PREPARATION OF SOAP IN THE PRESENCE OF LOCALLY AVAILABLE NATRON

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Abstract

This research work concerns with the preparation of soap from palm oil with locally available natron by hot process method. Locally available natron sample was collected from Aigther village, Wundwin Township, Mandalay Division in winter season. The purified natron was characterized by available modern techniques ED XRF and FT IR analyses. The physicochemical properties of prepared soaps such as texture, color, foam stability (%), foam height (cm), pH, degree of absorption activity (%) and antimicrobial activity etc. were determined. According to the physicochemical properties, all of the prepared soaps were found in the pH range of (10.2-10.8). This pH range was skin friendly pH and was accepted by National Agency for Food and Drug Administration and Control (pH 8-11). Antimicrobial activity of prepared soaps was investigated by agar well diffusion method at Meiktila University. The prepared soaps were found to be active against with *Bacillus subtilis, Staphylococcus aureus, Pseudomonas fluorescens, Bacillus pumilus, Candida albicans* and *Escherichia coli (E.coli).* From the preparation's stand point, the prepared soaps were utilized not only as laundry soap but also as medicated soap.

Keywords: natron, hot process method, antimicrobial, laundry soap, medicated soap

Introduction

As protection of the body from the outside, the skin has various problems such as dry skin, premature aging, chronic diseases like cancer. This can be caused by air pollution resulting in many free radicals, exposure ultraviolet, and also less care for cleanliness. The main treatment for maintaining skin health is to use soap regularly. The use of chemical will side effect on sensitive skin, while soaps with natural ingredient will provide the maximum nutrition on the skin (Putri and Anindia, 2017).

For generations, hand washing with soap and water been considered a measure of personal hygiene, bacteria are very diverse and present everywhere such as in soil, water, sewage, standing water and even in human body. Bacteria's that attacks on human body is of great importance with reference to health. In 1961 the U.S. public Health Service recommendations directed that personal wash their hands with soap and water for 1 to 2 minutes before and after client contact (Rama *et al*., 2011).

Soap is sodium or potassium salt of fatty acid produced by saponification reaction using sodium or potassium hydroxide. Based on its chemical properties as an anionic surface active agent (surfactant), soap is used to clean and wash skin and clothing. The fatty acids, such as stearic, palmitic, myristic, lauric and oleic acids, contribute to lathering and washing properties of the soaps. The chemical characteristics of soap depend on several factors: the strength and purity of alkali, the kind of oil used, completeness of saponification and age of the soap. Such chemical characteristics include moisture content, total fatty acids (TFM), pH, free alkali, and percent chloride (Mak-Mensah and Firempong, 2011).

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Natron, with its chemical composition of sodium carbonate 10-hydrate, had various applications in ancient technologies, ranging from the mummification of bodies to soap production and glassmaking (Jackson *et al*., 2018). This white powdery material is an evaporate deposit of alkaline lakes and is found in nature as fragile, whitish stone chunks and it remains a crucial industrial component of soap/detergent and glass industries today (Reade *et al*., 2005). In modern mineralogy the term natron has come to mean only the sodium carbonate decahydrate (hydrated soda ash) that makes up most of the historical salt. Historical natron was harvested directly as a salt mixture from dry lake beds in ancient Egypt, and has been used for thousands of years as a cleaning product for both the home and body. Blended with oil, it was an early form of soap. It softens water while removing oil and grease. Undiluted, natron was a cleanser for the teeth and an early mouthwash. The mineral was mixed into early antiseptics for wounds and minor cuts. Natron can be used to dry and preserve fish and meat. It was also an ancient household insecticide, and was used for making leather as well as a bleach for clothing. Today, natron is not used as readily in modern-day society due to being replaced with commercial detergent items along with soda ash, which made up for its use as a soap, glass-maker and household items (Noble, 1969).

Materials and Methods

Soap is common cleansing agent well known to everyone. Soaps are produced for varieties of purpose ranging from washing, bathing, medication etc. The use of locally available raw materials in soap production was carried out. The soap was prepared using palm oil, coconut oil and natron by hot process method.

Sample Collection and Purification of Natron Sample

The natron (sample) were collected from Aigther village, Wundwin Township, Mandalay Region in September, 2018. The sample collected area of natron was shown in Figure 1.

Figure 1 Sample collected area of natron

The collected natron sample (300 g) was purified by dissolution with 5 L distilled water and stand for three days. After standing for three days the solution was filtered to get the clear filtrate. Then the filtrate was gently heated to use throughout the research.

