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Synthesis of Medicinal Soap from Non Edible (Jatropha Oil) and Study of its Quality Parameters including Antimicrobial Activity

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Abstract

In this research sample of soap was prepared by using Jatropha Oil (purchased from dealer) by adding concentrate caustic soda solution in appropriate temperature range. Crude sample was washed, dried and several parameters such as % yield, TFM value, Total Alkali Content, Free Caustic Alkali Content, pH, Solubility, CMC Value and Antimicrobial Activity were determined. It was found that TFM value of Jatropha Soap is more than 60 %. According to BIS norms such soap can be categorized as Grade III Soap and it can be used for general bathing purpose. Also, Total Alkali Content,Free Caustic Alkali content,pH value etc. were found within prescribed value of BIS. CMC value of Jatropha Soap was around 0.012 M which shows that it can be used as a surfactant for purpose of micellar catalysis which is of great industrial significance owing to it's cheap price. Surprisingly, Study of Antimicrobial activity on S.aureus revealed that Jatropha Soap has more bactericidal effect as compared to commercial antiseptic soap which indicates that Jatropha Oil can be utilized for production of high quality medicated soap.

Keywords: Jatropha non edible oil, lipids, saponification, medicinal soap, chemical parameters

Introduction

Soaps and detergents are one of the essential items which we use in our day-to-day life. Soap is sodium or potassium salt of fatty acid. The fatty acids such as stearic, palmitic, myristic (saturated fatty acid) and linoleic acid and oleic acid (unsaturated fatty acids) are responsible for frothing and cleansing properties of the soaps. The chemical characteristics of soap depend on the kind of oil used, procedure of saponification and quantity of alkali used for saponification. In order to produce high quality soap one has to emphasise on several quality parameters such as Total fatty matter (TFM), Total alkali content, Free Caustic Alkalinity, pH, Solubility etc. which must comply with the limits of BIS. Soaps are generally manufactured using edible oils namely, *Cocos nucifera* oil, Palm oil, *Helianthus annus* oil, *Glycine max* oil, etc. If we go for non-edible oils as a substitute of it, we can reduce the consumption of edible oils in the field of soap manufacturing and ultimately the dependence on edible oils for making soaps would go down drastically. Among the non-edible oils, ***Jatropha*** oil can be utilised for soap production. ***Jatropha*** oil is not edible due to a toxic ingredient known as phorbol ester present in the seeds [1].

Soap from Jatropha Oil contains ingredients which have antifungal and bactericidal effect and it also prevents skin rashes[2-4]. The main fatty acids present in ***Jatropha curcas*** seed oil are Oleic acid (44%), Linoleic acid (34%),Palmitic acid (14%) and Stearic acid (6%). This ***Jatropha*** oil is classified as an unsaturated oil due to the presence of sufficient amounts of Oleic and Linoleic acids[5,6].

Material and Methods

Preparation of Soap: Lye Solution was prepared by adding NaOH in water. This Lye was warmed up to temperature of 40^0C. Jatropha oil figure-1 was heated on heating mantle up to temp. of 75^0C. When temp. of Oil decreased up to 55^0C, warm lye was added with continuous stirring in one direction. When Reaction Mass turned viscous like Honey it was poured in moulds for solidification[7]. After complete drying, crude soap was unloaded from mould and spray washed with water on Buchner funnel so as to remove unreacted caustic soda. Now soap was placed in hot air oven at temperature of 40-45^{0}C for drying figure-2.

Calculation of % yield of Jatropha Soap: % Yield = Output/Input x 100

Determination of Total Fatty Matter: About 5 g of the soap sample was dissolved in water and the solution is treated with dilute sulphuric acid. The soap decomposed in to sodium sulphate and fatty acids. The fatty acids so formed are separated by adding known quantity of bee wax in hot solution so that fatty acids get impregnated in bee wax. Fatty acid residue in water was extracted by the technique of Solvent extraction using Chloroform. Organic layer was combined with layer of wax and reheated so that total fatty acid content was impregnated in wax, after cooling increase in weight of bee wax was noted. From this TFM value was calculated[8,9].

Weight of Wax Layer (having fatty matter) = Weight of wax containing beaker –Weight of Empty beaker = X (say)

Quantity of Bee Wax Added=Y (say), Weight of Fatty Matter = X-Y
Total % of Fatty Matter-:
X-Y/Z x 100 Where, Z= Quantity of Soap utilized in experiment.

