RECOVERY OF GLYCERINE FROM SPENT PALM KERNEL SOAP AND PALM OIL SOAP LYE

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ABSTRACT:
The recovery of glycerine from spent soap lye has been done using soap lye samples obtained from the cold process of soap production using palm kernel oil (PKO) and palm oil (PO). The overall weight of glycerine recovered per 200g of oil used, was 9.8g (4.9%) and 9.4g (4.7%) from PKO and PO soap lye respectively. Thus an average of 56.3% and an average of 53.9% of the glycerine in spent soap lye were recovered from PKO and PO soap lye respectively. Higher quantity of brine (200g at 8% concentration) was needed to recover 9.8g of glycerine from PKO soap lye than that (50g at 12% concentration) required to recover 9.4g of glycerine from PO soap lye. The weight of glycerine obtained from palm kernel soap lye increased steadily going through some maxima at various brine concentrations before they began to drop. At 8% concentration, the maximum value of glycerine obtained was 9.8g, 7.9g at 10% concentration, 8g at 12 and 15% concentrations respectively. While the weight of glycerine recovered from palm oil soap lye increased minimally at all concentrations. At 8% concentration the maximum value of glycerine recovered was 8.2g, 9g at 10% concentration, 9.4g at 12% concentration and 9.1g at 15% concentration.

KEY WORDS: Glycerine, Recovery, Spent soap lye, soap quality.

INTRODUCTION:
Glycerol (propan-1, 2, 3-triol) is an important by-product of soap manufacture. It is found dissolved in the soap lye and as impurity in the crude soap when fats and oils are saponified by caustic soda. [1,2,3] The process of soap manufacture from fats and oil usually yields glycerol to about 10% of the value of the soap formed and because of its many uses, its recovery is vital to the manufacturing cost analysis for any soap making venture. Unfortunately many small scale and medium scale soap producers usually discard the lye as a waste.
In Nigeria, large tonnage of soap is produced annually from vegetable oils (principally from palm kernel and/or palm oils) by cottage and medium industries. In most cases, the soap as it is being used for laundry purposes is in its crude state because of the high level of glycerin and other impurities still embedded in it. The glycerin is eventually wasted or lost along with the soap usage because they are never salted to recover the glycerine. Hence, it becomes very advantageous economically to recover at least some of the glycerin from such soap during soap production. The glycerine, when further processed, can be an added source of income to the soap manufacturer because of its wide range of both industrial and domestic applicability. Soap is a cleansing agent made from the interaction of fats and oils with alkali. In chemistry, soap is a salt of a fatty acid. [1] Soap is mainly used for washing and cleaning, but soaps are also important components of lubricants. Soaps for cleansing are obtained by treating vegetable or animal oils and fats with a strongly alkaline solution. The alkaline solution, often lye, promotes what is known as saponification. In saponification, fats are broken down (hydrolyzed) yielding crude soap, i.e. impure salts of fatty acids and glycerol.

Fats and oils for soap are compounds of glycerin and a fatty acid. When oils are mixed with an alkali, they form glycerin and the sodium salt of the fatty acid. The fatty acids required for soap making are supplied by tallow, grease, fish oils, and vegetable oils. [4]

Lye, also known as caustic soda, is a basic ingredient in soap making. [1] It combines with fatty acid derivatives to produce soap. This chemical process is known as saponification. Traditionally, saponification involves hydrolysis of esters under basic conditions to form an alcohol and the salt of a carboxylic acid (carboxylates). Saponifiable substances are those that can be converted into soap. [5]

Soap comprises of sodium or potassium salts of various fatty acids but chiefly of oleic, stearic, palmitic, lauric and myristic acids and is obtained by reacting common oils or fats with a strong alkaline solution (the base, popularly referred to as lye) in a process known as saponification. The fats are hydrolyzed by the base, yielding alkali salts of fatty acids (crude soap) and glycerol[5]. Currently, sodium carbonate or sodium hydroxide is used to neutralize the fatty acid and convert it to the salt Charles, 2003), and its by-product.
In saponification, formation of salt by reaction of the base with a long chain fatty acid yields. [6]

$$\text{Fat} + 3\text{NaOH} \longrightarrow \text{Glycerin} + 3\text{Soap}$$

Splitting of oils and fats by hydrolysis, or under basic conditions (saponification), yields fatty acids, with glycerin (glycerol) as a byproduct. [7] In the process of salt formation between the reaction of the base or alkali and the fat, glycerin- a by-product is formed. Glycerin presence is responsible for the softening of soap and depending on the desired quality of the final product; varying amounts of glycerin may be incorporated. However, excess glycerin is removed and this process otherwise referred to as drying makes the soap hard enough to form a distinct shape. [8, 9] Addition of salt water to dissolve glycerine and precipitate the soap forms the basis of this process. [10, 11, 12]