(a)

(b)

Figure 2 Natron (a) unpurified (b) purified

Characterization of the Purified Natron Sample

The purified natron was characterized by using modern techniques such as EDXRF and FT IR.

Preparation of Soap using Natron and Lye (Sodium hydroxide) and without Natron

About 5 g of sodium hydroxide was added to 20 mL distilled water in a beaker and stirred to get sodium hydroxide solution. At the same time 20 mL of coconut oil was added to the beaker containing 20 mL of ethyl alcohol and heated together a few minutes. After cooling the sodium hydroxide solution, the two solutions were heated together and gently stirred to turn pasty. When all the paste had formed, 5 g of natron was added and the beaker was cooled at room temperature. Then 5 g of sodium chloride was added and filtered. Finally, the soap paste was washed with distilled water and filtered using a linen cloth, and then a small amount of water was added to soften it whist heating. The soap was placed in cast and allowed to dry. The same procedure was carried out with palm oil. The prepared soap samples were denoted by SN.I for palm oil and SN.II for coconut oil.

The same procedure was carried out by using 10 g of lye (sodium hydroxide) and without addition of natron. The prepared soap samples were denoted by SL.I for palm oil and SL.II for coconut oil.

(a) SN.I (b) SN.II (c) SL.I (d) SL.II

Figure 3 (a) Prepared soap using natron and lye with palm oil
(b) Prepared soap using natron and lye with coconut oil
(c) Prepared soap using lye with palm oil
(d) Prepared soap using lye with coconut oil

Determination of Physicochemical Properties of the Prepared Soaps

All the prepared soaps (SN.I, SN.II, SL.I and SL.II) were determined by texture, color, foam stability, foam height and pH. Then, the prepared soaps (SN.I and SN.II) and commercial soaps (Shwe war) were determined water absorption activity and antimicrobial activity (Zauro *et al*., 2016).

Results and Discussion

Characterization of the Purified Natron

The chemical composition of the purified natron was shown by EDXRF spectrum and represented in Figure 4. From the EDXRF spectrum, the trace amount of elements such as P, Al, K, Zn, Br, Fe and Cu were present. The spectrum indicated that S (89.07 %), Si (4.597 %) and P (4.313 %) are the major constituents in the purified natron. It is a semi quantitative value measured on a matrix basis.

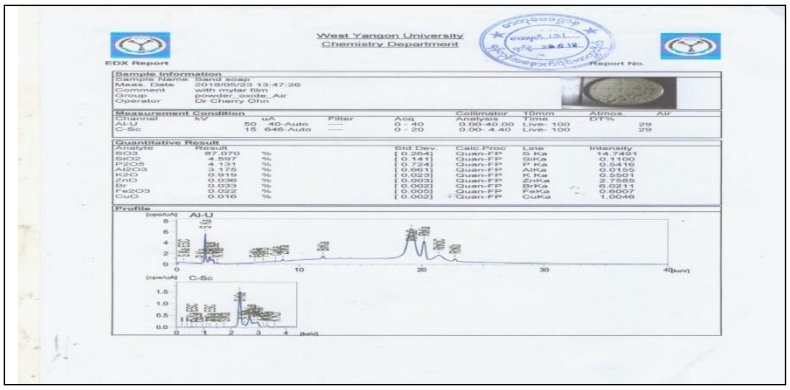

Figure 4 EDXRF spectrum of natron (purified)

The functional groups present in the purified natron were also studied by FT IR analysis. The FT IR spectrum of purified natron is shown in Figure 5 and the spectral assignment of purified natron was tabulated in Table 1. It can be observed that the frequency range was 4000-600 cm^{-1}. The strong stretching band at 2200-2000 cm^{-1} in spectrum is attributed to the aromatic thiocyanate. The sharp peak at 876.66 cm^{-1} in the spectrum are silica group in natron of Si-H stretching and Si-O stretching respectively. The strong stretching band at 778.29 cm^{-1} represent P-O-P and aromatic alkene.

