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Green synthesis of bio based detergent from *Madhuca longifolia* seed oil

Suresh Kumar S*, Venkatesh Srinivasan, Subashini R., Venkadeswaran Karuppasamy, Nithya S., Padmapriya B. and Sumitha R.
Department of Biotechnology, P.S.R. Engineering College, Sivakasi-626140, Tamilnadu, India
sureshkumar4681@gmail.com

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Abstract

Surfactant mixtures with cleaning properties make up bio-detergents. Surfactant agents are chemicals like detergents and soaps. Crude oil, which is a finite fossil fuel with a finite supply, is used to make these compounds. To deal with these issue, bio detergents were prepared by using natural oils. Mahua oil extracted from Madhuca longifolia seeds are the potential surfactants and they were rich in fatty acids used for the preparation of bio detergents. The combination of plant M. longifolia seed oil and Ocimum basilicum leaves allowed us to enhance the wash performance. This study found that mahua oil has a promising application, particularly in the soap industry.

Keywords: Bio detergent, *Madhuca longifolia*, *Ocimum basilicum*, surfactant, Antimicrobial Activity.

Introduction

The nature of synthetic or chemical detergents are non-Biodegradable, causes soil pollution and water pollution, in order to overcome the disadvantages, the production of bio detergent was established with the help of plant oil[1]. *Madhuca longifolia* is a fast-growing evergreen shrub that has a wide range of medicinal properties. Breathing disorders, indigestion, and headaches are treated with a decoction made from the leaves. Flowers are borne on hairy bunches of beginner or pink flowers, each with 12 aromatic cream-colored vegetation. The vegetation only lives for one night before dying and falling on the earth. Pollinated plants mature into a fleshy, greenish ovoid fruit with one to four shiny, oily brown seeds. The seeds are 3-five cm length, elliptical and flattened on one side[2]. The seeds were utilized for the production of mahua oil.

The Lamiaceae family includes sweet basil (Ocimum basilicum L.), which comprises approximately 200 species with a wide range of botanic varieties and forms[3-5]. Ocimum basilicum has traditionally used to treat diarrhoea, constipation, headaches, warts, worms, coughs, and kidney failure[6]. *Ocimum basilicum is a well-known medicinal herb as well as a source of essential oils derived from the leaves and flowering tips, which are used to flavour items, in dental and oral medicines, and in fragrances*[7-9]. Every basil type's aromatic characteristic is identified by genotype and is based on the key secondary metabolites of essential oils, which are primarily monoterpenes and phenyl propanoids[10,11] . Antibacterial activity, fungicidal, and insect repellent properties, as well as antiepileptic, seductive, and antioxidant properties, are all found in the essential oil. Surfactants are essential for laundry detergent's cleaning quality as well as the elimination of water surface tension. A surfactant molecule is made up of two components, one of which is hydrophobic (insoluble in water) and the other of which is hydrophilic (soluble in water). Biosurfactants have been used in a wide range of therapeutic applications, along with the solubilization of lipophilic materials in aqueous media and as emulsion compounds[12,13]. Currently, petroleum based surfactant are used which consist of many chemicals and these compounds are very toxic to the environment.

Soaps are long-chain fatty acid sodium or potassium salts. As aqueous NaOH or KOH reacts with fat or oil, it produces soap and glycerol[14]. This is referred to as alkaline ester hydrolysis, and it results in the formation of soap. Herbal soap is commonly used to cure a number of skin ailments and hair loss issues. Plants that contain more vitamins, antioxidants, tannins, terpenoids, and some bioactive molecules, refresh, and defend the hair and skin from psoriasis, eczema, dry skin, melanoma, and other skin and hair disorders[15]. Recently, oil is used as a surfactant for the production of bio detergent. Mahua oil is one of the medicinal oil extracted from *Madhuca longifolia* and it has a high saponification value and also anti inflammation and anti-bacterial properties[16]. Due to increase environmental pollution from chemical detergent few efforts have been made to enhance this production by varying the natural additive during formation of bio detergent.

Therefore, this study performed to formulate laundry detergent with combination of medicinal valued oil and bacteria protease enzyme to enhance the efficiency of Bio-detergent performance.

Materials and methods

Solvents and reagent: To preserve the fragrance content and improve efficiency, the seeds of *M. longifolia* were stored, dried at room temperature, and grinded, whereas the collected leaves of Ocimum basilicum used fresh when required. All grinded sources were stored in a cool, dark location for future use.

Extraction of oils from seed: At 60°C for approximately 3 hours, the pulverised *M. longifolia* seed (388g) was taken to soxhlet extraction with n-hexane as the solvent. To obtain the oil, the extract was concentrated by distillation. The collected oil was 59g.

Preparation of soap: 4.05g of NaOH dissolved in 16.2ml of distilled water and 30ml of pretreated *M. longifolia* oil were added to it. 3g sodium carbonate were added along with grinder O. basilicum fresh leaves. These mixture was poured into a mold. The mold was dried for 2 weeks.