MATERIALS AND METHODS:

The spent lye sample used in this study was generated from the soap samples prepared at the Chemical Engineering Laboratory, Covenant University, Canaan Land, Ota. The palm kernel oil, sodium chloride and caustic soda were purchased from a local Chemical market at Ojota, Lagos.

Brine Solution Preparation: 8% concentration (weight by weight) of brine solution was first prepared by dissolving 80g of sodium chloride in 920 g of distilled water in a one litre plastic container and covered with a lid. Various other concentrations 10, 12 and 15% wt/wt. were similarly prepared and stored.

Soap Preparation and Salting: The cold process was used. Here, 200g of the palm kernel oil whose saponification value had been determined was first weighed into a one-litre glass beaker and gently heated to a temperature of 40^{o}C. 23.6g of caustic soda was then weighed and dissolved in 78g of distilled water in a 500ml plastic container to give about 23.22% caustic solution. This was allowed to cool to a temperature of 40^{o}C. At 40^{o}C the caustic soda solution was then carefully poured into the oil and under continuous stirring until a homogenous soap paste or trace was formed. Salting of the soap samples was done using varied quantities of the 8% brine solution for each batch of soap sample prepared. Salting process was repeated using 10, 12 and 15% brine solutions for other soap batches prepared. The salting process separated the soap two phases; soap (upper phase) and the spent soap lye (lower phase). The spent soap lye contained the glycerin.

Glycerin Recovery From Spent Soap Lye: The spent soap lye was filtered in order to remove unwanted soap particles. Each filtrate was heated to different temperature of 60^{o}C in 250ml conical flasks. Acid treatment was followed by adding 0.1M Hydrochloric acid (HCl) drop wisely until the pH range was within 4.0-6.0. The sample was filtered into a conical flask. 0.1M sodium hydroxide was then added with the aid of a pipette to the filtrate in other to raise the pH again to a range of between (8.0-10.0). The sample was then filtered again and poured into a 250ml beaker. This was then kept in an oven for drying at 150^{0}C leaving the crude glycerine and salt. The salt is insoluble in glycerine. The crude glycerine sample was carefully decanted, weighed and stored in a refrigerator to further precipitate the remaining salt (if any) in the sample. The glycerine recovered was weighed again.

RESULTS AND DISCUSSION:

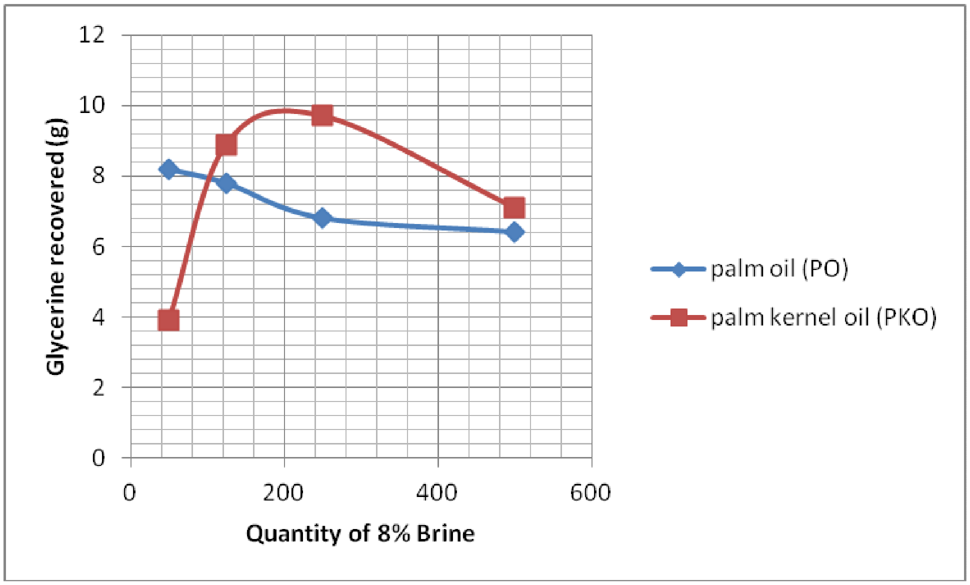

Fig.1: Recovery of Glycerine from Soap Lye at Varied Quantities of 8% Brine Concentration at 60^{o}C.

