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Development and evaluation of polyherbal foot care cream

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ABSTRACT

Feet are an important organ of the human body but are often neglect. Feet need to be taken care of comfort, beautification, and protection from various microorganisms. The object of the present work is to formulate and develop foot care cream with polyherbal ingredients having various activities like healing and antimicrobial. The various herbs have been reported to having antimicrobial activities are to be selected, aqueous and ethanolic extract of it has been incorporated in foot care cream and was evaluated for its activities. It has been concluded that the product has been good foot care property.

Keywords— Footcare, Polyherbal cream, Aqueous extract, Ethanolic extract, Antimicrobial

1. INTRODUCTION

The skin is the body's first line of defence for external exposure. The signs of ageing are most visible in the skin. Although ageing skin is not a threat to a person, it can have a detrimental effect on the psychology of a person^[3]. Much of the premature ageing occurs as a direct or indirect result of the skin's interaction with the environment. Feet is an important organ of the human body and are exposed to lots of friction and external environment. The lack of oil gland on the sole of foot predispose it to dry skin. Negligence to the feet can lead to different disorders generally due to improper footwear, and one can suffer from infections because of an external penetration of dirt, fungus, bacteria through these cuts and wound. It is reported that bacterial decomposition gives rise to foot odour, in which bacteria *Staphylococcus epidermidis* is responsible. Also, foot resident microorganisms are responsible for infection such as *Candida albicans*, *E.coli* and *Staphylococcus aureus*^[2].

The traditional systems of medicine evolved over centuries had been responsible for safeguarding healthcare of the world until the advent of the allopathic system of medicine. As the latter system used knowledge of modern biology and chemistry, for both discovery and treatment, it found fast acceptability among the users and now it occupies predominant space in the area of health care. In spite of this, the contribution of the traditional preparations, which are normally polyherbal, is increasing because of the general impression that these products are safe; while the single-molecule based modern drugs used in the allopathic system can have severe adverse effects^[3]. The polyherbal plant extract is known to have antibacterial, healing, smoothening activity improves skin texture. In these studies, attempts have been made to develop foot care cream from the polyherbal extract. Plants and their extracts have immense potential for the management and treatment of wounds. The phytochemicals for wound healing are not only cheap and affordable but are also safe as hypersensitive reactions are rarely encountered with the use of these agents World Health Organization (WHO) has been promoting traditional medicine as a source of less expensive, comprehensive medical care, especially in developing countries. Eight per cent of the world's population relies on medicinal plants for their primary health care. WHO also recognized the importance of traditional medicine and has treated.

2. OBJECTIVES

To develop the most effective dosage of a drug to meet patient compliance. To evaluate the prepared dosing to establish a desired effect on the patient. The objective in foot care is to heal the cuts, cracks in the shortest time possible, with minimal pain, discomfort, and scarring to the patient certain factors that affect the wound healing process include bacterial infection.

3. MATERIAL AND METHOD

3.1 Selection of material

In the present study, an indigenous herbal formulation containing *Moringa oleifera* (Drumstick plant), *Ficus religiosa* (Peepal), *Bryophyllum pinnatum* (Panfuti), *Annona squamosa* (custard apple), *Trigonella foenum* (fenugreek seed), *Azadirachta indica* (Neem oil) which claims to have the potential in the treatment of wounds, burns, etc.

3.1.1 *Moringa oleifera* (Drumstick plant): *M. oleifera* is a small or middle-sized tree about 10m in height cultivated throughout India. It is known as drumstick in English, Shevga in Marathi. The leaves are bipinnate or more commonly tripinnate usually 1-2 cm long.

- **Taxonomical classification**

Kingdom: - Plantae

Order: - Brassicales

Family: - Moringaceae

Genus: - *Moringa*

Species: - *M.oleifera*

- **Phytochemical constituents:** The leaves contain niazirin, niazirinine- a nitrile glycoside, benzyl isothiocyanate, benzyl glucosinolate, aminoglycoside, vitamins, sterols, palmitic acid ethyl esters, magnesium, iron, calcium, potassium, etc. Tannins in aq. Ext. show a potent antibacterial effect [12].

- **Uses:** It is known to show Antioxidant, Antimicrobial, Anti-inflammatory, Wound healing, Antiseptic, Anthelmintic activities.



Fig. 1: Moleifera

3.1.2 *Ficus religiosa* (Peepal): The tree grows very large in size with wide-spreading branches and brown colored bark. It has thin shiny leaves and the fruit is compressed and circular in shape. New immature leaves are red pinkish in color which turns into deep green at the stage of maturity. Leaves are chordate in shape with a distinctive extended drip tip 10-17 cm in length, 8-12 cm broad, and 6-10 cm petiole. Upto 30 meter tall and 3 meter trunk diameter.