Figure-1
Pure Jatropha Oil

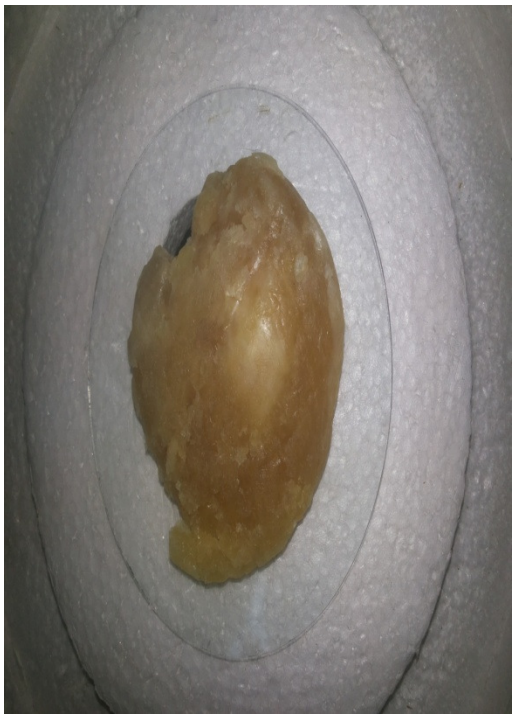

Figure-2
Picture of Soap Prepared from Pure Jatropha Oil

Determination of Total Alkali Content: 10 gram of Soap was added to sufficient quantity of neutralised Ethanol in a R.B.F and 1 N H_2SO_4 was added. This mixture was refluxed at heating mantle till entire soap sample was dissolved in Ethanol followed by hydrolysis in acidic medium. Flask was gradually cooled up to room temp. and remaining amount of sulphuric acid (after hydrolysis and neutralisation of all alkaline components in soap) was estimated by back titrating test mixture with standard 1 N NaOH. The total alkali content expressed as a percentage (m/m) is given by the formula[8,9]:

4.0 x [Va - Vb]/m (for sodium soap) Where, Va = Volume of Acid added in experiment, Vb= Volume of Base at end point, m = Mass of soap used in experiment.

Determination Of Free Caustic Alkali Content: 10 gm of Soap was added to sufficient quantity of neutralised Ethanol in a R.B.F and refluxed at heating mantle till entire soap sample was dissolved in Ethanol. Dilute $BaCl_2$ was added to precipitate the possible impurities of carbonate and silicate. Free caustic alkali was calculated by titrating reaction mass with 0.05 M H_2SO_4 (0.1N H_2SO_4). The free caustic alkali content expressed as a percentage (m/m) is given by the formula[8,9]:

0.4 x Va/m, Where, Va = Volume of Acid added in experiment, m = Mass of soap used in experiment.

Determination of Antimicrobial activity Of Jatropha Soap: Preparation of Nutrient Agar plate: 28.00 gms of Nutrient Agar was dissolved by boiling in 1000 ml Distilled water. Resulting solution was sterilized and cooled first at RT and then at low temp. so that media sets into gel like mass. This Agar Plate was divided into three sector and small hole was punched in each sector known as "well". ***Staphylococcus aureus*** was selected as test organism. With the help of sterile Platinum Loop colony of S.aureus was spread on Agar medium. In first well few micro-litre of sample (5% Jatropha Soap Solution) was injected with the help of syringe, in second well 5% Antiseptic Soap Solution and third well was left as such as "control". Plates were left for incubation at 37^0C. After 24 hrs. of incubation zone of inhibition of sample was observed. Antimicrobial activity can be calculated by following formula[10]:

Inhibition (%) = (a-b)/a x 100 where, a=Average diameter of growth of organisms in the control, b= Average diameter of growth of organisms in the Sample region, a-b= Zone of Inhibition.

Determination of pH: pH of Aqueous Jatropha Soap Solution (5%) was recorded by using pH paper as well as pH meter (Systronics, MK5).

Determination Of CMC (Critical Micelle Concenteration) Value: 0.1 M solution of Pure Jatropha Soap was prepared. Conductivity of this Soap solution was determined by using

well calibrated conductivity meter (Systronics 306) table-2. By using the above stock solution various dilutions were prepared viz. 0.05 M, 0.01 M, 0.005 M, 0.001 M, 0.0001M. Conductivity of all above solutions were recorded with the help of conductivity meter and a graph was plotted between Conductivity v/s Concentration. From this graph value of CMC was determined at point of intersection of 2 curves[11,12] figure-4.

Table-1
Antimicrobial activity

Name of Soap	a (in mm)	b (in mm)	a-b (in mm)	% Inhibition (a-b)/a x 100
Jatropha	8.30	5.90	2.40	28.91%
Antiseptic	8.30	6.80	1.50	18.07%

Table-2
Conductance of Jatropha Soap Solution

Concentration	Value of conductivity(in mS)
0.1 M	2.4
0.05 M	1.2
0.01 M	0.3
0.005M	0.2
0.001 M	0.06
0.0001 M	0.02

Results and Discussion

It was observed that % yield of pure Jatropha Oil Soap was found to be almost 97% (48.6gm of soap from 50 gm oil). TFM value of soap was 60.20%. According to BIS norms such soap can be categorized as Grade III Soap and it can be used for general bathing purpose. Total Alkali Content was 0.76% (BIS Limit:- 1%)[13], Free Caustic Alkalinity Content 0.024% (BIS Limit:- 0.05%), pH 8.6, % zone of inhibition (Antimicrobial activity) 28.91% Table-1, CMC Value:- 12.5 x 10^{-3}M figure-4.

