REIMAGINING THE PURPOSE OF ENERGY EDUCATION BEYOND CONSERVATION

Editors

Dr. DIVYA C. SENAN

ANNIE FEBA VARGHESE

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PRODUCTION AND EVALUATION OF HANDMADE HERBAL SOAPS

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Abstract

Toilet soaps are a part of our daily life of their cleaning properties also due to their cosmeticaspects. Due to the increasing awareness and importance of cleanliness and health, the use ofherbal products is also increasing. In the present study, the antimicrobial activity of handmade herbalsoaps and commercial market soaps were determined against bacterial isolates present on theskin surface like Escherichia coli and Staphylococcus using the agar well diffusion method.Results show that the soaps have antimicrobial activity, though to varying degrees as indicatedby the inhibition of the growth pattern of the isolates. Some quality parameters of soap weredetermined such as total fatty matter content (TMF), Alkali content, foamability and pH insoap. Values for pH ranged between 6.5 to 7; total fatty matter 71.5-75%; total alkalinity content2.08 -2.42 % and the foam height was measured in the range of 3.7-4.7 cm. The analyzed sampleswere found to fall within the standard values recommended.

Keywords: *Handmade, Herbal Soaps*

I. INTRODUCTION

Soap is the salt which is produced by the reaction alkaline substance with a fatty acid. The history of soap, which is an important part of our daily life and which we use many times a day, goes back about 6000 years. There are findings that soap was first discovered by women. Production of soap started with the addition of wood ash to fatty acids M.S. In 1790, with Nicolas Leblanc's production of NaOH, it was able to move towards more professional production. Scientific soap production was created in the 18th century with the contributions of Michel Eugène Chevreul and soap production was turned into a real industry. Soap making consists of washing, cooking, liquefying and saponification stages of sodium salts formed after treatment of olive oil, pomace oil, sunflower oil, peanut oil, palm kernel oil with alkalis. Many different methods are used in soap production and the most common being the cold process and the classical method so-called Marseille type. Other international soap-making methods include the Clayton method, Gunther Jacobs's (P) method, the Du Pont de Nemours method and the Monsavon method. Potassium soaps areobtained.

Hand washing is a simple and very effective method of protecting people from pathogens and infections. Today, there are many commercial soaps with antimicrobial content that are sold for this purpose. These soaps contain antiseptic active ingredients in very low concentrations. Bacteria from environmental sources can accumulate on the skin surface and may cause skin infections. Examples of such bacteria are Pseudomonas aeruginosa and Staphylococcus aureus. Hand washing is even more important especially when associated with possible cross-contamination of potentially pathogenic bacteria. Providing personal care and hand hygiene is very important for preventingcontamination.

Chemically soaps are a combination of fats, oils (of animal or vegetable origin) and Salt [2]. Soaps are generally salts of free fatty acid made via saponification, where alkaline substances react with fatty acids in fats or oils. Other substances are then added to this salt of free fatty acid or soap base, to produce the different types of soaps we have. They are mainly used as surfactants for washing, bathing and cleaning [3]. Soaps are either non-antimicrobial soaps or antimicrobial soap, also known as antiseptic or medicated soap. Antibacterial soap can remove 65% to 85% of bacteria from human skin[4].

Antiseptic soaps are incorporated with a specified number of germicidal substances in addition to the ordinary soap base to increase their antibacterial activity. These antiseptic substances impart the ability for the soap to kill germs even after it has been used as residual antiseptic substances remain on the skin. It is proved experimentally that antibacterial soaps kill the bacteria at a specific concentration; they also have bacteriostatic activity and can inhibit the growth of bacteria. Herbal soaps are prepared by adding dried herbs, flowers and stems into the soap base. Herbs are natural products that can be found in the treatment of almost alldiseases and skin problems owing to their high medicinal value, cost-effectiveness, availability and compatibility [5, 6].

