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EVALUATION OF THE EFFECT OF VARIOUS AGENCIES ON THE PROPERTIES OF SOME SELECTED COMMERCIAL SOAPS AND DETERGENTS IN LAFIA, NASARAWA STATE, NIGERIA

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ABSTRACT

The effect of various agencies (pH, lathering, oils/fats and hard water) on the properties of some selected commercial soaps and detergents was evaluated. This is sequel to the problem associated with soap and detergent as a result of false declaration of ingredient formulations and complains by consumers (e.g. irritation of the skin, eye, lack of lathering properties, lack of emulsification of oils/fats) and the continued need to seek out the best ways of minimizing them. In the study, ten (10) samples each of commercial hard soaps, soft soaps, baby soaps and detergents making a total of forty (40) samples were used. 10% stock solution of the different commercial soaps and detergents were used for the evaluation. The properties of the commercial hard soaps in various agencies show that most of the soaps except CHS10 (p^H-12.50) fall within the P^H range for soaps. However, for the properties of the commercial soft soaps in various agencies, all the samples CSS1-CSS10 falls within the P^H range while for the properties of the commercial baby soaps in various agencies show that, CBS1-CBS10 all the samples also fall within the P^H range. However, in table 4, CD1-CD10 The samples fall within the P^H ranges. From the evaluation all the samples CHS, CSS, and CD Perform satisfactory in terms of lathering properties while in case of emulsification evaluation, samples CHS and CD perform credibility well but samples CSS and CBS were fair in their properties performance. This may be attributed to the fact that soft and baby soaps are milder in terms of chemical composition. From the evaluation also, it was observed in terms of performance of the samples to hard water that all the samples, CHS, CSS, CBS and CD performs appropriately well, but the performance was in the order CD>CHS>CSS>CBS respectively. This is as the result of the builders that are incorporated in the detergent which tends to "lock up" the metals that causes hardness of water. In the evaluation of the effectiveness in cleaning, samples had properties performance in the range CD> CHS>CSS>CBS. This is normal in the sense that emulsification of the oils/fats is higher in detergents and hard soaps which are laundry soaps that in soft and baby which are bathing soaps. It is therefore recommended that the soaps and detergents mentioned above can be used for washing and bathing but in case of dermatitis, sensitive and acne prone skin, due consideration to the p^H of the soaps and detergents especially sample CH_{10} (12.36) should taking into consideration.

Key words: Detergent, Hard water, pH, Saponification, Soap,

INTRODUCTION

Soap has numerous applications in daily life. Larson (2001) noted that in everyday life one use soap and detergent to wash dishes, clean clothes, or keep our bodies presentable to nose and eye. One of its great values is keeping our household a far better place to live and work and they are manufactured in bars, granules, flakes, or liquid form, made from a mixture of mostly sodium or potassium salts of various fatty acids of natural oils and fats and other synthetic materials (Jarvis, Wynne, Enright and Williams, 1999). Early soap makers probably used ashes and animal fats. Simple wood or plant ashes containing potassium carbonate were dispersed in water, and fat was added to the solution (Litsky and Litsky, 2006). This mixture was then boiled; ashes were added again and again as the water evaporated. During this process a slow chemical spitting of the neutral fat took place; the fatty acids could then react with the alkali carbonates of the plant ash to form soap (this reaction is called saponification) (Yosipovitch and Maibach, 2002). The presence of free fatty acid certainly helped to get the process started. This method probably prevailed until the end of middle Ages, when slaked limes come to be used to causticize the alkali carbonate. Through this process, chemically neutral fats could be saponified easily with the caustic lye (Karaba, 2005). The production of soap from the handicraft to an industry was helped by the introduction of the Leblanc process for the production of soda ash from brine (about 1790) and by the work of a French chemist, Michel Eugene Chevreul, who in 1823 showed that the process of saponification is the chemical process of splitting fat into the alkali salt of fatty acids (that is soap) and glycerin (Graham-Brown, 2007) According to Werners (2002) detergent is a surfactant or a mixture of surfactants with "cleaning properties of in dilute solution in common usage, "Detergent" refers to alkylbenzene sulphonates, a family of compounds that are similar to soap but are more soluble in hard water, because the polar carboxyl (of soap) to bind to calcium and other ions found in hard water. In most household contexts, the term detergent by itself refers specifically to laundry detergent or dish detergent as opposed to hand soap or other types of cleaning agents. Detergents are commonly available as powders or concentrated solutions. Detergents, like soaps, work because they are amphiphilic: partly hydrophilic (polar) and partly hydrophobic (non polar).Their dual nature facilitates the mixture of hydrophobic compounds (like oil and grease) with water (Heinze, 2008). Because air is not hydrophilic, detergents are also foaming agents to varying degrees. Completely non polar solvent known as degreasers can also remove hydrophobic contaminants but may not dissolve in water because of a lack of polar elements ((Heinze, 2009) The first synthetic detergents synthesized were derived from fats by reduction with hydrogen, followed by reaction with sulphuric acid, and then neutralization (Kirsner and Froelich, 2009). Dirt and grime usually adhere to skin, clothing and other surfaces because they are combined with greases and oils – body oil, cooking fats, lubricating greases and a variety of similar substances – which act a little like sticky glue. Since oils are not miscible with water, washing with water alone does little good (Housecroft and Constable, 2006). Soap molecules have a split personality; one end is ionic and dissolves in water. The other end is like a hydrocarbon and dissolves in oils. If one imagine the ionic end of the molecule as 'head' and hydrocarbon chain as 'tail', then we can explain the clearing action of soap clearly. The hydrocarbon 'tails' stick into the oil while the ionic 'heads' remain in the aqueous phase. In this manner, the oil is broken into tiny droplets and dispersed throughout the solution. The droplets don't coagulate because of the repulsions of the charged groups (the carboxyl anions) on their surfaces. The oil and water form an emulsion, with soap and detergent acting as an emulsifier, with the oil no longer "gluing" it to the surface, the dirt can be removed easily. Every housewife knows that the amount of soap or synthetic detergent she need is determined, in part, by the hardness of the water she uses (McGraw-Hill Encyclopedia, 2007). This article reports the results of a study made to correlate varying degrees of water hardness with the detergent consumption of the people who use the water. The presence of certain metal ions e.g. Mg^{2+} in water causes a variety of problems (Jones and Atkins, 2002). These ions interfere with the action of soaps they also lead to buildup of lime scale, which can foul plumbing, and promote galvanic corrosion. (Lower, 2007).The pH of soap and detergent is very important to make sure that the soap or detergent is safe to use and doesn't contain any extra lye (Gehring *et al*., 1991) It shows the strength of an acid or base. Soap with a high pH (above 10) is likely to be too harsh, or lye-heavy for use(Bechor , Zlotogorski , Dikstein, 1988). The p^H of soap and detergent has a significant effect on the irritation potential. The influence of formulation p^H on the irritation potential of soaps and detergents can be noticed by increasing the pH from it neutral value to a p^H 10 hence reduced it mildness. The difference in alkalinity as measured by p^H is directly related to the lower irritation potential of both of these formulations (Korting *et al*., 1991) This shows that pH has an important role in determining the differences in irritation potential of soaps and detergents (Sauermann *et al*., 2006)

