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Research Article

Assessment of Physicochemical Properties of Soaps, Detergents and Water Samples Originated From Nigeria

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Abstract

A study determined the physicochemical properties (pH, temperature, Total Dissolve Solids (TDS), Electrical Conductivity (EC) and color) of 36 commercial soaps and detergent purchased from local markets in Akure, Nigeria. The soaps included: Toilet, medicated, glycerin, liquid and local black soaps. Standard methods were used in the study. From the mean results of pH (10.2), TDS (1433mg/L) and EC (2848µS/cm) were higher in detergents than liquid and bar soaps. Temperature of all samples were 30°C. Water samples were colorless, whereas all other samples were colored depending on the manufacturers.

Keywords: Soaps, bathing, washing, surfactants, waste water, WHO.

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Introduction

Soap, detergents and water are important because they are frequently utilized in day to day activities of people. They are used in bathing, washing hands and clothes. Soaps have been in existence date back to the 2800 B.C. The cleaning power of soap was discovered accidentally by the Romans. Their women washed their clothes in the stream using some of the clay mixture Colwell and Blawn (2016).

Chemically, soaps and detergents are similar, but the difference is that soaps are produced from natural products, while detergents are man-made (synthetic). Both soaps and detergents when used in water reduce the surface tension of water by this, clothes soak easily and stains are removed faster.

Most people do not just purchase soaps and detergent, but there are many factors put into consideration. The purchasing attitude depends on the physico chemical properties - the appearance and texture, the effect on skin, hand and clothes, quantity of suds produced, odor, high solubilization of dirt and clarity of the solution. When soaps and detergents are used with water, they are expected to be flushed or poured into the drains as waste water, if not handled well, by treating they become environmental hazards (Abulude *et al*., 2007). To mitigate against this, manufacturers of the products should imbibe perfect waste disposal and enlightenment campaigns should be put in place to educate consumers (American Cleaning Institute, 2017).

Gfatter *et al*. (1997), studied the effect of soaps and detergents on the skin pH of infants, they reported increase in pH of skin (mean 6.60) after bathing the children. Kulthanan *et al*. (2014) from the report of their study concluded that pH of cleanser depends on the composition of the cleanser. Goel and Kaur, (2012) from their study, found significant increase in physico chemical properties (pH, TDS, chloride, sulphate, nitrate, bicarbonates and alkalinity) of wash water after washings with powder detergent. Vivian *et al*. (2014), worked on soaps and detergents obtained from Kenya, it was found out that a balance must be strike out among the physicochemical parameters they worked upon. From their results, soap had minimal insoluble matter, low moisture, high levels of total fat matter, low levels of alkalinity and high pH values.

The aim of this study is to present data for some physico-chemical characteristics of aqueous solutions of soaps, detergents and water samples obtained in Akure, Nigeria and to interpret the significance of the results.

Materials and Methods

Experimental Design and Sample Collection

A total of 36 samples were collected for this study. The compositions were: detergents (9), soaps (14 bar and 3 liquid), and water (well 3, borehole 2, rain 3, river 3 and distilled 1) samples. Many of the soaps and detergents were purchased in a local market, while others were provided by friends within the vicinity of study area. The bar soaps were cut into pieces before analysis. The water samples were collected in plastic containers pre-washed with concentrated HCl, washed with soap and water, rinsed with distilled water and thereafter, the water samples.

Determination of the Physicochemical Properties of Soaps and detergents

The parameters analysed were: pH, temperature, Total Dissolve Solids (TDS), Electrical Conductivity (EC) and color. Ten (10) grams of the detergents, liquid and powdered bar soaps were weighed and dissolved in distilled water and made up to 100 cm^3 (10%) soap solution. The solutions were allowed to stand and settle for 24h before determinations. The pH of the soap solution was determined using a pH meter (pH – 009 (l) made by CE, RoHS, China). Temperature, Total Dissolve Solids (TDS), and Electrical Conductivity (EC) were determined with handheld TDS & EC meter EZ-1 (made in China).