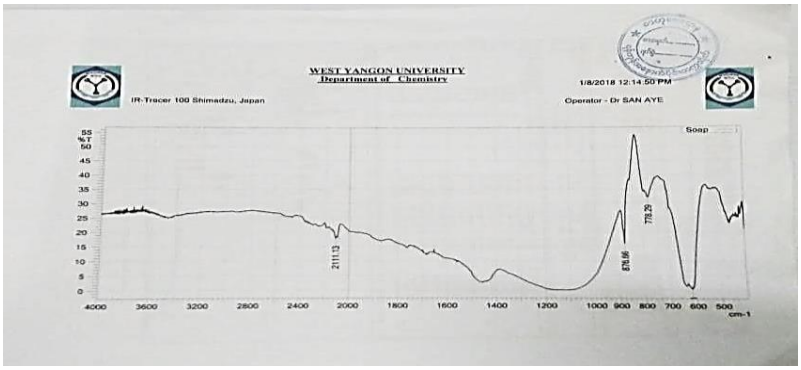

Figure 5 FT IR spectrum of natron (purified)

Table 1 FTIR Spectral Assignment of Natron (purified)

Observed wave number (cm^{-1})	Literature Frequency (cm^{-1})	Possible Assignment
2111.13	2000-2200	C=C, SCN (aromatic) stretching,
876.66	800-950	Si-H stretching, Si-O stretching
778.29	700-800	P-O-P stretching, aromatic amine

Physicochemical Properties of the Prepared Soap

pH

pH values of the prepared soaps are presented in Table 2. pH is a chemical parameter for knowing characteristic of the soap kind of alkaline or acidic. pH of the prepare soap was strongly basic in nature. According to the literature, the pH values of all soaps were in the range of National Agency for Food and Drug Administration and Control (pH value of 8-11).

Foam Stability

The foam stability was determined by measuring the time it takes for the lather formed by the soap with pure water to collapse. The foam height (6.7 cm) of soap prepared with palm oil containing natron was higher than that of coconut oil (2.5 cm). Palm oil is very popular for its ability to add hardness to soap and produce creamy leather (Azeman *et al.*, 2015). A good foam stability criterion is when subjected to a foam stability range of about 60-70 % in the first five minutes (Wara *et al.*, 2014). In each soap formula containing stearic acid so that the resulting foam stability is good enough to be proved in the foam stability data within the first minutes.

Table 2 Physicochemical Properties of the Prepared Soaps Using Natron with Lye and without Natron

Parameters	SN.I	SN.II	SL.I	SL.II
Texture	soft	hard	soft	hard
Colour	white	white	white	white
Foam stability (%)	89.55	20	89.71	17.77
Foam height (cm)	6.7	2.5	7	4.5
pH	10.4	10.3	10.2	10.5

According to the physicochemical properties, the prepared soaps (SN.I, SN.II, SL.I and SL.II) were nearly the same properties. Therefore, the amount of lye (sodium hydroxide) can be reduced by using natron in the preparing of soap with suitable oils.

Water Absorption Activity of the Prepared Soap

The dissolution of soap in water is very important, if the soap is very soluble water it is not suitable for commercially used and not effective for customers. The degree of absorption (%) of prepared soap (SN.I and SN.II) and commercial soap sample (Shwe war) are shown in Figure 6 as a function of absorption time in water. According to this result, the prepared soap SN.I and SN.II showed the decreasing in absorption (%) than the commercial soap sample. In addition, the prepared soap SN.I was the least absorption (%) than that of SN.II and commercial soap (Shwe war). Therefore, it can be concluded that the prepared soap may be used in laundry soap.