Different methods are used in soap production and the most common being the cold process and the classical method so-called Marseille type. Other international soap-making methods include the Clayton method, Gunther Jacobs's JPC method, the Du Pont de Nemours method and the Monsavon method [3]. Potassium soaps are obtained when KOH base is used instead of base NaOH. Antiseptic soaps are classified as soaps used in the field of pharmacy and cosmetic soaps [2]. While soap is produced, glycerin is added which has a softening effect on the soap tissue. In addition, sorbitol is used for transparency, TiO_2 for opacification, triclosan/tri-chlorocarbon for antibacterial purposes, plant-based essential oils for odour, milk/aloe vera, honey, filling oil and paling as filler for moisture and softening activity [4]. Hand washing is simple and very effective. Hence it can be used in various bases. The attributes of the soap include gentleness on the skin, rich lather, protection against skin disorders (including rashes, eczema, and scabies), treatment of skin infection (such as ringworm), and protection of even skin toning and smoothness of the skin [7].

The soap should have good ingredients which can kill bacteria but not damage body tissues. Several bacteria including Gram Positive and Gram-negative are deposited from the environment on the surface of the skin and cause skin infection. Examples of these bacteria include Staphylococcus aureus [8], Bacillus subtilis and Pseudomonas aeruginosa [9]. The spread of infection by such bacteria can be prevented by the use of antiseptic soaps, as it contains antimicrobial chemicals, but overuse of soaps might result in antimicrobial resistance and even render a person more sensitive to allergies, 202 skin rashes [10]. The present research work aims to compare the efficacy of locally available market herbal soaps and antiseptic soaps against skin infecting human pathogenic bacteria such as Staphylococcus aureus, and Pseudomonas aeruginosa, Bacillus subtilis and E.coli.

After hydrolysis of animal/vegetable oils, they are changed into glycerol and fatty acids. Following the release of water, the fatty acids react with the alkali to form metal salts called soaps. It is known that there are more than 100 oils that are used in soap production which occur in most varieties [Amponsah 2014 et al.] But unfortunately, most soaps form non-saponifiable fatty acids and cannot be suitable for soap production. In soap production mixtures of oils are usually used to produce a high-quality product. Some components of these combinations may not underg hydrolysis saponification and may be left out in the soap a unreacted fatty acids [Ahmed 1984 et al.,].

Skin irritation can be caused by the short chain of fatty acid in soaps. As there occurs a tendency to bleach the skin with soap production, it is necessary to wash out the unreacted use of alkali. Unfortunately, for profit, most soap producers sacrifice quality and retain unreacted soap alkali [Idoko 2018 et al.,]. Sometimes to produce a soap that bleaches, the alkali is left in the soap. Soap is a mixture of Na+ or K+ ions with fatty acids chemically. It is possible to classify fatty acids into saturated and unsaturated fatty acids. The most abundant saturated fatty acids are palmitic and stearic acids, whereas the most abundant unsaturated fatty acids are oleic and linoleic acids. Production of quality soap consist largely of choosing the right proportions of the right oils with thei different fattyacids.

II. METHODOLOGY

Materials required for the production of Soap are, Soap base moulds or containers, Cups or spoons for mixing, Mortar and pestle/mixer jar. Collections of plants are done by nearby localitie or from plant shops. Aloe vera plants, Neem leaves, Tulsi leaves and Ixora flowers are used in the process.

Procedure of soap production is as follows:

a. Aloe vera soap

Take 150 g soap base and 2 tablespoons aloevera gel (aloe vera gel taken from the plant and grind by using a mixer jar or by mortar and pestle). Add 1 spoon of coconut oil to it. Mix aloe vera gel and oil very well so that the soap comes out easily. Melt soap base using the double boiling method. After melting the soap mould or container is taken and greased with oil, then add the aloe vera mixture to the melted soap base. Mix well. Then pour it into the mould or container and allow for setting at room temperature.

b. Neem soap

Take a handful of fresh neem leaves and wash them thoroughly. Put them into a mixture jar/by mortar and pestle and blend them into a paste. After that take a soap mould or container and grease it with coconut oil. Then take 150 g soap base and melt it by double boiler method. Add 1 teaspoon of neem leaves paste and 1 spoon of coconut oil into the melted soap base. Allow it for setting.

c. Mixed herbal soap

Aloe vera, Neem leaves, Tulsi leaves and Ixora flowers are taken in an equal proportion. Make them into a paste by using the mixer jar/mortar and pestle without using water. The 150 g soap base is melted using a double boiling method. Add the paste to t[he base.] Then pour it into the mould or container for setting.