- **Taxonomical classification**

Kingdom: - Plantae

Order: - Rosales

Family: - Moraceae

Genus: - *Ficus*

Species: - *F.religiosa*

- **Chemical constituents**

Bark – Steroids, flavonoids, alkaloids, phenol content, glycoside compounds, sterols.

Leaves- Steroids, flavonoids, glycosides, tannins, terpenoids, saponins, polyphenolic compounds, sterols. Tannins possess an ability to increase a collagen content which promotes healing of the skin [10].

- **Uses:** It is having wound healing (leaves), Anti-inflammatory and antimicrobial (bark), an anti-ulcer activity which is some mentioned here.



Fig. 2: Peepal leaves and bark

3.1.3 *Bryophyllum pinnatum* (Panfuti): It is an erect, more or less branched, smooth, succulent herb, 0.4-1.4 meter in height. Leaves are simple or pinnately compound, with the leaflets elliptic, usually about 10 cm long, thick, succulent and scalloped margins. They widely grow in hot and humid areas around the dwelling places, along with roadsides and abandoned farm and fields.

- **Taxonomical classification**

Kingdom: - Plantae
Order: - Saxifragales
Family: - Crassulaceae
Genus: - Bryophyllum
Species: - B.plantae

- **Chemical constituents:** The plant contains alkaloids, flavonoids, phenolic compounds, tannins, macroelements (magnesium, calcium, potassium, phosphorous, sodium), microelements (iron and zinc), vitamins (ascorbic acid, riboflavin, thiamine, niacin), carbohydrates make plant fleshy and thick. It also contains phenolic acid and caffeic acid, syringic acid malic acid, oxalic acid, ferulic acid^[11].
- **Uses:** Bryophyllum shows useful activities among them useful for skin care is, antibacterial, Antifungal, Anti-inflammatory, Wound healing, in the treatment of hypertension



Fig. 3: Bryophyllum

3.1.4 Annona squamosal (Custard apple): The custard apple tree is erect with a rounded and spreading crown trunk height ranges from 15-35 feet. The leaves are 5cm-17cm long, 2cm-6cm wide rounded at the base and pointed at the tip. The leaves are 4cm-8cm long, light green and become pale yellow on drying.

- **Taxonomical classification:**

Kingdom: Plantae
Order: Magnoliales
Family: Annonaceae
Genus: Annona
Species: A.squamosa

- **Chemical constituents:** The plant is reported to contain alkaloids, flavonoids, carbohydrates, proteins, phenolic compounds, phytosterols and amino acids. Tannins are responsible for promotes collagen formation and helps in healing, alkaloids produce antimicrobial effect^[9].
- **Uses:** A squamosa shows the antimicrobial, wound healing, Antiparasitic also used in the treatment of dysentery and urinary tract infection which is commonly known.



Fig. 4: Squamosal leaves

3.1.5 Trigonella foenum (Fenugreek): Fenugreek plant is a herbaceous annual plant grown for its seeds and leaves. The leaves of the plant are trifoliate with ova leaflet. 10-20 seeds are produced per pod and they are small smooth and yellow each divided into two lobes.

- **Taxonomical classification**

Kingdom: - Plantae
Order: - Fabales
Family: - Fabaceae
Genus: - Trigonella
Species: - T.foenum-graecum

- **Chemical constituents:** The plant contains alkaloids, saponins, tannins, sterols. The seed contains 45-60% carbohydrates, 20-30% of proteins. Trigonelline and coumarins are the alkaloids which include cinnamic acid and scopoletin^[8].

- **Uses:** Fenugreek shows many useful actions the antibacterial, antifungal action is most useful in the preparation of formulation.



Fig. 5: Fenugreek seeds and leaves

3.1.6 Azadirachta indica (Neem): Neem is a fast-growing tree that can reach a height of 15-20 meter. It is an evergreen tree. Neem oil is obtained from seeds. It is a medicinal tree with many uses found throughout India^[1]

- **Taxonomical classification:-**

Kingdom: - Plantae

Order: Sapindales

Family: Meliaceae

Genus: Azadirachta

Species: A.indica

- **Chemical constituents:** Leaves contains Nimbin, nimbolinin, nimbidine, sodium nimbinat, ascorbic acid, sitosterol, polyphenolics, flavonoids, triterpenoids, and proline. Nimbidin and Nimbolinine show antifungal and antibacterial activity^{[1],[4]}.

- **Uses:** Neem is found to be very useful plant it shows Antibacterial, Antifungal, Anti-inflammatory, Antiviral, Ant diabetics, Anthelmintic activity.



