# MAKING SOAP FROM READILY AVAILABLE AGRICULTURAL AND HOUSEHOLD WASTES CAN INCREASE CLEANLESS IN RURAL AREA

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**ABSTRACT**

In some areas of the world, soap is too expensive for many people to afford. For these people an alternative exists. They can make their own soap. In general, soap is made by the reaction of triglycerides and caustic soda. However, caustic soda, too, may be difficult to find or too expensive. The aim of this project is to develop a process for making soap from readily available agricultural and household waste materials, and other inexpensive chemicals. By using this process, rural people can get the benefits of readily available, inexpensive soap.

Soap is made from animal fats or vegetable oils by saponification using strong base. The simple soaps can be isolated as cakes or bars, or it can be used as water solution. Many reaction conditions were studied to develop a recommended process that can be done using equipment and reaction conditions that can be performed in a kitchen or a fireplace.

The soaps from this project were characterized primarily using infrared spectroscopy and several other analytical techniques as well as tests to show their effectiveness.

People in Tanzanian Village with Banana Plantation

## INTRODUCTION

In rural parts of wealthy countries and in many poor countries, soap is expensive and/or not readily available. To address this need, this project was initiated. The goal was to develop a process for making soap that could be shared with unsophisticated people, so that they could make their own soap. Although the tools used were typical chemical laboratory equipment, the process could be easily adapted to a kitchen or even a fireplace. The most difficult challenge not yet addressed completely is the isolation of strong enough base from ashes to provide an efficient conversation of fat to soap.

## MATERIALS

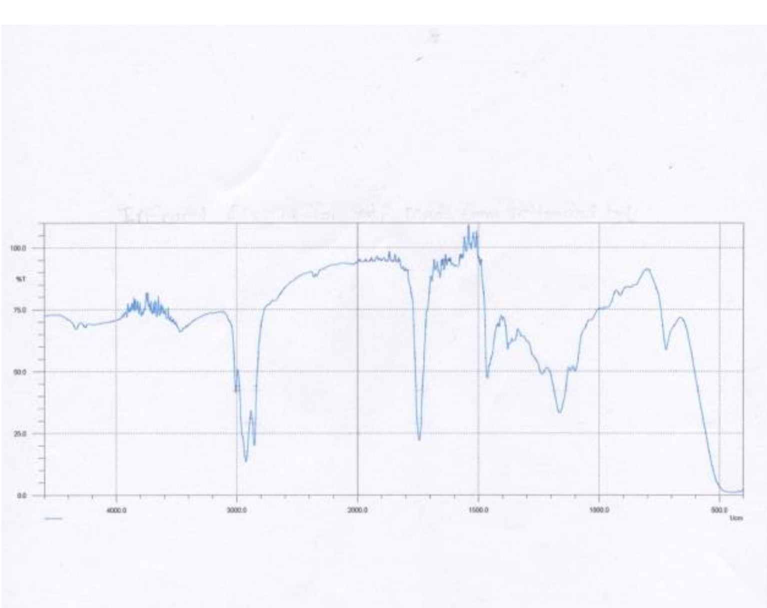
Distilled water or rain water, animal fats or vegetable oil, sodium hydroxide (NaOH) or potassium hydroxide (KOH), lye made from ashes, an oven or fire place for making ashes, scale for measuring the lye and fats, a large enamel or stainless steel saucepan, strong plastic or wooden spoon, a plastic rectangular container to be used as the primary soap mould, and rubber gloves and eye protection.

## METHOD FOR PREPARATION OF BASE FROM ASHES

Preparing ashes; collect the unripe plantains peels, or bananas peels and dry them in the sun, then dry them in the oven for three hours at 100Ċ and let them cool. Place the peels in the open combustion pan and heat until ignited. When heating, make sure to mix them to ensure uniform combustion. Heat until the ashes turn to a white gray color. This process may take 3-4 hours.

Alkali extraction; for extracting high concentration of base, make sure the particle size is small about 0.16cm, dissolve 150g of ashes in 250milliliters of rainwater or distilled water. Heat the solution to 60Ċ for eight hours or twelve hours. Cool and filter it to obtain the basic extract.

Moles determination; titrate the filtered solution against 0.1M HCl by using phenolphthein indicator. Obtain the spectrophotometer analysis of the extracted solution by using atomic absorption spectrophotometer. (See table 1 for data)



Infrared Spectrum of Soap Made from Cottonseed Oil

## GENERAL REACTION

When fats or oils are treated with strong bases such sodium hydroxide (NaOH) or, potash (KOH) they undergo saponification to form glycerol and soap (the salt of the long chain fatty acid) (Bettelheim 2004)