III. EVALUATION OF HERBAL SOAPS

Various physicochemical properties and anti-microbial activity of soaps will be analyzed. The physicochemical properties include:

- **Determination of colour and odour**

The colour was checked by naked eyes against a white background, the odour was smelled.

- **Determination of pH**

The pH was determined by using pH paper and also can be done by using a pH meter.

- **Determination of foamability**

About 2.0 g of each soap (shavings) was added into a 100 ml graduated Measuring cylinder containing 50 ml of distilled water. The mixture was shaken vigorously to generate foams. After shaking for about 2 minutes, the cylinder was allowed to stand for about 10 minutes. The height of the foam in the solution was measured and recorded.

3.2.1 Determination of Total Fatty Matter content (TFM)

Soap (5.0 g) was weighed out and the water (100 ml) was added then it was shaken well and heated directly for (20-30 min). Then concentric sulfuric acid was added until the fatty acid layer separated. The solution was filtered by using filter paper and transferred to a preweighed petri dish. Finally, the content was evaporated in an electric oven and the residue was weighed.

Calculation of the total fatty matter content (TMF) is done with the following equation. TMF = (y-x) × 100 × weight of soap sample.

x-weight of the petri dish, y-weight of petri dish and soap after drying.

3.2.2 Determination of alkali content in soap

Determination of Total Alkali Content in the Soap Samples 5 gm of soap sample is dissolved in 100 ml of hot water. About 40 ml of 0.5 N HNO3 is added to make it acidic. The mixture is heated until fatty acids are floating as a layer above the solution. It is cooled in ice water to solidify the fatty acids. The fatty acids were separated and the aqueous solution was treated with 50 ml chloroform to remove the remaining fatty acids. The aqueous solution was measured and 10 ml of it was titrated against 0.5 N Na OH using methyl orange as an indicator and from the titer value, the total alkali content was determined.

3.2.3 Antimicrobial Activity

Reagents, chemicals and other requirements for carrying out the antimicrobial susceptibility testing KNH4Zn

- Muller-Hinton agar
- Nutrient broth
- Methanol
- Sterile distilled water
- Sterile cotton swabs
- Standard antibiotic (Amoxycillin- 1mg/ml)
- Laminar air flow
- Incubator
- Bacterial strains used- Escherichia coli, Staphylococcus sp

Preparation Of Extract

- The methanolic and aqueous extracts were prepared by dissolving 100 mg soap powder separately in 1 ml of methanol and water respectively. The contents were kept in a shaker for 24 h (stock concentration of the extract: 100mg/mL).
- After 24 hours, the supernatant was filtered and used for the study.

Dilutions and Inoculum Preparations

- From the stock concentration (100 mg/mL), a lower concentration of 50 mg/mL was prepared.
- The inoculum of Escherichia coli and Staphylococcus sp. were prepared in nutrient broth medium and kept incubated at 37°C for 8 hours. After growth was observed, the cultures are stored in the refrigerator at 2-8°C for analysis.

Antibacterial Screening Using the Agar Well Diffusion Method

- 20 ml of sterilized Muller Hinton Agar was poured into a sterile Petri plate, after solidification, 100 µl (10^8c.f.u./mL) of test organisms were swabbed on the respective plates.
- Wells of 6 mm diameter were punched into the agar medium and filled with 100 µL of plant extract (of 100 mg/mL and 50 mg/mL concentration), antibiotic solution (positive control) and solvent blank (methanol and water) (negative control).
- The plates were incubated for 24 hours at 37°C.
- After incubation the diameter of inhibitory zones formed around each disc was measured in cm and recorded.

IV. RESULTS AND DISCUSSION

The physicochemical properties of handmade soaps (aloe vera, neem and mixed herbal soaps) were evaluated. The chemical analysis includes onsite analysis (colour and odour, pH) and in-laboratory analysis (Foam retention, TFM and Total Alkali Content) of the handmade soaps. These properties were evaluated to compare the values on quality criteria for Ph, Alkali content and total fatty matter.