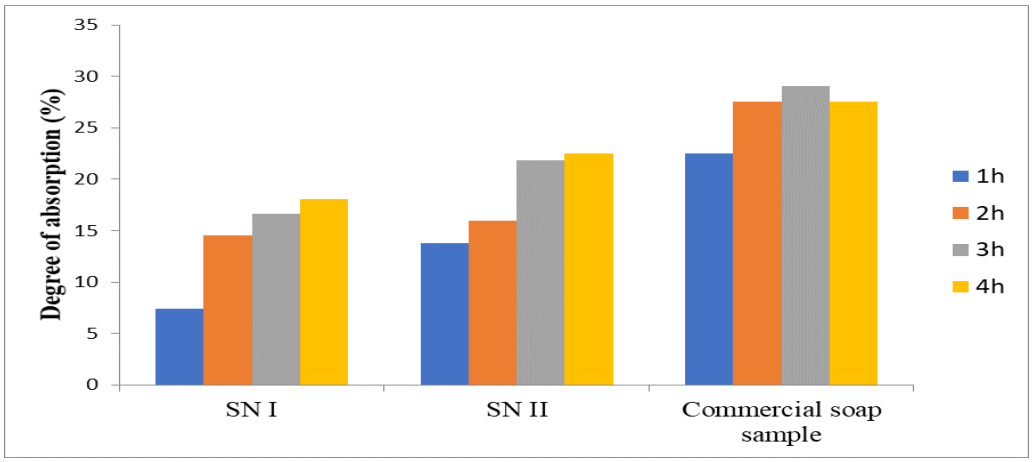

Figure 6 Degree of absorption (%) of the prepared soap with time

Antimicrobial Activity of the Prepared Soap

Antimicrobial activity of prepared soap SN.I, SN.II, purified natron and commercial soap sample (Shwe war) were shown in Table 2. The tested organisms were *Agrobacterium tumefaciens* (plant disease), *Bacillus pumilus* (fever), *Bacillus subtilis* (fever), *Candida albicans* (candidosis), *Escherichia coli (E.coil)* (cholera, diarrhea and vomiting urinary tract infection), *Pseudomonas fluorescens* (Plant disease) and *Staphylococcus aureus* (skin disease, food poison and wound infection) species, as seen in Figure 7and Figure 8. The prepared soaps SN.I, SN.II, purified natron and commercial soap sample (Shwe war) were used for the agar medium cultivation. It was evident from the antimicrobial activity studies, the prepared soaps SN.I, SN.II and purified natron showed antimicrobial activity against all the given strains. This is due to the fact that the purified natron contained sulphur, as a major constituent in this sample from EDXRF analysis. Moreover, from FT IR analysis, it can be seen strong stretching band at 2200-2000 cm^{-1} in spectrum is attributed to the aromatic thiocyanate. Consequently, these results were agreed with EDXRF and FT IR observations. From these studies, prepared soap SN.I, SN.II and natron (purified) were better than the commercial soap sample (Shwe War). Therefore, it can be concluded that according to the antimicrobial activity, purified natron and prepared soap SN.I and SN.II may be commonly used antimicrobial in medicated soap.

Table 4 Antimicrobial Activities of Prepared Soap (SN and SL), Natron (purified), and Commercial Soap (Shwe war)

Sample	***B. subtilis***	***S. aureus***	***P. fluorescens***	***B. pumilus***	***C. albicans***	***E. coli***	***A. tumefaci-ens***
SN.I	+++	+++	+++	++	+++	+++	+++
SN.II	++	++	+++	++	++	+++	+++
Commercial (Shwe war)	++	++	++	++	+++	++	++
Natron	23.30 mm +++	22.41 mm +++	21.64 mm +++	17.79 mm ++	21.69 mm +++	18.61 mm ++	21.62 mm +++
Control	-	-	-	-	-	-	-

Auger Well -10mm
10mm~14mm (+) low activity
15mm~19mm (++) medium activity
20mm~above (+++) high activity