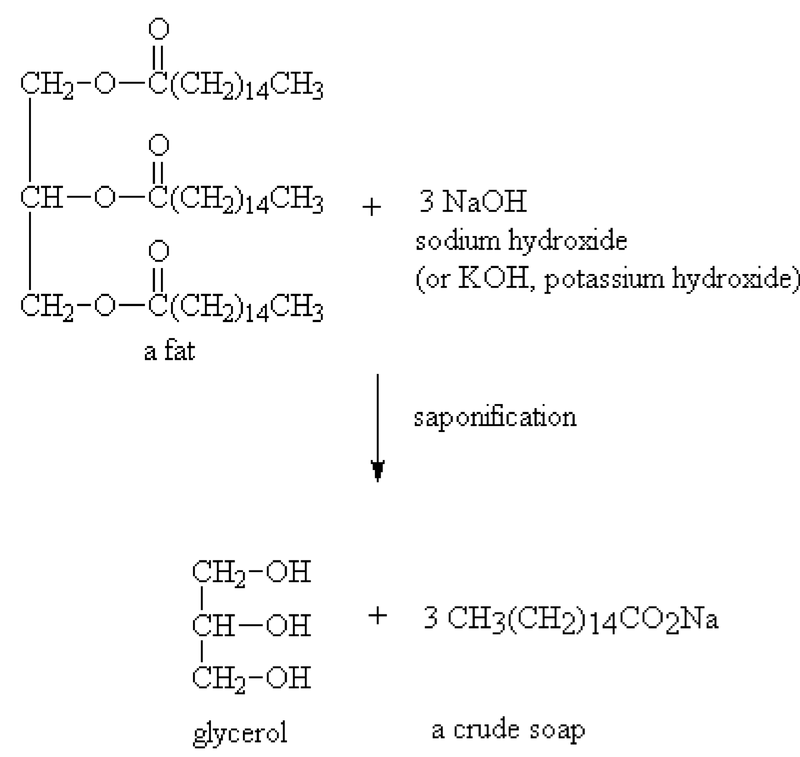



Table 1. Titration Results

| | Initial HCl | Final HCl | Total | Weight NaOH | Weight KOH | Moles NaOH | Moles KOH |
|---|---|---|---|---|---|---|---|
| Wood ash solution | 0.00ml | 5.5ml | 5.5 ml | 0.02g | 0.03g | 5,5 x 10^-4 | 5.6 x 10^-4 |
| ICPCT data | | | | 0.003g | 0.03g | | |
| Banana ash solution | 5.5ml | 12.0ml | 6.5ml | 0.03g | 0.04g | 6.5 x 10^-4 | 6.7 x 10^-4 |
| | 12.0ml | 18.4ml | 6.4ml | | | | |

Table1 shows the titration results of 1g of banana ashes and wood ashes dissolved in 100ml of distilled water and titrated against 0.1M HCl by using three drops of phenolphlated. The 0.02g NaOH and 0.03g KOH in wood ashes based on calculation assuming all the base comes from either NaOH or KOH. The 0.003g NaOH and 0.03g KOH in the same ash are based on ICPCT data for % Na+ and % K+.

## PREPARATION OF FATS & OILS

Cut the fat from meat and wash it with clean cold water. Cut it in small pieces and place it in cooking pan with water to fill the pan¾ full. Boil it until the water evaporates, then reduce the heat and continue heating slowly until the fats melt out. Pour the oil into a container and save it at room temperature for several weeks before using it to make soap. Another methods; fry the bacon in the frying pan and pour the oil after it has cooled to a safe temperature into a glass or metal container (recycle jar or can). A similar process can be used for any fatty meat.

Oil extraction; oils can be extracted from fruits, nuts or seeds by heating, solvent or pressure. Pressure extraction separates oil from the solid particles by squeezing the oil out of the crushed mass of the seeds. Some oils need to be pressed out mechanically. Filter the oil to remove particles from the pressing operation and save the oil.

## PREPARATION OF SOAP USING LABORATORY PROTOCAL

12g sodium hydroxide dissolved in 50ml water and 50ml of 95% ethanol. The solution was mixed with 25g of shortening and heated for 45 minutes in a boiling water bath. 50:50 solutions of ethanol and water was added in portion in the mixture and stirred occasionally. After heating, the soap solution was poured into a solution of 125d sodium chloride in 375 ml of water. The soap was isolated by vacuum filtration using a buchner funnel from the combined reaction mixture and sodium chloride solution. Then the soap was allowed to dry for several days.

