Evaluation of Some Soaps and Detergents in the Lagos, Nigeria Market for Standard Organization of Nigerian Specification Compliance

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ABSTRACT
Background: Soaps and detergents are tools for maintaining personal and environmental hygiene, thus helps in the protection from harmful bacteria and dirt.
Objective: This study assessed the compliance of some soaps and liquid detergents in Lagos, Nigeria to the Nigerian Industrial Standard (NIS) specification of 2006 (2010 for medicated soaps).
Methods: Toilet (A, B, C, D E), laundry (F, G, H, I), medicated (J, K, L), black (M, N, O) soaps and liquid detergents (P, Q) were purchased from local markets in Lagos, Nigeria. All parameters stipulated for soaps were determined as specified in the test method for soaps by the Standard Organization of Nigeria (SON) in the NIS.
Results: Apart from samples D, G and J which had total fatty matter (TFM) values of 65.14%, 53.34% and 24.50% respectively, TFM of other soaps complied with the NIS specifications of 50%, 62% and 70% for black laundry, toilet and medicated soaps respectively. The results of this study showed that all liquid detergent parameters complied with their standard values save for inorganic matter and insoluble matter in water, while only five of fifteen different soap brands complied with NIS specification. No liquid detergent showed no compliance.
Conclusion: Many of the soaps and detergents studied from the Nigeria market did not conform to the minimum standard recommended by SON, therefore regular quality check and enforcement is necessary.

Keywords: Analysis, specification, compliance, parameters, soap, detergent.

INTRODUCTION

Soap is a product from the reaction of a fatty acid with a metallic base (saponification) (1) while detergents are surfactants or a mixture of surfactants with cleansing properties in dilute solution. Soaps can be classified based on the use (e.g. toilet, laundry, medicated soaps), texture, and appearance (e.g. black soap, transparent soaps) (2). There are also hard and soft soaps. Hardness of soap is often achieved through the addition of hardening agents, so natural soaps tend to be softer. Detergents are usually synthetic in nature. They evolved after World War II to deal with dual problems of poor cleaning performance of soaps under certain conditions and competition for fat by both the food and soap industry (3). A typical detergent contains surfactant(s), builder, and other miscellaneous ingredients including brighteners, perfumes, and enzymes (4). Detergents are sodium salts of long chain hydrophobic alkyl sulphates or alkyl benzene sulphonates. They are prepared from petrochemicals obtained from refining crude oil, which react with sulphonic acid through a process known as sulphonation and do not produce insoluble precipitates in hard water like soaps. They are effective in soft, hard or salt water (5).

The chemical characteristic of soaps and detergents depend on several factors which includes total fatty matter (TFM), matter insoluble in water, chloride content, free caustic alkali, total free caustic alkali, matter insoluble in ethanol, moisture content, pH, inorganic matter and impact resistance (6). These impacts on soap qualities. Soaps sold in the Nigerian market are of different types and qualities. Standard Organization of Nigeria (SON), responsible for ensuring products are safe for use by consumers in Nigeria, has drawn up standards for soaps and detergents in Nigerian Industrial Standard (NIS) specification. In recent time, there has been a proliferation of different soaps into the Lagos, Nigeria market and the compliance as at today is not known. The aim of this study is to assess the compliance of different soaps and liquid detergents in Nigeria (Lagos markets) with the current NIS specification of SON.

MATERIALS AND METHODS

Sampling and Preparation of Soap for Analysis

Fifteen different soaps from four classes of soap; toilet (A, B, C, D, E), laundry (F, G, H, I, J), medicated (K, L, M), black soaps (N, O) and two liquid detergents (P, Q) were purchased from local markets in Lagos, Nigeria in the first quarter of 2014. The soaps as shown in Table 1 were chopped into pieces after removing their wrappers.

