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THE CHEMICAL AND PHYSICAL CHARACTERISTICS OF BAR SOAP: A REVIEW

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Abstract

Soap is made of alkaline solutions to release glycerol by the process of saponification of fatty oils. Soaps are able to dissolve the dirt on the surface of the skin and cleanse it well. There is not much difference between bar soaps and liquid soaps, both can clean well. However, bar soap is more eco-friendly and also cheaper than liquid soap, making it a better choice for certain people. There are two characteristics of soap that are used to determine a good soap. They are chemical and physical characteristics. The chemical characteristics include free fatty acid, total free alkali, free caustic alkali, total fatty matter, pH, and moisture content and the physical characteristics include foam stability, and weight loss on curing (hardening process). These characteristics are important to determine the quality of soap. Some of these characteristics are good in high value but there are also some parameters that are required in small quantities to make a good quality of bar soap. The objective of this review is to study the chemical and physical characteristics of different type of bar soaps from the data obtained from the articles. The moisture content will affect the hardness of the soap and the soap's shelf life while pH, total free alkali, and free caustic alkali may influence the side effects of soap to irritate the skin, cause skin scraping and also make the skin oilier. TFM value also has an effect on the skin as low TFM are not suitable for certain skin conditions. The foam stability of soap can be affected by the moisture content and the addition of suitable types of oil added to the oil blends and the addition of additives during the saponification process could influence the free fatty acid level of soap. In the chemical characteristics, the values of free fatty acid from the chosen data were ranged between 0.171 – 0.426%, total free alkali ranged between 0.13 – 1.6%, free caustic alkali ranged between 0.01 – 0.62%, the total fatty matter was found between 13.3 to 80.5%, pH ranged between 9.6 – 10.4 value and moisture content was found between 1.9 – 5.8%. Meanwhile, in physical characteristics, the value of foam stability and weight loss on curing (hardening process) were ranged from 5.45 – 6.30 min and 13 – 18g respectively. Free fatty acid and foam stability values were obtained from palm kernel oil : beef tallow oil blends samples while total free alkali and free caustic alkali were both obtained from commercial soap samples. For pH and total fatty matter, soap samples from coconut oil, gee oil, olive oil, castor oil, and palm oil were used. Lastly, palm kernel oil, palm oil, shea butter oil, peanut oil, and tallow oil soap samples were used to analyze the hardening process and moisture content characteristics in soap. As a conclusion, a good soap contains low free fatty acid level, low total free alkali, low free caustic alkali, low moisture content, high total fatty matter, high value of foam stability, has a hard texture, and a good pH soap standard range from 9 to 11.

1.0 Introduction

Soap is a common cleaning or emulsifying agent produced by reacting animal or vegetable fats or oils with potassium or sodium hydroxide (Mohammed & Usman, 2018). Soaps also can be classified as water-soluble fatty acids that contain more than eight carbon atoms. Vegetable oils from plant sources, such as palm kernel oil, olive oil, and coconut oil are used by the soap industry as one of the main raw materials for soap processing (Kaigama et al., 2020). Types of oil/fat and alkali used to produce soaps have a large impact on the soap's consistency and physicochemical properties (Mahesar et al., 2019).

The soaps that are used in our everyday lives have a history that goes back to about six thousand years ago. The ancient Babylonians found a cleaning product which was later known as "soap" (Wijetunge & Perera, 2016). The existence of the basic soap can be linked back to the Egyptians when the alkaline plant was combined with animal fats to produce raw soaps (Sindhu, et al., 2019). Soap was produced by heating animal fat or wood ash oil. Wood ash contains potassium carbonate and sodium carbonate that make a simple solution. The modern industrial way of producing soap involves heating fats or oils in aqueous sodium hydroxide or potassium hydroxide and adding sodium chloride or potassium chloride to the soap respectively. Then the soap is dried and pressed into bars. Perfumes may be applied for scented soaps, dyes may be added for coloured soaps, sand may be added to scouring the soaps and air is used to make the soap float by blowing into it (Idoko, et al., 2018).

The types of soap may differ, such as solid soap, soft soap, liquid soap, and powder soap. If the alkali used is sodium hydroxide, the final product is a solid soap and when potassium hydroxide is used, the outcome is soft soap (Sulistiawati, et al., 2019). Liquid soap serves as the emulsifying and wetting med for antiseptic, shampoos, etc. Unfortunately, the price of liquid soap on the market tends to be higher which can even be up to 5 times more expensive when compared to the price of bar soap (Munawar, 2020). People often use bar soap to cleanse the body because bar soap is cheaper, easier to use, and effective for cleaning the skin (Febriani, et al., 2020). Therefore, bar soaps are better to use based on the factor of cost, and cleanse ability.