Results and Discussion

The pH values ranged as follows: Detergent had pH ranging between 10.1 and 10.2. The standard deviation (0.05) and Coefficient of variation (10.1) depicted that there were no much differences in the values obtained for the samples. Likewise, all other samples, bar and liquid soaps, and water samples did not show much variations. The detergent results compared with results (10.4) reported by Warra *et al.* (2011) and Tarun *et al.*, (2014). The results of bars soaps ranged between 9.20 and 10.2 with mean and standard errors of 10.2 and 0.02 respectively. Kulthanan *et al.*, (2014) reported pH 9.8–11.3 for cleansing bars obtained in Thailand. From the look of things there are similarities between pH of our bar soaps and those found in Thailand. Liquid soaps results in this study ranged from 8.00 to 8.60, this is not in agreement with 9.6 recorded for general liquid cleaners (Kulthanan *et al.*, 2014). Generally, the results of the soaps and detergents used for this study ranged between 8.00 and 10.20. There are some relationships between the results of this study and those reported in Kenya (Vivian *et al.*, 2014). Our local soap had a pH of 9.0 and compared with the one determined by Beetseh and Anza (2013). The pH values of water samples for cleaning, washing and bathing are depicted in Table 1. The results ranged from 6.60 to 7.60. It is gratifying that they are within 6.5–8.5 of WHO guidelines (Goncharuk 2013).

The values of soaps and detergents obtained in this study were above standard limits (6.50-8.50) set by Standard Organization of Nigeria (1997). According to Hattiangdi *et al.*

(1949), high alkalinity in soaps could be as a result of the way they hydrolyze in different water so also through the free alkali present in the commercial products. The different situations has an unpleasant effect on the skin. The detergents too may cause irritations too depending on the contents of the products. The irritations or the unpleasant situations maybe reduced when the soaps and detergents are diluted in many folds. The waters in this study when used adequately may dilute the alkaline or acidic contents of the soaps and detergents there reducing the effect they may likely have on skin. Like the work of Tarun *et al*. (2014), the detergents and soaps determined in this study possessed pH far above the range of normal skin and hair values. From our observation, liquid soaps have lower pH than detergents and bar soaps, the reason may be due to their formulations, the use of combination of surfactants (amphoteric, anionic, non-ionic, and silicone surfactants) (Kuehl *et al.,* 2003), also liquid soaps contain a mixture of emollients and humectants, which lowers the pH of products (Abbas *et al*., 2004).

The EC of the detergents ranged from 1362 to 3430µS/cm. The results had a mean of 2848, the variance depicted high variability. Bar and liquid soaps showed means of 329.1 and 147.3 respectively. Mean results of the water samples were (wells, 271.3; boreholes, 129; rain, 120 and rivers, 210.7 µS/cm). Table 1 showed that detergent had the highest values. The reason may be due to the presence of the colloidal ions which are highly mobile forming clusters known as micelles. The low values obtained for other soaps could be due to the replacement of ions by colloidal particles of different sizes and types of colloidal particles which are in equilibrium with one another and to the shifting of the equilibrium position with concentration and soap type (Hattiangdi *et al*., 1949).

TDS results provided in Table 1 also depicted high variations between detergent and other soaps solutions. Our results compared with the results on powered detergent (1306 -1829 mg/L) released in the gardenweb by Alice (2013). The reason for higher concentration of TDS in detergents in comparison with other soaps may be the addition of filler and builders added to detergents.

The water samples compared with WHO (2013) limits. They showed that they are good for household uses. However, there should be concern with washings with detergents because the wash water can cause damage to the environment, due to the filler/builders added which play a major role in chemical pollution of water (Goel and Kaur, 2012). TDS is known to give water at a low concentration a flat taste, which is acceptable to the users. In the other way round, increased concentrations of dissolved solids may likewise give undesirable effects. TDS can produce hard water, which produces deposits and films on fixtures, pipes and boilers (Kamel**, 2017).** Infact, washings in hard water using soaps and detergents can be said to be a fruitless effort because it cannot be used to clean anything, more soap will be needed which eventually turns to waste.

Conclusion

It is concluded that the pH, TDS and EC of detergents were higher than those of the liquid and bar soaps. The reasons for this may be the addition of filler and builders added to detergents. The water samples were within the WHO guidelines. When water is used as bathing or washing, it turns to waste water. The waste water could be polluted due to the accumulated dirt's from the washings. Due mitigation must be ensured to avoid environmental pollution. The purchasing attitudes consumers depend on the physico chemical properties - the appearance and texture, the effect on skin, hand and clothes, quantity of suds produced, odor, high solubilization of dirt and clarity of the solution.