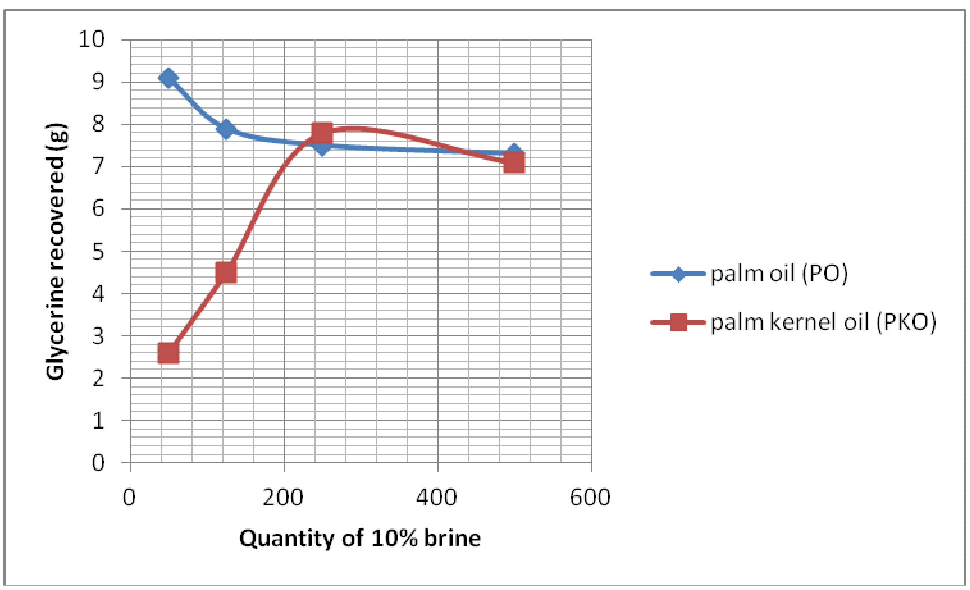

Fig.2: Recovery of Glycerine from Soap Lye at Varied Quantities of 10% Brine Concentration at 60^{o}C.

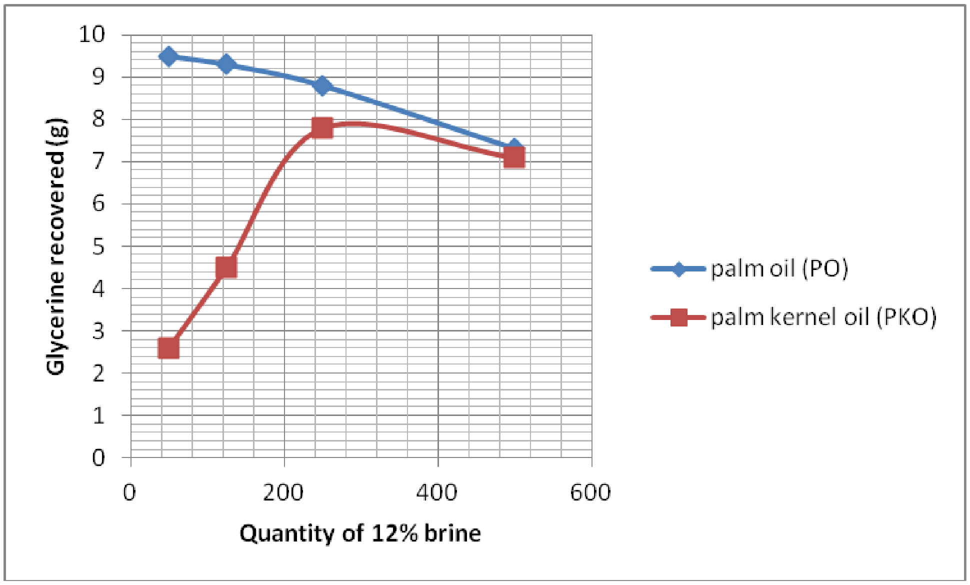

Fig.3: Recovery of Glycerine from Soap Lye at Varied Quantities of 12% Brine Concentration at 60^{o}C.