B. subtilis
S. aureus
P. fluorescens
B. Pumilus
C. albicans
E. coli
A. tumefaciens

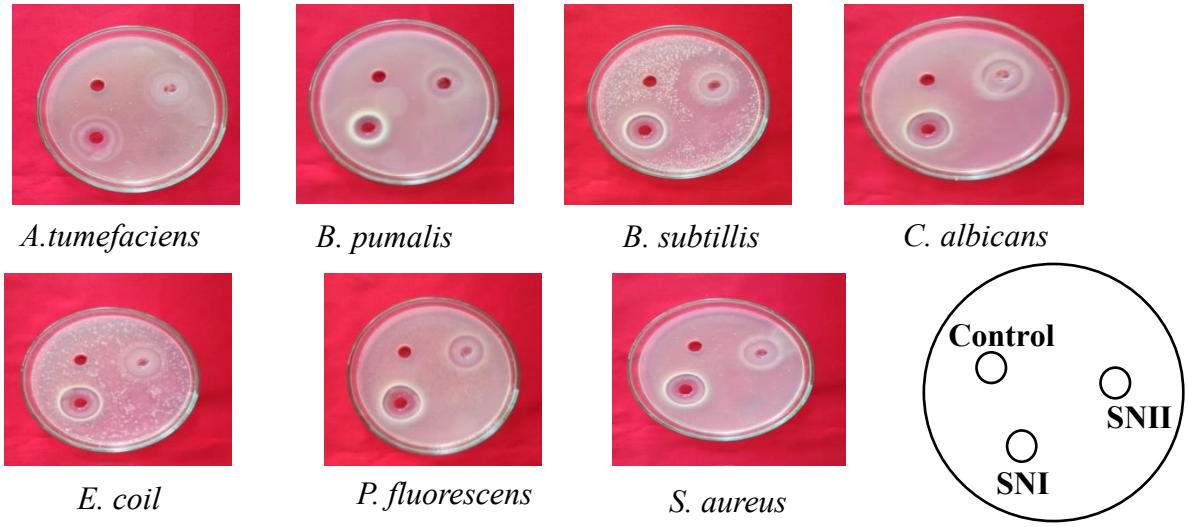

Figure 7 Antimicrobial activity of SN.I and SN.II

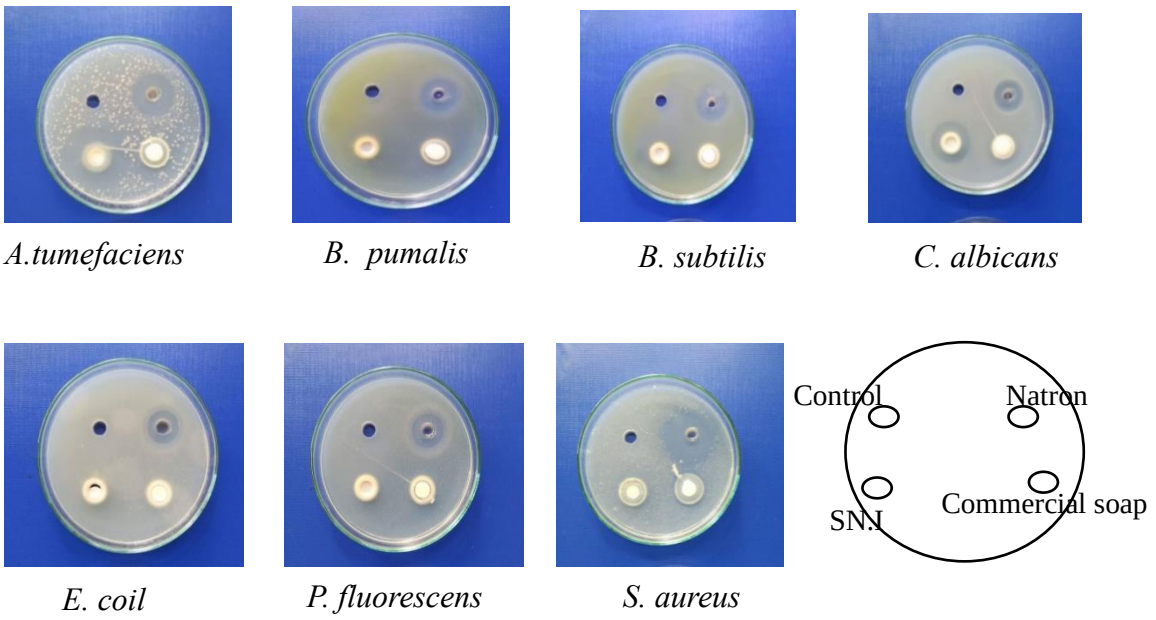

Figure 8 Antimicrobial activity of natron (purified), SN.I and commercial soap (Shwe war)

Conclusion

The preparation of soap from locally available natron with palm oils was successfully achieved using a hot- process method. The purified natron was characterized by EDXRF and FT IR analyses. The chemical composition of EDXRF spectrum showed sulphur (87.07 %) was the major constituent in natron sample and the other elements (Si, P, Al) contained trace elements. The pH of the prepared soaps from natron was in the range of 10.2-10.8 and it was strongly basic in nature. The pH values of all soaps were in the range of National Agency for Food and Drug Administration and Control (pH value of 8-11). Therefore, the amount of natron added was not affected the pH of the soap. The prepared soap SN.I and SN.II showed the decreasing absorption (%) than the commercial soap sample. Therefore, the prepared soaps are suitable for customers commercially used. From the antimicrobial activity studies, the prepared soaps SN.I, SN.II and purified natron showed antimicrobial activity against all the given strains. Especially, it was suitable for production of toilet and bathing soap due to antimicrobial activity on *Escherichia coli (E.coli)* and *S. aureus.* This fact was due to the presence of purified natron contained sulphur.

According to the antimicrobial activity, prepared soaps from natron may be commonly used antimicrobial medicated soap and laundry soap making. Therefore, it can be concluded that the using of natron instead of lye will save the environment from the potential harmful effect on pollution that commonly associate with these synthetic chemicals.

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