It has been observed that research work on Jatropha oil is restricted to production of biodiesel[14,15]. Owing to low price, high availability and cheaper technique of production, there is tremendous scope in soap production from non edible Jatropha oil, very few efforts have been made to improve the quality of soap produced from this oil. From experiments carried out during this Research work it is clear that Soaps produced from non edible oil such as Jatropha has several quality parameters such as TFM, Total alkali content, pH etc. which makes it suitable for production of high quality soap. Antimicrobial activity of soap prepared from Jatropha Oil (28.91%) figure-3a is much greater as compared to commercial Antiseptic Soap (18.07%) figure-3b, table-1. This can be a real breakthrough in the field of medicinal soaps. Further, extension of this work can be carried out by applying Antimicrobial Test on different microbes so as to obtain vast information about antimicrobial activity of these natural soaps from non edible oil which may prove to be beneficial in pharmaceutical sector. CMC value obtained is 12.5x10^{-3}M. Thus study of micellar properties of soap synthesized could lead to the development of a new surfactant of higher efficiency and cheaper rate which is of industrial significance.

Figure-3a)
Antimicrobial activity of Jatropha Soap

Figure-3b)
Antimicrobial activity of Antiseptic Soap

From above two picture it is evident that Jatropha Soap has more Bactericidal Action as compared to Antiseptic Soap.

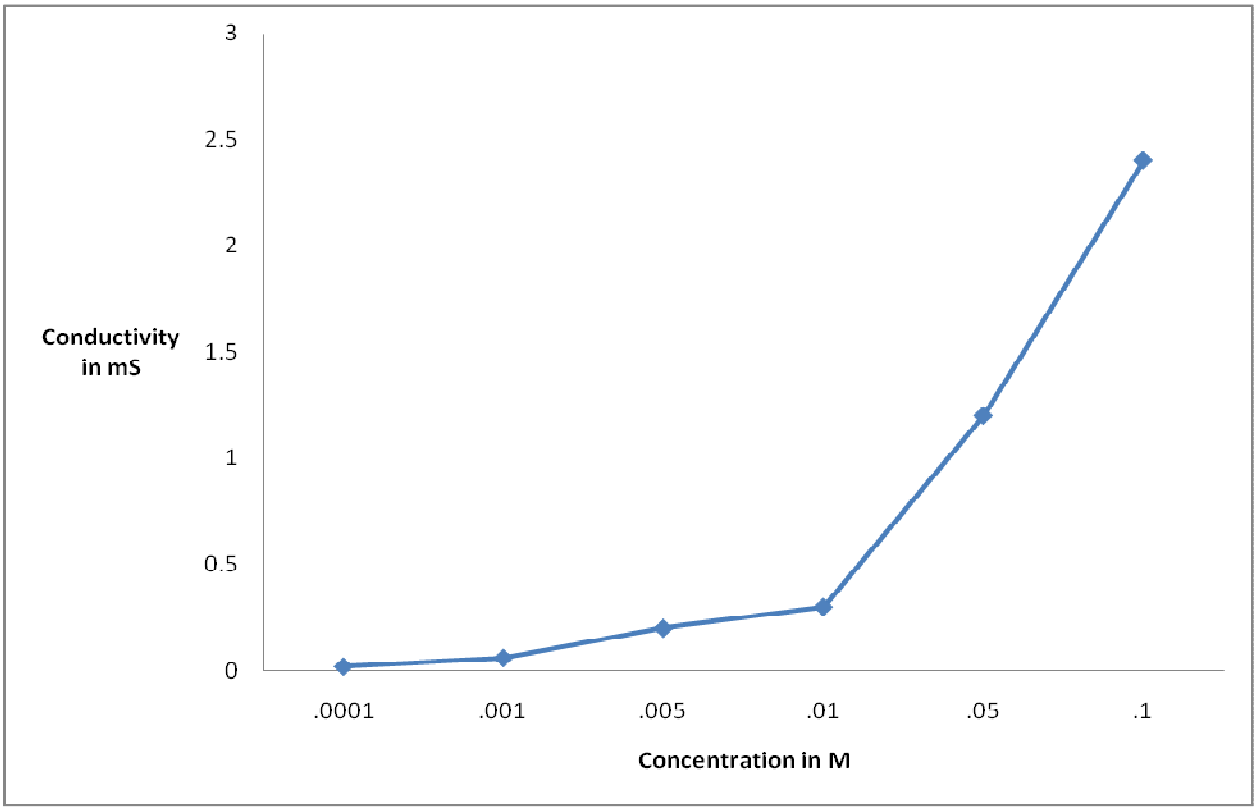

Figure-4
Graph for CMC of Jatropha Soap

Conclusion

Jatropha oil soap was prepared by using Jatropha Oil. Quality parameters such as TFM Value, Total Alkali Content, Free Caustic Alkali content, pH value etc. were found suitable for production of Toilet/Bathing Soap. Antimicrobial activity of Jatropha oil could be utilized for production of medicinal soap and also there is possibility of production of cheap surfactants for purpose of micellar catalysis.

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