicate skin
since it functions as a natural surfactant, offering foaming and washing qualities without the use of harsh chemicals[19].

9 Conclusion-

A potential natural substitute for hand hygiene products based on artificial chemicals is the creation of a polyherbal handwash utilizing Terminalia catappa, Elettaria cardamomum, Aloe barbadensis, and Sapindus mukorossi. Each of these plants has special advantages: Aloe barbadensis provides moisturizing and calming qualities[8], Terminalia catappa gives antimicrobial and anti-inflammatory qualities[6], Elettaria cardamomum delivers antibacterial and skin-conditioning benefits[7], and Sapindus mukorossi functions as a natural surfactant with potent cleaning capabilities[9]. It is appropriate for regular use because of the combination of these substances, which guarantees both excellent antibacterial action and skin health. For consumers looking for natural personal care products, this formulation provides a safe, environmentally responsible, and efficient substitute.

10. References:

1. Mehta Y, Gupta A, Todi S, Myatra SN, Samaddar DP, Patil V, Bhattacharya PK, Ramasubban

S. Guidelines for prevention of hospital acquired infections. Indian journal of critical care medicine: peer-reviewed, official publication of Indian Society of Critical Care Medicine. 2014 Mar;18(3):149.

2. Gall E, Long A, Hall KK. Infections due to other multidrug-resistant organisms. InMaking Healthcare Safer III: A Critical Analysis of Existing and Emerging Patient Safety Practices [Internet] 2020 Mar. Agency for Healthcare Research and Quality (US).

3. Lompo P, Agbobli E, Heroes AS, Van den Poel B, Kühne V, Kpossou CM, Zida A, Tinto H, Affolabi D, Jacobs J. Bacterial contamination of antiseptics, disinfectants, and hand hygiene products used in healthcare settings in low-and middle-income countries—A systematic review. Hygiene. 2023 Apr 13;3(2):93-124.

4. Lansdown AB. Silver in health care: antimicrobial effects and safety in use. CURRENT PROBLEMS IN DERMATOLOGY-BASEL-. 2006 Jun 13;33(R):17.

5. Laube S. Skin infections and ageing. Ageing research reviews. 2004 Jan 1;3(1):69-89.

6. Venkatalakshmi P, Vadivel V, Brindha P. www. ijrap. net.

7. Pomy SJ. *Physicochemical, Bioactive & Antimicrobial Property Analysis of Cardamom (Elettaria cardamomum) Seed and Husk and its Flavor Extracted by Different Extraction Methods* (Doctoral dissertation, Chittagong Veterinary and Animal Sciences University Chittagong–4225, Bangladesh).

8. Tyowua AT, Vitalis TB, Terhemen MM, Mbaawuaga EM. Aloe Vera (Aloe barbadensis Miller) Extract as a Natural Antimicrobial Agent in Hand-Washing Liquid Soap. Nigerian Annals of Pure and Applied Sciences. 2019 Dec 31;2:96-107.

9. Kora AJ. Antibacterial and Antioxidant Activities of Aqueous Extract of Soapnuts (Sapindus mukorossi). Current Trends in Biotechnology & Pharmacy. 2020 Oct 1;14(4).

10. Ganguly D, Banerjee M, Chakraborty A, Das H, Sekh A, Arif MD, Arif ST, Ghosh R, Ghosh S, Sahoo DK. Preparation and Evaluation of Polyherbal Handwash of Different Herbal Sources. Neuroquantology. 2022 Nov;20(11):8113-23.

11. Sharma SK, Singh S. Antimicrobial herbal soap formulation. J. Pharmaceut. Res. Int. 2020;32(36):82-8.

12. Anand A, Divya N, Kotti P. An updated review of Terminalia catappa. Pharmacognosy reviews. 2015 Jul 1;9(18):93.

13. Nair R, Chanda S. Antimicrobial activity of Terminalia catappa, Manilkara zapota and Piper betel leaf extract. Indian journal of pharmaceutical sciences. 2008 May;70(3):390.

14. Bhatti HN, Zafar F, Jamal MA. Evaluation of phenolic contents and antioxidant potential of methanolic extracts of green cardamom (Elettaria cardamomum). Asian Journal of Chemistry. 2010 Jul 1;22(6):4787.

15. Arbab S, Ullah H, Weiwei W, Wei X, Ahmad SU, Wu L, Zhang J. Comparative study of antimicrobial action of aloe vera and antibiotics against different bacterial isolates from skin infection. Veterinary Medicine and Science. 2021 Sep;7(5):2061-7.

16. Joseph A, Subramanian S, Ramamurthy PC, Sampath S, Kumar RV, Schwandt C. Iminodiacetic acid functionalized polypyrrole modified electrode as Pb (II) sensor: synthesis and DPASV studies. Electrochimica Acta. 2014 Aug 10;137:557-63.

17. Sivaperumal P, Rajendran R. Antimicrobial and antioxidant activity of cardamom (*Elettaria cardamomum*). *J Med Plants Res*. 2010;4(6):438-442.

18. Boudreau MD, Beland FA. An evaluation of the biological and toxicological properties of Aloe vera. J Environ Sci Health C. 2006;24(1):103-129.

19. Mukherjee TK, Saha S, Datta S. Soapnut as a natural cleansing agent: A review of traditional and current uses. *Asian J Nat Appl Sci*. 2016;5(2):69-74.