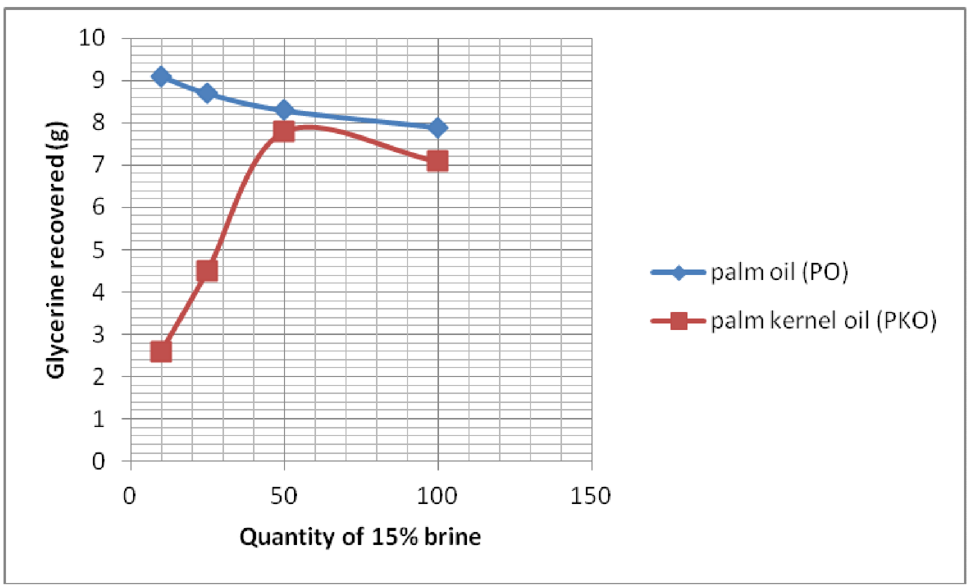

Fig.4: Recovery of Glycerine from Soap Lye at Varied Quantities of 15% Brine Concentration at 60^{o}C.

From the graphs 1-4, weights of glycerine recovered from lye obtained from PKO progressively increased until they got to their respective maxima and then begins to drop. The highest value of glycerine recovered was 9.8g at 8% brine concentration using 200g quantity of same for salting. While the weights of glycerine recovered from the lye obtained from PO showed slight decreases at all conditions (see graphs 1-4). The highest value of glycerine recovered was 9.4g at 12% brine concentration using 50g quantity of it for salting. Generally, it was observed that the higher the percentage brine concentration, the higher the value of glycerine recovered. The overall effect of percentage brine concentration on glycerine recovery was more

pronounced than the quantity of brine used. This effect could be seen from the curves of the weight of glycerine recovered moving upward as brine concentrations were increased. Also, the highest yields of glycerine in all of the conditions were obtained at relatively lower amounts of the respective brine concentrations.
It was further noticed that the variation in amount of glycerine recovered from spent soap lye depended very much on the nature of the soap lye and the method of treatment. The acid and alkaline treatments of the soap lye in adjusting the pH of the lye helped to reduce the amount of salt originally combined with the soap by precipitation, coagulation and flocculation[10].

CONCLUSION

The recovery of glycerine from spent soap lye indicates that:

* Glycerine can be successfully separated from soap lye irrespective of the source or nature of the fatty acids from which the soap was made.
* The weight of glycerine obtained from the two soap lye depended more on the percentage brine concentration rather than its quantity.
* Higher yields of glycerine were obtained from the two soap lye for all concentrations investigated at lower brine quantities.
* The salt used for salting was at some point in the process recovered. Salt is insoluble in glycerine and hence could be reused. This makes the economy of the process (glycerine recovery) a viable option for local soap manufacturers as it would be an added source of income to them aside from improving both the texture and overall quality of the soap obtained.

It is suggested that further work on the recovery of glycerine from spent palm kernel and palm oils soap lye using the hot process of soap manufacture be investigated. This is because local soap manufacturers use either the hot or cold process for soap making. Such investigations will provide the needed platform for effective comparison of glycerine yields from both processes.

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