- **Determination of colour and odour**

The colour of aloe vera soap turned out to be transparent and there is a pleasant odour. The colour of neem soap is found to be dark green to dark brownish and has an odour of neem leaves. The mixed herbal soap has the odour of the herbals and is dark brownish

- **Determination of pH**

The pH was tested. Solution of each sample was made and pH was measured using pH paper. It is very much important to give preference to pH because the skin produces some natural essential oil from glands, that glands should never damage. And cells should not get damaged by pH.

Different soaps have different pH values. But on an overall basis soaps are naturally basic (that is over a pH of 7).

The pH was found to be:

Aloe vera soap: pH paper shows a range of 6.5-7.

Neem soap: pH paper shows a range of 6.5-7.

Mixed herbal soap: pH paper shows a range of 6.5-7.

Plate 2: pH of soaps

4.1 Determination of Foamability

For the determination of the herbal soaps for their ability to form foam, about 2 gm of soap was taken and dissolved in water (about 50 ml) in a 100 ml graduated measuring cylinder. The measuring cylinder was then shaken for about 2-3 minutes and it was allowed to stand for about 10 min. Foam height was measured and the results were 3.7, 4.2, and 4.7 for aloe vera soap, neem soap and mixed herbal soaps respectively. Recorded the observation for three consecutive experiments and the mean was taken.

4.2 Determination of total fatty matter content (TFM)

Sl. No.	Name of Soap	Weight of petri dish (g) (x)	Weight of petridish + soap after drying (g) (y)	% of fatty matter (y-x) x 100 x 5
1	Mixed herbal	42.51	42.657	73.50%
2	Neem	42.51	42.653	71.50%
3	Aloe vera	42.51	42.66	75%

Table 1: Total fatty matter content (TFM)

The Total Fatty Matter (TFM) is one of the most significant features which describe the quality of soap. It measures the amount of fatty matter contained in the soaps. Bureau of Indian Standards (BIS) categorized toilet soaps into three grades based on the total fatty matter present in them. If TFM is beyond 76%, grade I has good quality. TFM above 60% fits grade II and TFM above 50% fits gradeIII.

Higher TFM confirms that soaps are less damaging to the skin. Less TFM means very harmful soap, soap captures all the moisture in the skin that makes it dry.TFM is observed to be 73.5% for Mixed herbal soap,71.5% for Neem soap and 75 % for Aloe vera soap.

From the study, it is found that the soaps belong to the Grade 2 category

4.3 Determination of Total Alkali Content in theSoap

Sl. No.	Name of Soap	Volume of Soap (ml)	Burette reading		Volume of NaOH	% of Alkalinity
			Initial	Final		
1	Mixed herbal	10	0	0.6	0.6	2.42%
2	Neem	10	0	0.6	0.6	2.44%
3	Aloe vera	10	0	1	1	2.08%

Table 2: Total Alkali Content in the Soap Samples

Total alkalinity means the presence of total alkaline components (hydroxides, sodium (II) oxide, carbonates and bicarbonates) in the finished soap. According to the Bureau of Indian Standards (BIS), good quality soaps must have less than 5% of alkali content.

The obtained data for the prepared soaps indicate that the total alkali content is in the range of 2.08 % to 2.44%. These soaps cannot be considered harmful since the amount of alkali contents [illegible] at acceptable levels.

Sl. No.	Name of Soap	Colour	Odour	Appearance	pH	Foam height (cm)	TFM (%)	% of Alkalinity
1	Mixed herbal	Dark brownish	The odour of herbs	Good	6.5-7	4.7	73.50%	2.4[illegible]
2	Neem	Dark green to brownish	The odour of neem	Good	6.5-7	4.2	71.50%	2.4[illegible]
3	Aloe vera	Transparent colour	Pleasant odour	Good	6.5-7	3.7	75%	2.08%

Table 3: Observations of the total physicochemical properties of the handmade soaps