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Table 1: Physico-chemical parameters of the Samples

S/N	Name of Samples	pH	Temperature (^oC)	TDS (mg/L)	Electrical Conductivity (µS/cm)	Colour
				DETERGENT		
1.	Bonus	10.2	30	1615	3010	Colorless
2.	Soklin	10.1	30	1204	2410	Colorless
3.	MyMy	10.2	30	1708	3430	Colorless
4.	Canoe Extra Care	10.2	30	1584	3168	Colorless
5.	Sunlight	10.2	31	1286	2578	Colorless
6.	WAW	10.2	30	1541	3080	Colorless
7.	SAY JAY	10.1	30	677	1362	Milky
8.	ZIP	10.1	30	1664	3328	Colorless
9.	Omo	10.2	30	1627	3266	Colorless
Mean		10.2	30.1	1433	2848	
SE Mean		0.02	0.11	111	217	
StDev		0.05	0.33	334	652	
Variance		0.00	0.11	1119	4249	
CoefVar		10.10	30.0	23.34	22.80	

BAR SOAPS

10. Premier	10.1	30	146	294	Green
11. Njoi	9.80	30	111	223	Milky
12. Bright	9.60	30	86	172	Yellow
13. Holan	9.60	30	265	530	Colorless
14. Crusaders	9.20	30	120	241	Milky
15. Eva	9.90	30	97	194	Pink
16. Maliza	10.0	30	183	368	White
17. Tetmosol	10.0	30	145	298	Milky
18. Soda	10.2	30	561	1118	Colorless
19. Premier Cool	9.00	30	41	83	White
20. MP 3	10.0	30	121	243	White
21. Black Soap	9.00	30	256	516	Black
33. Bloosm White	9.10	30	75	150	White
30. Asantee	9.70	30	89	178	Pink
Mean	9.66	30	164	329.1	-
SE Mean	0.11	-	35	69.8	-
StDev	0.42	-	131	261.1	-
Variance	1.88	-	171	681	-
CoefVar	4.37	-	79.89	79.33	-

LIQUID SOAPS

22. A.	8.20	30	50	112	Colorless
23. B.	8.00	30	90	180	Colorless
24. C.	8.60	30	75	150	Colorless

Mean	8.27	30	71.7	147.3	-
SE Mean	0.18	-	11.7	19.7	-
StDev	0.31	-	20.2	34.1	-
Variance	0.01	-	408.3	1161.3	-
CoefVar	3.70	-	28.20	23.13	-
			WATER		
Well					
25. Mountain Area	6.60	30	97	194	Colorless
26. Oba-Ile Area	6.60	29	179	358	Colorless
27. FECA Area	6.80	29	131	262	Colorless
Mean	6.67	29.3	135.7	271.3	-
SE Mean	0.01	0.33	23.8	47.6	-
StDev	0.12	0.58	41.2	82.4	-
Variance	0.01	0.33	1697.3	6789.3	-
CoefVar	1.73	1.97	30.37	30.37	-
Borehole					
28. FECA Area	7.30	29	121	242	Colorless
29. Enikuomehin Avenue	7.60	30	89	178	Colorless
Mean	7.35	29.50	105.0	129	-
SE Mean	0.05	0.50	16.0	113	-
StDev	0.07	0.71	22.6	160	-
Variance	0.01	0.50	512.0	25538	-
CoefVar	0.96	2.40	21.55	123.88	-

Rain					
31. FECA Area	7.30	30	112	224	Colorless
32. Oba-Ile Area	7.40	30	7	16	Colorless
Mean	7.35	-	59.5	120	-
SE Mean	0.50	-	52.5	104	-
StDev	0.07	-	74.2	147	-
Variance	0.01	-	5512.5	21632	-
CoefVar	0.96	-	124.78	122.57	-
River					
33. Ogijan	9.10	30	75	150	Colorless
34. Ala	7.30	30	184	368	Colorless
35. Ikeji-Arakeji	7.30	31	57	114	Brown
Mean	7.90	30.33	105.3	210.7	-
SE Mean	0.06	0.33	39.7	79.4	-
StDev	1.04	0.58	68.7	137.4	-
Variance	1.08	0.33	4722.3	18889	-
CoefVar	13.15	1.90	65.24	65.24	-
36. Distilled	7.04	30	3	5	Colorless

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