Table 1: List of Soaps Sampled

Soap Class	Soap name	Alphabet
Toilet	Eva	A
	Joy	B
	Lux	C
	Premier	D
	Imperial leather	E
Laundry	Canoe	F
	Bubble	G
	B29	H
	Zip	I
	Ibukun	J
Medicated	Dettol	K
	Safeguard	L
	Tetmosol	M
Black Soap	Zee	N
	Dudu osun	O
Liquid detergent	Morning fresh	P
	Mama lemon	Q

Analysis of Soap

The analysis of the TFM, moisture content, pH value, free caustic alkali, chloride content, matter insoluble in ethanol, total caustic alkali and matter insoluble in water for all the samples were by the test methods for soaps of SON (7). TFM was determined gravimetrically by dissolving the soap, solidifying the fat using bee wax and reweighing the resultant solid. The percentage moisture of soap was determined gravimetrically as described in Anzene and Aremu (8). Matter insoluble in water was also determined gravimetrically. pH of soap was determined with a pH meter after dissolving the soap in hot distilled water. Chloride content, matter in soluble in ethanol, free caustic alkali and total caustic alkali were determined as described by Mak-Mensah and Firempong (6). Inorganic salt content, moisture and volatile matter were also determined (only for liquid detergent) gravimetrically. Briefly, 5 g of liquid detergents were weighed, oven dried and cooled in evaporating dishes. The dishes were heated on a steam bath until most volatile matter has escaped. The heating was continued at 105 °C in an oven for 2 h till constant weights were achieved. The difference in weight was attributed to moisture and volatile content. The residue in the dish was retained for a subsequent test. Residues obtained from moisture and volatile content determinations were heated in a muffle furnace at 450 °C. The aim was to destroy the organic content, hence determine inorganic salt content of liquid soaps. The dish and its content were cooled. Few drops of concentrated sulphuric acid were added to the dish and this was heated again to dryness. The process of heating, cooling and weighing was repeated until a constant mass was obtained.

RESULTS

The result of the analysis of the soaps and detergents are as shown in Tables 2 and 3. TFM, moisture content, pH value, free caustic alkali, chloride content, matter insoluble in ethanol, total caustic alkali and matter insoluble in water for toilet soaps were between the range of 65.14–94.62%, 3.31–10.48%, 9.1–

Table 2: Summary of Results for Soaps

ID	TFM (%)	Moisture (%)	pH	Free Caustic (%)	Total Free Caustic Alkali (%)	Matter Insoluble in Water (%)	Water in Insoluble in Ethanol (%)	Chloride (%)
Toilet Soaps								
A	80.40 ± 0.42	3.70±0.42	9.5	0.03±0	0.06±0	0.40	16.90±1.84	0.10±0.01
B	83.15±1.24	10.48±0.40	9.3	0.03±0	0.06±0	9.45±0.07	8.40±2.82	0.30
C	70.71±0.69	7.97±0.16	9.1	0.03±0	0.07±0.01	0.35±0.07	8.60±0.02	0.10±0.01
D	65.14±1.07	7.70±0.30	9.2	0.03±0	0.08±0	5.65±0.07	13.6±0.57	0.29±0.01
E	94.62±0.56	3.31±0.21	9.1	0.03±0	0.05±0.01	2.30±0.42	5.80±0.28	0.20
	70.00			**0.05**	**0.1**	**5.00**	**10.00**	**0.75**
Laundry Soap								
F	76.43±4.72	15.35±0.40	9.6	0.03±0	0.04.±0.01	13.1	22.5±0.42	0.42±0.01
G	53.34±2.77	8.77±0.21	9.6	0.05±0	0.11±0	57.25±0.71	21.5±0.42	0.19±0.01
H	78.44± 2.77	6.45±0.07	9.5	0.03±0	0.062±0	7.85±0.21	17.60±0.28	0.49±0.01
I	74.63±4.06	12.70±0.08	10.3	0.03±0	0.09±0	12.6	22.50±0.70	0.15±0.01
J	24.50±1.48	29.03±0.54	11.2	0.08±0	0.12±0	10.65±0.07	25.20±0.23	0.07
	70.00			**0.05**	**0.1**	**5.00**	**10.00**	**0.75**
Medicated Bar								
K	80.48±1.45	7.50±0.57	9.6	0.03±0	0.12±0	0.45±0.07	7.20±1.41	0.09
L	92.23±1.33	6.52±0.20	9.9	0.03±0	0.14±0	3.75±0.22	6.85±0.21	0.49±0.01
M	82.51± 0.42	4.49±0.50	9.5	0.03±0	0.09±0	0.65±0.07	8.30 ±1.27	0.20
	70.00			**0.05**	**0.2**	**5.00**	**10.00**	**0.75**
Black Soap								
N	56.13±0.73	18.45±0.30	10.2	0.05±0	0.79±0	2.0±0.14	8.00±0.85	0.07
O	68.85±7.95	11.49±0.69	9.2	0.05±0	0.76±0	6.45±0.21	8.90±1.56	0.06±0.01
	50.00	**10.00**	**7-10**	**0.05**	**1.0**	**15.00**	**0.2**	**2.0**