Saponification value of mahua oil: The saponification value was carried by Said Nurdin[17]. 1ml of *M. longifolia* oil was taken with 25ml of 0.1M KOH and add 10 ml of Ethanol. 25ml of 0.1M KOH is mixed with 10ml of ethanol was taken as a blank. Both sample and blank are boiled for 30mins shaking at regular intervals of 5mins then cooled at room temperature. Sample and blank was titrated against the 0.5M of HCl. Few drops of phenolphthalein indicator were added. At which point pink colour will turn to colourless that point will be noted as the value of volume consumed by HCl.

Soap characterization: Foam ability test: 2g of each sample detergent was put into 100 ml of distilled water. The mixture was shaken vigorously and allow to stand for about 5 to 10 minutes. The foam's height was measured and recorded.

Hardness tests: By injecting a regular hand-sewing needle into the soap, the hardness was determined. The average depth of the needle's penetration was identified and recorded.

pH test: 1g of soap was weighed and liquefied in 10ml distilled water and made up to 100ml. The pH metre electrode was put in into the detergent solution and the value was noted.

Solubility tests: In a 50ml measuring jar having 10ml of distilled water, 0.2g piece of soap was introduced. The time it took for the soap to liquefy was noted.

Wash performance analysis: White Cotton cloth sample were cut to into five pieces and were stained with starch. The stains were allowed to dry and they were washed with S1 and S2 detergents.

Results and discussion

Physical Characteristics of the soap samples: Soap samples (S1 and S2) were investigated for their physicochemical properties. The extract of *O. basilicum* is high in vitamin C, which helps to prevent wrinkles and fine lines. It also has antibacterial properties and can be used as an active ingredient. Normally, pH value of the soap ranges from 8-10 which determine the acquired pH suggest that the soaps might be much less eroding and is predicted to have less skin response. Higher pH values are typically acquired (with the frequent use of NaOH or KOH) due to partial hydrolysis, which effects from the saponification reaction. The use of detergent with a high pH content raises the pH of the skin, causing inflammation, itching, and the loss of bacterial flora[18]. The hardness value is directly proportional to the hardness of the soap, more hard oils (Mahua oil) helps create a firmer bar of soap.

Figure-1: Bio detergent.

Table-1: S1: Mahua oil S2: Mahua oil + *O. basilicum* extract.

Soap Sample	pH	Height of Foam(cm)	Solubility (sec)	Hardness (cm)	Texture
S1	8.73	3.15	420	1.57	Hard
S2	8.61	2.61	420	1.07	Hard

Table-2: Physiochemical characteristics of the oil.

Parameter	Mahua oil
Saponification (mg KOH/g)	190.7
Physical state at room temperature	Liquid
Color	Pale Yellow

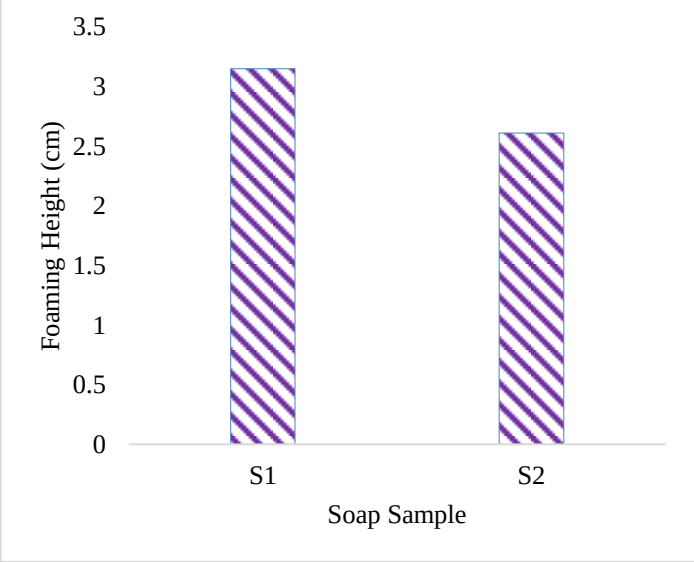

Figure-2: Foaming ability of the soap. Where S1: Mahua oil S2: Mahua oil + *O. basilicum* extract.

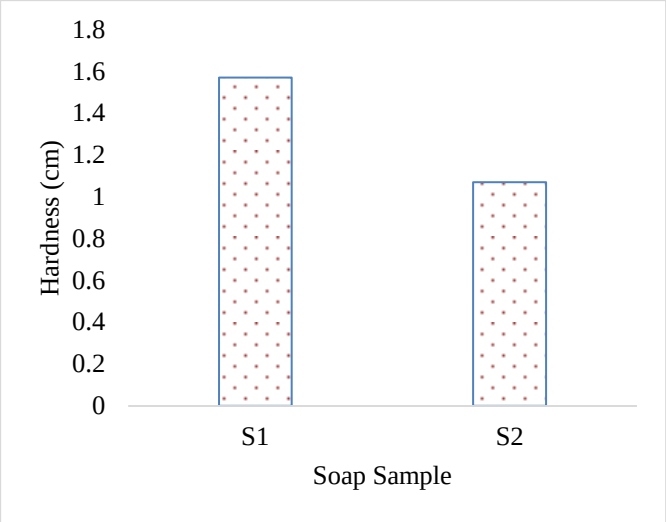

Figure-3: Hardness of the soap. Where S1: Mahua oil S2: Mahua oil + *O. basilicum* extract.