The skin is the main organ of the body and serves as a protective shield for the body and certain toxins in the environment. The chemicals in them come into close contact with the skin as items such as soaps are used on the skin. Bar soap is mainly used to scrub the body and improve personal hygiene (Mahesar et al., 2019). People utilize soap as a cleaning product as it can eliminate the dirt that is attached to the body (Senny, et al., 2018). Soaps are being used to remove dirt, such as dust, microorganisms, smudges, and odors in an attempt to maintain health, beauty and eliminate bad smells from the body or inanimate objects, like clothes. Bar soap is perfect for personal use at home but besides home use, bar soaps are also common in commercial settings for hotel use. Bar soap is typically presented in these settings to prevent the expense of wasting large quantities of soap, since users only need the soap for a few days, and each new guest must use a new soap.

Most of the modern or commercial soap preparation methods used today have evolved with some variations over time from ancient methods (Adane, 2020). Soap is made of alkaline solutions to release glycerol by the process of saponification of fatty oils (Nurasia. et al.,2019). Saponification or the hydrolysis of fats and oil is a process to produce soap from natural oils or fats by reacting them with lye.

Fat + Potassium Hydroxide ⟶ Soap + Glycerol

3H5 (OOCR)3 +3KOH ⟶ 3KOOCR + C 3H5 (OH)3

OR

Fat + Sodium Hydroxide ⟶ Soap + Glycerol

C3H5 (OOCR)3 +3NaOH ⟶ NaOOCR + C3H5 (OH)3

Figure 1: Saponification processes (Zauro, et al., 2016)

Saponification can be performed in a hot or cold condition. For hot saponification, the method is simple, all the required substances are added to the container, equipped with the heat source and it is stirred continuously until the reaction is finished. At the end of the process, the soap is separated from the glycerin water and the soap can be used straight away (Cobzaru, et al., 2017). Cold saponification utilizes the heat generated by the combination of fatty acids in melted oils and fats with sodium hydroxide to enhance the saponification process, where it takes 18–24 hours to finish, and another 3–4 weeks to cure the final soaps (Vidal et al., 2018). Although hot soap is obtained relatively quick, it is less preferred in cosmetics since it separates glycerin water which has emollient properties on the skin, meanwhile, in cold soap, the glycerin is still included in the final product. Also, the cold soap has a better foaming effect and sustains its quality for a long time (Cobzaru, et al., 2017).

The quality of soap product features and their characteristics will satisfy the needs of consumers (Idoko, et al., 2018). The chemical characteristics of soaps include pH, moisture content, free fatty acid, total fatty matter, total free alkali, free caustic alkali, and volatile matter. pH is a chemical factor used to identify whether the resulting soap is alkaline or acidic (Widyasanti & Hasna, 2016) .The pH value may influence the side effects of soap to irritate the skin (Fransisca & Dianursanti, 2019). The pH of the soap shall not be much different from the pH of the skin, in which the pH of the skin surface is usually between 5 to 7 (Widyasanti, et al., 2020). A good pH soap standard for skin ranges from 9 to 11 (Sany, at al.,2019). A high value of pH is not suitable for the skin as it harms the skin and can create dry skin irritation that can cause redness (Pathan, et al., 2019). Although the pH of the soap is over the pH of the skin, the usage of soap with a higher pH (lower than 11) does not lead to skin irritation. It is because the rise in the pH of the skin would begin to recover 30 minutes after using soap (Fransisca & Dianursanti, 2019).

According to the study conducted by Arasaretnam and Venujah (2019), gee oil soap recorded a highest pH value which is 10.4, whereas in olive oil soap the lowest pH value obtained with 9.6. In this study, the soap is prepared by dissolving the lye (NaOH) in distilled water and it is cooled to room temperature, then it was blended with oil and heated to room temperature once more. It was carefully transferred into lye water and mixed to develop a "trace." Various types of oil have been used to produce the soaps, like coconut oil, olive oil, castor oil, gee oil and palm oil, composed mainly of NaOH, H2O, oil (1:3:7). The pH is determined with 1.0 g of soap added to the 99.0 g of distilled water that was heated to 70°C and it is stirred until the soap has dissolved. The pH values were recorded using a pH meter and the value soap is measured when the soap solution is at 40°C, because if the temperature increases, the solution will become thicker and the pH will be hard to measure. In other research from Helsy et al. (2018), the highest pH value which is 10.04 is obtained from the soap sample with 38% compositions