Table 3: Summary of Result for Liquid Detergents

S/NO	Mean (%) Moisture and Volatile Matter	Mean (%) Inorganic Salt	Mean (%) Matter Insoluble in Water	pH	Appearance
P	69.12±0.03	5.74±0.68	0.51±0.01	7.65	Homogenous
Q	77.59±0.30	5.17±0.19	0.33±0.42	7.90	Homogenous
Standard values	**80.00**	**5.00**	**0.10**	**6–10**	**Homogenous**

9.5, 0.03–0.03%, 0.10–0.30%, 5.80–16.90%, 0.05–0.08% and 0.35–9.45% respectively. The values for laundry soaps were between the range of 24.50–78.44%, 6.45–29.03%, 9.5–11.2, 0.03%–0.08%, 0.07–0.49%, 17.6–25.2%, 0.04–0.12%, 7.85%–57.25%, and 7.85–7.25% respectively. For medicated soap samples, the results were between the range of 80.48–92.23%, 4.49–7.50%, 9.5–9.9, 0.03–0.03%, 0.02–0.49%, 6.85–8.30%, and 0.09–0.14% respectively. The result of TFM, moisture content, pH value, free caustic alkali, chloride content, matter insoluble in ethanol, total caustic alkali and matter insoluble in water for two black soaps (N and O) were determined to be 56.13 and 68.79%, 11.49% and 18.45, 9.2 and 10.2, 0.05 and 0.05%, 0.06 and 0.07%, 8.0 and 8.9%, 0.76 and 0.79%, 2% and 6.5% respectively. For the liquid detergents (P and Q), inorganic salt content, matter insoluble in water, pH, moisture and volatile matter were measured and results were 5.17% and 5.74 %, 0.33% and 0.51 %, 7.65 and 7.90, 69.14% and 77.59 % respectively.

DISSCUSSION

The regulatory standard for toilet, laundry, medicated and black soaps are stipulated by SON in NIS 004:2006, NIS 005:2006, NIS 515:2010 and NIS 490:2006 (9-12) respectively. TFM of soap is a measure of its suitability for bathing and washing of materials (13). Dry skins need soaps that are high in TFM because the fatty matter rehydrates the skin making it smooth and acts as a lubricant for the skin all day long (14). Low TFM values are due to the presence of unreacted alkali in the soap (15) and this decreases the soap quality. Low TFM is usually associated with hardness, lower quality soaps and ineffective removal of grease and other fatty matter from clothing during laundry. The standard of TFM specified according to NIS 004:2006 (9), NIS 005:2006 (10), NIS 515:2010 (12) for toilet, laundry and medicated soaps respectively is 70% while (NIS 490:2006) (11) value for black soap is 50%. From the results, sample E (Imperial Leather) had the highest TFM (94.62%) of all the toilet soaps while sample D had the lowest (65.14%). In terms of TFM, samples A, B, C and E showed compliance with the standard while only sample D (Premier soap) fell below (65.14%) the 70% TFM specification for toilet soaps. In a similar study conducted in Ghana, higher TFM for Neem toilet soap (63.75%) was observed compared with toilet soaps in this study(6).

Out of the five different laundry soaps, three (F, I and H) soaps complied with the specified standard for TFM. The other two laundry soaps (G and J) had lower values (53.34% and 24.50%). The TFM values for medicated soaps and black soaps in this study were all higher than their NIS standards of 70% and 50% respectively. TFM values for black soaps in this study (56.13% and 68.85 for N and O respectively) were similar to the findings of Ogunsuyi and Akinawo (13) (55.45%) and Beetseh and Anza (16) (62%). Since TFM values are due to the presence of unreacted alkali (with fat) in soap, this decreases the soap quality. Soaps with TFM values less than the stipulated value can be improved upon by either increasing the amount of fat used or decreasing the amount of alkali used in the soap making process (15).