Antimicrobial Activity of the produced Bio Detergent: As compared to the standard drug, the prepared soaps had the maximum Zone of Inhibition (Table-3) against *Streptococcus aureus* (Ampicillin). The antimicrobial activity showed that the produced soap will prevent microbial infections. Similarly, *O. basilicum* leaf extract nanoparticles inhibited the growth of *Escherichia coli, Klebsiella pneumoniae*, and the gram negative bacteria *Staphylococcus aureus* and *Bacillus subtilis*[20]. Washing the fabric or body with antiseptic or medicated soaps is the first line defense against pathogens and other infectious agents colds, fevers, dermatitis, and even fatal communicable diseases.

Table-3: Zone of Inhibition of *Streptococcus aureus* using Ampicillin.

Sample code	Zone of *streptococcus aureus* (mm)
S1	18
S2	25
Ampicillin	14

Stain removal by bio detergent with mahua oil extract: Destaining experiment carried out at normal room temperature showed visual effect when compared to the controls. Figure4 reveals that the *M. longifolia* extract greatly improves the capability to eliminate starchy stains from cotton cloth compared to the mere use of detergent S1. The increase in washing efficacy revealed by adding *O. basilicum* flavour to detergent was consistent with other studies.

Conclusion

This analysis of physiochemical characteristics of *M. longifolia* oil revealed a promising pH stability spectrum. This research is important because it demonstrates antimicrobial activity and is a better alternative to chemical surfactants. Furthermore, the association of its additives with bio detergent components to increase wash efficiency by effectively eliminating starch stain leads one to believe that the potential use of this plant-based detergent as laundry detergent is very promising.

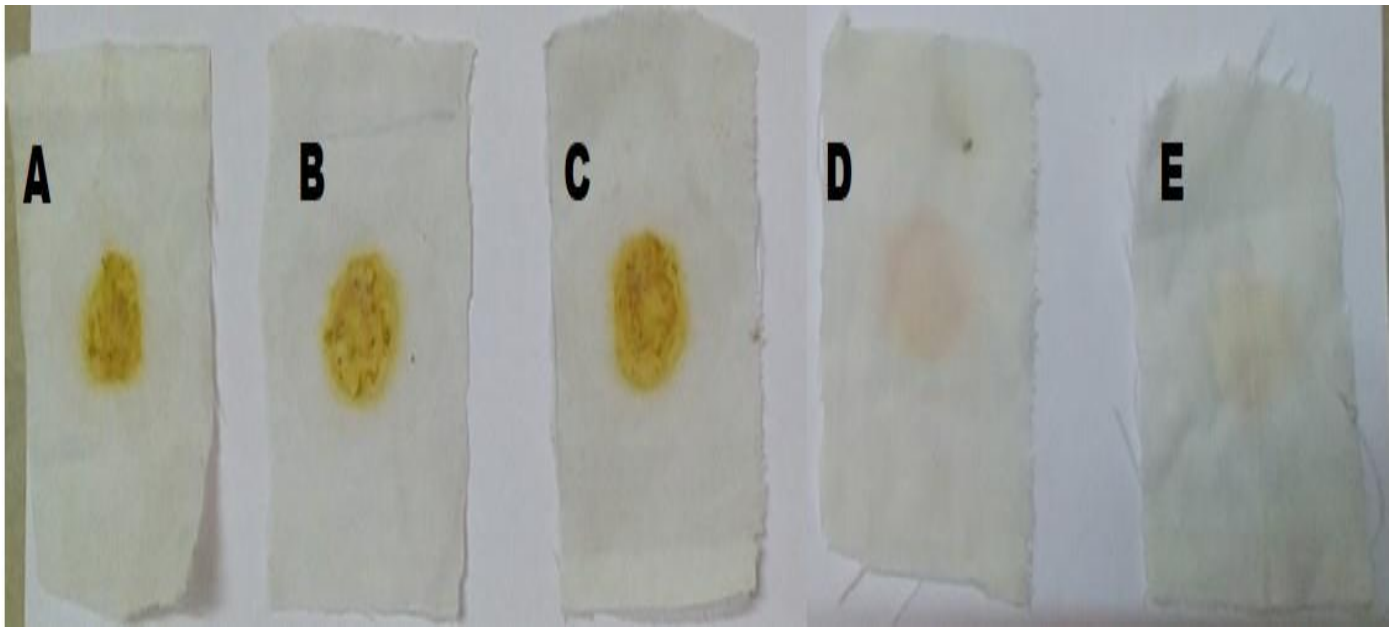

Figure-4: Effectiveness of starch stain elimination of *M. longifolia* oil based detergent. A, B, C Control unwashed cotton, D) washed with S1 detergent (Mahua oil, E) washed with S2 detergent (Mahua oil + *O. basilicum* plant).

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