In a study done by Tyebkhan G, in which pH paper was used for measuring the pH of soaps/cleansers, it was found that the soaps commonly used by the population at large have a pH ranging between 7 and 9. Also, only 3 samples of those tested had a pH in keeping with the normal skin. But in our study, it is found that the soap samples had a pH ranging between 6 and 7.5. The three samples tested had a pH corresponding to that of the skin pH. To perceive the physical and chemical characteristics of commercially available soap prepared and sold in the Bangladeshi market, research was supervised by analyzing five toilet and four aundry soap samples. The obtained results for total alkali content of toilet soap samples were observed from 0.00% to 1.45%, while he results found for laundry soaps were between 1.18% to 6.20%. otal fatty matter values of the toilet soaps were observed from 8.37% to 100%, while laundry soaps showed from 68.33% to .37%.In our study total alkalinity is found in a range of 2.08% to

2.44 % and the total fatty matter is in the range of 71.5 to 75 %. The physicochemical properties are shown in table 3. In the analysis, standard methods of analysis were used. From the study, it is discovered that some obtained values have shown some proximity with the results reported in previous literature. Observation has shown that the variations are widespread even amongst the results of the investigations conducted previously. The test values have shown that all the soaps analysed are good quality soaps and can be used as toilet soaps.

4.3 Antimicrobial activity

Sl.No.	Name of Soap	Organism	Concentration	Inhibition zone(cm)
1	Mixed herbal	Staphylococcus	50 mg	1
			100 mg	1.1
		E Coli	50 mg	1.3
			100 mg	1.5
2	Neem	Staphylococcus	50 mg	1
			100 mg	1
		E Coli	50 mg	1.1
			100 mg	1.2
3	Aloe vera	Staphylococcus	50 mg	1
			100 mg	1.5
		E Coli	50 mg	1.3
			100 mg	1.5
4	Dove	Staphylococcus	50 mg	1
			100 mg	1.3
		E Coli	50 mg	0.8
			100 mg	1.6
5	Hamam	Staphylococcus	50 mg	1
			100 mg	1
		E Coli	50 mg	1.2
			100 mg	1.7

		Staphylococcus	50 mg	[illegible]
			100 mg	[illegible]
6	Pears	E. Coli	50 mg	[illegible]
			100 mg	[illegible]

Table 4: Observed results of antimicrobial activity of handmade and commercial soaps

A similar study on to determine the antimicrobial efficacy of antiseptic soaps like Dettol, Savlon, Lifebuoy Plus and herbal soaps like Haldi Chandan, Aloe Vera and Neem against [illegible] microflora isolates Staphylococcus aureus, Bacillus subtilis, E. coli and Pseudomonas aeruginosa was observed.

Results obtained from the study showed that Dettol was found to be most effective against all the pathogenic strains tested having the highest zone of inhibition (42mm) against Staphylococcus aureus and 30 mm against Bacillus subtilis at the highest concentration of 500 mg/ml when used. Followed by Dettol, Savlon also inhibits the growth of Staphylococcus but the least zone appeared for Bacillus species. Among the antiseptic soaps, Lifebuoy Plus showed the least zone of inhibition against Staphylococcus and Bacillus but it inhibits the growth of E. coli and Pseudomonas species.

Among the different herbal soaps studied Neem showed the highest antimicrobial activity against all pathogens studied as compared to Haldi Chandan soaps. Haldi Chandan exhibited the least antibacterial activity with a zone of inhibitions of 10.2 mm for S. aureus, 11.4 mm for Bacillus and11.8 for E. coli species. The main aim of this study was to identify the antimicrobial activity of antiseptic soaps and herbal soaps. The herbal soaps revealed similar antimicrobial activity to that of antiseptic soaps.

Results obtained from our study revealed that handmade and

commercial soaps have antimicrobial activity. The soaps were
observed against the isolated skin flora pathogens (E. coliand
Staphylococcus SPS). The skin carries large numbers of bacteria
flora, mainly Gram-positive and Gram-negative. Staphylococcus
aureus is one of this natural flora commonly found on the hands,
face and in deep layers of the skin. Escherichia coli is a Gram-
negative bacterium.

Analysis of data revealed no significant difference between
the two types- handmade soaps and commercial soaps. It was
observed that differences exist among the different concentrations
of soaps used for the study with 100mg/ml, a higher concentration
having a higher zone of inhibitions was observed than the lower
concentration (50 mg /ml).