Moisture content of soap is used to assess the shelf-life of a product. On storage, hydrolysis of water unsaponified fat to give free fatty acid and glycerol occurs when there is high moisture content (14). High moisture content increases the solubility of the soap and leads to waste. As the moisture content reduces, the foaming strength increases. Generally, moisture content is usually higher immediately after soap production but reduces as the soap ages (17). Though water is an essential soap ingredient, it is not expected to exceed 10% for black soap (11). Although there is no stated limit for moisture content for medicated, laundry and toilet soaps, the Encyclopaedia of Industrial Chemical Analysis suggested the limit should be between 10% and 15% moisture content for all soaps (18). Therefore, moisture content limit in this study was chosen to be between 10% and 15%. The moisture content for all the toilet soaps analysed in this study were below 10%. For laundry soaps, two samples - F and J (Canoe and Ibukun) had moisture content above 15% while the range for laundry soap moisture content was 6.45 - 29.03%. This observation was similar to a previous study by Anzene and Aremu (8) on laundry soaps in Nasarawa, Nigeria, where the moisture content of laundry soaps were observed to be between 14% and 18%. All the medicated soap samples had less than 10% moisture content which is lower than the 10% to 15% suggested as limit by the Encyclopaedia of Industrial Chemical Analysis. Sample N (Zee) and O (Dudu Osun), which are black soaps, had moisture content of 18.45% and 11.49%, and were therefore higher than the 10% moisture content and did not comply with the NIS Limit. However, the moisture content (29.05%) obtained by Ogunsuyi and Akinawo (13) for black soap was higher than in this study. The moisture content of solid soap can be adjusted by evaporation (drying) after the chemical reaction is complete to the defined level (19).

pH is a measure of the degree of acidity or alkalinity of a substance or medium. The pH of a normal skin is 4.5 to 6 while pH of soaps are usually in the alkaline region (7-10) since alkalis are used to saponify fat or oil in the production of soap. As the pH of soaps increases, there is a tendency to affect the fat

content of the skin (21). Increase in pH cause skin irritations, micro flora of the skin is affected and this can lead to acne and alteration of the skin surface. The closer the pH of soap is to that of the skin, the milder the drying effect on the skin (20, 21). Apart from black soap with a limit of 7-10, there is no specified pH limit for toilet soap, laundry and medicated soap. From Table 2, the pH values for toilet soaps (9.1 - 9.5) were generally lower than values for laundry (9.5 - 11.2) and medicated (9.5 - 9.6) soaps. The two black soaps had pH values of 10.2 and 9.2 for N and O (Zee and Dudu Osun). Applying the 7-10 range limits to all the soap types sampled, only three soaps exceeded the limit. Two laundry soap samples, I (Zip) and J (Ibukun), and N (Zee) a black soap with pH values above 10. Sample J (Ibukun) had the highest pH (11.2). A pH value of 10.4 for Neem toilet soap was obtained by Mak-Mensah and Firempong (6); this was also high. The addition of pH regulators (such as citric acid, borax) and increasing the quantity of the non-soap surfactants as compared to the quantity of soap-based surfactants reduces the pH of soaps (22).

Free caustic alkali determines the abrasiveness of any soap. It is defined as the free NaOH or free alkali used in making the soap, while total free alkali refer to the free alkali from which the soap was made and any other alkaline substance present in soap such as sodium silicate and sodium carbonate. From NIS, the free caustic alkali should not exceed 0.05% for any soap. All the soap samples analysed had values lower than the 0.05% specification. Excess alkali is harsh to sensitive skin.