Fig. 6: Neem leaves and oil

3.2 Collection of plants

All Plant materials (M.oleifera leaves, Annona squamosal leaves, Bryophyllum pinnatum leaves, Ficus religiosa(leaves and bark) were collected from the local areas of Solapur and are confirmed to be the same. TheAzadirachat indica (Neem oil) is purchased from Peacock Pharm, Solapur. The Trigonella foenum (fenugreek) seeds purchased from Ayurvedic Medicine shop and confirmed to be the same by Department of Pharmacognosy D.S.T.S. Mandal's College of Pharmacy, Solapur.

4. EXTRACTION

All the plant leaf were washed under running tap water and are separated from the twigs, spread and allow shade dry for 5 to 7 days for complete drying which is powdered, which is later used for the extraction process.

4.1 Aqueous extraction process

The method used in aqueous extraction is Decoction method. The accurately weighed 50gm of fine powder is added into a beaker, the sufficient quantity of distilled water is added into a beaker and is heated with frequent stirring for the specified period of time until complete decoction occurs. The solution is allowed to cool for some period and allow filtration, the filtrate is evaporated on a water bath until solid extract is obtained. This extract is used for formulation. In the decoction method, the water-soluble constituents from the plant are dissolved in it at a moderately high-temperature condition. These water-soluble contents are then crystallized on evaporation of water leaving behind the solid extract. The percentage yield obtained as -Peepal leaves-14.08%, Peepal bark-1.44%, Drumstick leaves-13.56%, Panfuti leaves-22.12%, Sitafal leaves-14.24%

4.2 Organic extraction process

In organic Extraction process the ethanolic extract is obtained by using Soxhlet Apparatus. Air dried coarsely powdered plant material (Drumstick leaves, Custard apple leaves, Panfuti leaves, Peepal leaves and bark) were extracted with ethanol (95%) using Soxhlet apparatus. The solution is then concentrated using evaporation on a water bath at a moderate temperature, the residue obtained is crystallized. The percentage yield was obtained to be 15.72%

5. FORMULATION

The formulation of foot care cream was carried out by using a cream base. The formulation of the foot care cream contains the following contents:

Neem oil- as a natural preservative, antimicrobial, Fenugreek seed powder- as an antimicrobial, soothing agent, Sitalfal aq. Extract- like a wound healer, antimicrobial, Drumstick aq. Ext.- as an antimicrobial, anti-inflammatory, Panfuti aq. Ext.-as a wound healer, antimicrobial, antifungal, Peepal aq. Ext. (leaves and bark)- as an anti-inflammatory, wound healer. Ethanolic Ext. - Antimicrobial, antifungal, wound healer, anti-inflammatory, Urea - as a permeation enhancer, karyolytic. Glycerin- as a humectant, soothing agent. Steric acid- like a cream base, Potassium hydroxide- as an emulsifier in the formulation.

5.1 Procedure

An oil in water emulsion type cream was Formulated and different concentration of extracts was incorporated as per given in the formulation table.

Table 1: formulation table of footcare cream (for 10 gm.)

Ingredients	F1	F2	F3	F4	F5
Aqueous Ext.	250mg	350mg	400mg	450mg	500mg
Ethanolic Ext.	50mg	60mg	70mg	80mg	90mg
Steric acid	2gm	2.2gm	2.3gm	2.4gm	2.5gm
Potassium hydroxide	100mg	110mg	12mg	130mg	140mg
Urea	1gm	1.1gm	1.3gm	1.4gm	1.5gm
Glycerin	1gm	1.1gm	1.3gm	1.4gm	1.5gm
Distilled Water	6.5gm	6.7gm	6.8gm	6.9gm	7gm
Neem oil	0.1ml	0.1ml	0.1ml	0.1ml	0.1ml
Perfume	0.1ml	0.1ml	0.1ml	0.1ml	0.1ml

6. EVALUATION

6.1 Physico-chemical evaluation parameters

- **Appearance:** The appearance of the cream was judged by its color, pearlescence and roughness^[6]
- **pH:** Accurately weighed 5 g of the sample was dispersed in 45 ml. The pH is determined by using pH paper.
- **Spreadability:** Spread ability may be expressed by the extent of the area to which the topical application spreads when applied to the affected parts on the skin.
- **Washability:** This test is carried out by simply washing applied cream with water.
- **Determination of type of smear:** It was determined by applying the cream on the skin surface of a human volunteer. After application of the cream, the type of film or smear formed on the skin were checked.
- **Homogeneity:** The formulations were tested for the homogeneity by visual appearance and by touch.