## PREPARATION OF SOAP USING FAT ISOLATED IN COOKING

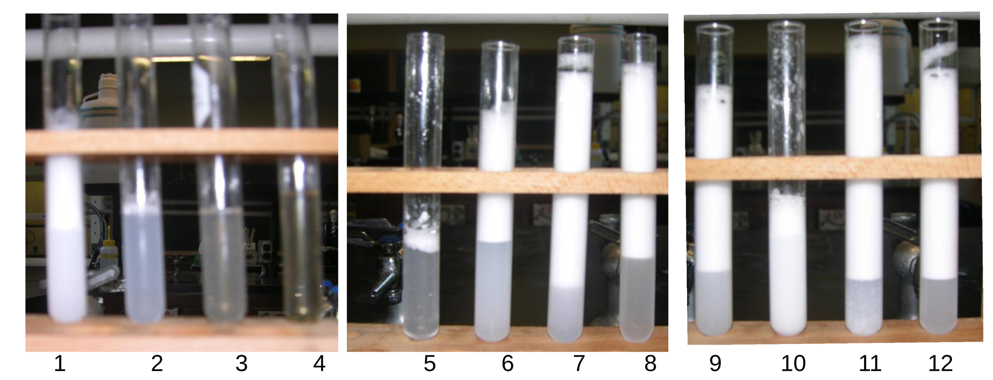
12g of sodium hydroxide dissolved in 30ml of water and warmed to 50Ċ. The solution was mixed with 100g of melted fat at 50Ċ and heated and stirred for 45 minutes. Then the soap was allowed to cure for several weeks. Soap from vegetable oils and ash-extract alkali use the same procedure as above.

Sr. Eugenia and Roberto Zecca in front of granite wheels of olive press

Table 2. Data for Soap Samples

| Foam Test | pH | # of Test Tube | Lather |
|---|---|---|---|
| Dove soap (Control) | 7 | 7 | Strong |
| Soap made from beef fat | 7 | 11 | Very strong |
| Soap made from corn oil | 7 | 12 | Strong |
| Soap made from bacon fat | 7 | 8 | strong |
| Soap made from cotton seeds oil | 8 | 9 | Strong |
| Soap made from shortening | 8.5 | 1 | Medium |
| Soap made from banana ash solution& shortening | 9 | 4 | Nothing formed |
| Soap made from wood ash & bacon fat | 9 | 3 | Nothing formed |

Table 2 shows the end point of soaps made from different fats and oils. The pH of soaps made from 100g of beef, bacon fat and corn oil with 12g NaOH have same pH as Dove soap from Rite Aid Drug Store. The other soaps have higher pH. No foam formed on soaps made from ash extract alkali.




Test Tubes for foam Test

## DISCUSSION

The soap produced using 50% sodium hydroxide solution was hard and gave the most foam in our foam test. The ash alkali soap had a harder consistency. The difference in harness between the pure sodium hydroxide and the ash-extract soap could be accounted for the presence of other metallic ions in the ashes.

The foam ability of the pure sodium hydroxide soap was very different from that of the ash-extract soap (table 2). This could be caused by the presence of calcium ions in the ash which reduced the carboxylate solubility and hence could reduce soap foam formation. Also, it could be the result of low concentration of extracted alkali, which was not as effective as the pure sodium hydroxide.

The results in table 2 shows the pH and the foam formation in different soaps made from different fats and vegetable oils. By using Dove soap as a control, the results give the possibility of that, soaps were made in this project could be safe on human skin. The infrared spectra show absorbances typical of alkali metal carboxylates.

## SOAP RECIPE

Ingredients For a Traditional Animal Fat Soap (For example if you want to make a one bar of soap)

100g of fat

12g of sodium hydroxide (NaOH) or 18g of potassium hydroxide (KOH)

30 ml of distilled water or rainwater

**Instruction** Add the NaOH in the water, mixing careful until dissolved. Heat the lye solution to 50Ċ on a stove. Melt the fat in a saucepan and bring it to 50Ċ on the stove. Blend the lye solution into the fat, stirring clockwise. Maintain the temperature about 45Ċ to 50Ċ and stir for 45minutes or until the soap shows tracing. Then pour it into a clean mould and leave to set for 2 days. Then release it from the mould and leave it to cure for 3-5 weeks.

## UPISHI WA SABUNI

Vitu vinavohitajika kwa kutengeneza kipande kimoja cha sabuni ya mafuta kutoka kwa mnyama

100g za mafuta

12g za tindikali (NaOH) au 18g za KOH

30ml za maji ya mvua

**Mwongozo**

Pima kiwango cha maji kama ilivohapo juu. Pima kiasi cha tindikali na kichanganye kwenye maji. Koronga ili tindikali iyeyuke kwenye maji na kisha upashe moto ule mchanganyiko hadi kipimo cha joto kifikie 50. Yapashe moto mafuta kwa kiasi kile kile cha joto. Kwa utaratibu mimina tindikali kwenye mafuta huku ukikoroga kwa nguvu. Hakikisha kipimo cha joto kisipande ama kupugua 50. Endelea kukoronga mpaka mchanganyiko umekuwa mzito kama uji. Ipua sabuni na iweke kwenye chombo safi. Iache sabuni ipoe kwa muda wa siku mbili hivi na baadae unaweza kuitoa kwenye chombo na itakuwa tayari kutumika baada ya majuma 3-5

## CONCLUSION

The soap made from pure sodium hydroxide with animal fat extracted in the kitchen, corn oil, and cottonseed oil was good and acceptable for household use.

More study is needed for the alkali derived from plantain peels ashes because the resultant soap was not effective as soap made from pure sodium hydroxide.

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