The total free caustic alkali specified by SON for toilet and laundry soaps is 0.1% while for medicated soap it is 0.2% and 1% for black soap (7). Total free caustic alkali for toilet soap samples (0.05 - 0.08%) complied with the standard. Laundry soaps had total free alkali in range of 0.04 - 0.12%. Two soaps, G (Bubble) with total free alkali of 0.11% and J (Ibukun) with a total free caustic alkali value of 0.12% did not comply with the specification. All the medicated soaps analysed in this study for total free alkali had less than the specified 0.2%, hence complied with the standard. Total free caustic alkali obtained for the two black soaps were 0.76% and 0.79% (N and O respectively). The black soaps complied with the specification. Generally, Bubble and Ibukun soaps had higher total free alkali than the other soaps. The total free alkali obtained by Mak-Mensah and Firempong (6) for Neem soap was 0.24% while the study by Vivian *et al*. (14) for commercial soaps reported a range of 0.00% to 0.99%.

High amount of matter insoluble in water and/or ethanol implies lower purity of the soap (13). Samples A, C, and E (Eva, Lux and Imperial leather) complied with the maximum of 5% matter insoluble in water specified by SON for toilet, laundry and medicated soaps. However, B and D (Premier and Joy) did not comply. All the laundry soaps analysed had higher matter insoluble in water than 5% specified. The percentage matter insoluble in water for black soap stated by NIS of SON is 15% and the two black soaps in this study complied (Zee and Dudu Osun). Hence, both N and O (Zee (2.0%) and Dudu Osun (6.45%)) complied with the specification. The high amount of matter insoluble in water of Bubble soap might be attributed to the level of impurity of the alkali used for producing the soap.

The soap matter insoluble in ethanol should not exceed 10% as specified by SON for all soaps except black soaps for which a value of 0.2% was fixed. Three of the toilet soap samples (B (Joy), C (Lux) and E (Imperial leather)) complied with specification while samples A (Eva) and D (Premier) did not. None of the laundry soap complied with the specification for soap matter insoluble in ethanol while the medicated soaps all complied. Soap matter insoluble in ethanol obtained for black soaps did not comply with the standard of 0.2% set for black soaps. The soap matter insoluble in water and/or ethanol, along with other impurities such as glycerol and high chloride can be reduced or removed during purification of soaps obtained from the saponification reaction. Purification of soaps to remove impurities involves boiling the crude soap curds in water and re-precipitating the soap with salt. The purification process can be repeated several times until impurities are removed or greatly reduced (6).

According to the NIS set by SON for different soap types, chloride content should not exceed 0.75% except for black soap which should not exceed 2%. All the soap (toilet, laundry, medicated and black) samples complied with their respective chloride standards. The chloride content was similar to chloride (0.30 - 0.59%) reported by Moulay *et al.* (23). Residue of sodium chloride from salting out of soap (13) is not desired because it reduces the solubility of soap in water (24).

Specification for household liquid detergents is contained in NIS 519:2006 of SON. Only two different brands of liquid detergents were sampled. The moisture and volatile matter specified for liquid detergent is a maximum of 80%. Both liquid detergents complied with the specification for moisture and volatile content in the NIS 519:2006 (25) of SON for household liquid detergents. The NIS of SON also stated a value of 5% as the maximum allowed inorganic salt content. Both samples P and Q (liquid detergents) had values higher than the stated standard value. The standard for amount of matter insoluble in water is 0.1%. However, both samples P and Q (Morning Fresh and Mama lemon) exceeded the standard value of 0.1% for matter insoluble in water, thus did not comply with the specification required. The specified pH range according to NIS of SON is between 6 and 10. pH obtained for sample P and Q were 7.65 and 7.90 respectively. Both complied with the pH standard. Impact resistance carried out revealed both sample containers were able to withstand the experimental conditions without leakage, hence complied. Both samples complied with the specification for appearance of liquid detergent which stated the sample must be homogenous and free from any sediment or foreign matter.

CONCLUSION

The results obtained had showed that soaps like C (Lux), E (Imperial Leather), K (Tetmolsol), L (Safeguard), and M (Dettol) had full compliance with standard. Other soap samples had deviation of one or more parameters from the specified standard. From the findings of this study, SON should carry out continuous monitoring of the products in the market to ensure continuous compliance with standard. The Nigerian public should be encouraged to purchase only products with the inscription "NIS" on them.

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