6.2 Determination of the type of emulsion

- **Dye solubility test:** In this test, an emulsion is mixed with a water-soluble dye (amaranth) and observed under the microscope. If the continuous phase appears red, it means that the emulsion is o/w type as the water is in the external phase and the dye will dissolve in it to give color^{[6],[3]}.
- **Stability study:** Physical stability test of the formulations were carried out for four weeks at various temperature conditions like 2°C, 25°C and 37°C. The formulations were found to be physically stable at different temperature i.e. 2°C, 25°C and 37°C within four weeks
- **Observations**

Table 2: Observations of evaluation parameters

Parameter	F1	F2	F3	F4	F5
Appearance	Faint green	Faint green	Faint green	green	green
pH	5	5	5	6	6
Spreadability	Fair	Fair	Good	Good	Good
Washability	Non-washable	Non-washable	Somewhat washable	Washable	Washable
Type of Smear	Greasy	Greasy	Greasy	Non-greasy	Non-greasy
Homogeneity	Non-homogenous	Non-homogenous	Non-homogenous	Homogenous	Homogenous
Type of Emulsion	O/W	O/W	O/W	O/W	O/W

6.3 Antimicrobial evaluation

- **Procedure:** For screening, this test the dilution of the extract was prepared. For this 0.2 gm. of cream was weighed and to this 0.8 ml of sterile distilled water was added^[7]. Antimicrobial activity of cream was observed against *Sephylococcus aureus* by using well plate method, for studying zone of inhibition. Microorganisms were grown in a suitable culture medium. The wells were filled with the diluted formulation, the plates were incubated at 37°C for 48 hrs. The activity of cream is indicated by a clear zone of inhibition around wells, this zone of inhibition was recorded. The results are summarized in the table.

Table 3: Microbiological observation

	F4	F5
S.aureus	Resistant	Resistant

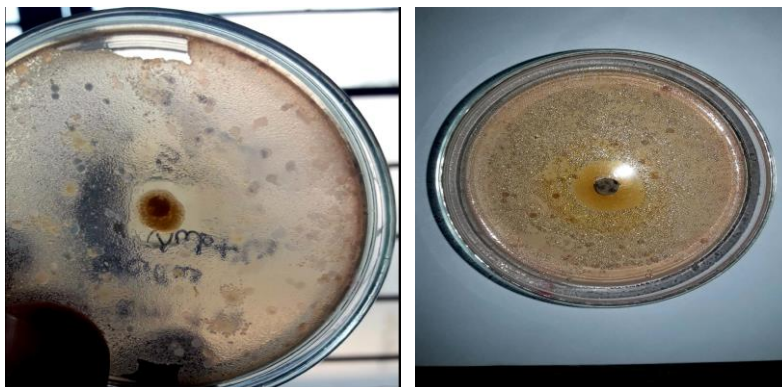


Fig. 7: Microbiological observation

6.4 Subjective Evaluation

From antimicrobial observation the formulation with highest ability was selected for subjective evaluation [2]. Foot cream was given to 5 subjects to use for 1 week to carry out the evaluation. These subjects were asked to use the cream for a week and note down the changes after the use of cream. They were asked to evaluate cream on the basis of appearance, spreadability, skin changes on feet and irritancy (if any). They were asked to rate the product on overall performance. The result is then interpreted in the compiled form.

Table 4: Observation of the subjective evaluation.

Subject			Parameters for evaluations		
S.no.	Age	Sex	Appearance	Spreadability	Skin changes
1	44	Male	Good	Good	Appears
2	28	Male	Good	Good	Appear
3	30	Female	Good	Good	Appear
4	22	Male	Good	Good	Appear
5	32	Female	Good	Good	Appear



(a) Subject 1



(b) Subject 2



(c) Subject 3



(d) Subject 4



(e) Subject 5

Fig. 8: Subjective Evaluation

7. RESULTS AND DISCUSSION

The polyherbal foot care cream was prepared using the aqueous extract and ethanolic extract of plants mentioned above shows good antimicrobial test against *S.aureus* found to be maximum with formula5. From the antimicrobial evaluation, it is found that the foot care cream prepared using the aqueous and ethanolic extract of plants mentioned above are found to be effective against *S. aureus* which is mainly responsible for foot disorders. From the subjective evaluation, it is found that foot care cream is having a good appearance, spreadability and provide the necessary protection against foot infection and provide good healing property for cracked heels.

8. CONCLUSION

Thus from the present study, it can conclude the polyherbal foot care cream prepared from the different plants mentioned above are acceptable in view of appearance, spreadability and antimicrobial activity. The polyherbal foot care cream effective against *S.aureus* and good healing property for cracked heels.

9. ACKNOWLEDGEMENT

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