When the antibacterial activity of handmade and commercial soaps was compared, Aloe Vera (1.5cm) soaps have a similar zone of inhibition with Dove soap(1.3cm) in Staphylococcus aureus and Mixed Aloe vera soap(1.5cm)and Aloe vera soaps (1.5cm) have a similar zone of inhibition with Dove(1.6cm) and Hamam soaps (1.7cm) in Escherichia coli.

Pears were most effective against the two pathogenic strains
tested with the highest zone of inhibition (2cm) against
Escherichia coli and 1.2cm against Staphylococcus aureus at the
highest concentration of 100 mg/ml when used. Among the
handmade soaps, Aloe vera showed the highest zone of inhibition
against Staphylococcus SPS (1.5cm) and Escherichia coli(1.5cm).

I. CONCLUSION

The resulting soaps when subjected to evaluation tests gave
good results. It does not give any irritations to the skin; it was
determined by using these soaps by a few volunteers including
myself. Hence it is proved that the soaps do not cause any irritations

to the skin. Also, the various properties such as pH, appearance, odour, and foam retention exhibit a satisfactory effect. Hence, these soaps can be further used as normal herbal bathing soap.

The antimicrobial activity of methanol was investigated using the agar diffusion method against selected human pathogens such as Escherichia coli and Staphylococcus sp. All the extracts used against the pathogenic organisms have shown varying degrees of antimicrobial activity against the pathogens. The various concentrations of the extract were found to be effective against the selected strains (Staphylococcus and E. coli). Because the growth of these organisms inhibited the extracts by forming an inhibitory zone of different diameters. Results obtained from the study revealed that most of the studied handmade and commercial soaps have antimicrobial activity, though to varying degrees as indicated by the inhibition of the growth pattern of the isolates. Varying levels of effectiveness by soaps were observed against the isolated skin flora pathogens.

Among handmade soaps, the highest inhibition was observed with Staphylococcus which was found to be 1.5 cm at 100mg/ml concentration in aloe vera soap extract. Similarly, a good inhibitory zone (1.5cm) was also observed with E. coli at 100mg/ml concentration in aloe vera and mixed herbal soap. These results revealed the significant antibacterial activity of the extract against studied bacteria. Among commercial soaps, the highest inhibition was observed with Staphylococcus which was found to be 1.3 cm at 100mg/ml concentration in dove soap extract. Similarly, a good inhibitory zone (2.0 cm) was also observed with E. coli at 100mg/ml concentration in Pears Soap. These results revealed the significant antibacterial activity of the extract against studied bacteria.

The highest inhibition was observed with Staphylococcus which was found to be 2 cm at 100mg/ml concentration in Pears Soap. Similarly, a satisfactory inhibitory zone (1.7 cm) was also observed with E. coli at 100mg/ml concentration in Hamam Soap. These results revealed the significant antibacterial activity of the extract against studied bacteria. Also, it is clear from the results that, the gram-positive strain (Staphylococcus) is found to be more sensitive than the gram-negative strain (E. coli). Because its zone of inhibition is higher than that of E. coli.

It can be summarized that the study intended to determine the total alkali content and total fatty matter of soaps revealed that the soaps which have high total fatty matter and low alkali content are having good quality. The low total fatty matter is associated with hardness and lower quality of soap and it is the most important characteristic describing the quality of soap. The bathing samples which we have studied are all in the standard range of TFM values. From this we can conclude that our commonly used soap samples are of lower alkali content and higher TFM value, making them good for health and the environment.

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This book constitutes the refereed proceedings of the First International Conference on Sustainable Energy Education, ICSEE 2021, held in Department of Education, University of Kerala, on 10-12, January, 2022 in the online mode. The conference discussed "WHAT" of energy education - should be. It then asks the contributors to bring forth their best ideas regarding "HOW" to implement the education process, and finally "WHY" we should be educating about energy. We hope that the interesting scholarly work and case studies that the contributors have brought us, will trigger an on-going dialog about how to frame energy education in the much bigger picture of energy cycles and their fundamental importance to powering our life, and its increasingly energy - hungry industrialized, urbanized and digitized infrastructure. The book serves as a reference resource on sustainable energy education for researchers and practitioners in academia and industry.

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