The Main and/or Broad Objectives of the Study is to evaluate the effect of agencies such as alkali/acid, oils/fats, water hardness and effectiveness in cleaning on different brands of commercial soaps and detergents in order to determine their pH value, lathering (foaming), oils/fats emulsification and cleaning properties in oils/fats in the study area.

MATERIALS AND METHODS

Experimental

The experimental study was carried out keeping in mind the aims and objectives of the research work.

Materials and Equipment: Magnetic Stirrer, Ph Meter, Syringe, Stop watch, Filter paper, Beaker, Measuring cylinder, Test tubes, Water bath, Weighing balance, Hot plate, Volumetric flask,

CHEMICALS: Water, Fats/oils, Soaps and detergents, $Mgcl_2$, $Cacl_2$, $Fecl_3$, Ethanol, Sodium hydroxide,

Methodology: In this part of the experiment~~al~~, the properties of the commercial soaps and detergents–in various agencies were determined

Preparation of The Stock Solution of The Soaps: 10g shavings of the different soaps were weighed out using the Analytical weighing balance (Saronus Max. 320g) and was added to a 500ml of measuring cylinder containing 100ml of water.. The mixture was slightly agitated to obtain a homogeneous soap solution.

Method Used To Determine The Selection of Soap and Detergent: 10 samples of different categories of soaps (soft, hard and baby soaps) and 10 samples of detergents based on their level of patronage which was determined by one on one random interview with ten (10) consumers/users and sellers of these soaps and detergents. The research work is carried out to know whether the soaps and detergents available in the study area can perform in agencies such as hard water, oils/fats, their pH falls within the acceptable standard and their cleaning ability in oils/fats.

Assessment of The Soaps and Detergents To The Various Agencies

pH TEST: 10g powder of the different soaps and detergents were weighed out using the Analytical weighing balance (Saronus Max. 320g) and was added to a 500ml of measuring cylinder containing 100ml of water.. The mixture was slightly agitated to obtain a homogeneous detergent solution. The pH for each solution of the soap and detergent was measured with a pH meter and record for each soaps and detergents

Lathering (Foaming) Test: 10% stock solution of the soaps and detergents were pour into forty (40) beakers (ten each for soft soap, hard soap baby soap and detergent). The solution was stirred using magnetic stirrer so as to generate lather. After stirring for about 10 minutes, the content was allowed to stand for 20 seconds for the lather to stabilizer. The height of the lather in the solution was measured and recorded for CHS and was repeated for the other samples-CSS, CBS and CD respectively.

Interaction With Oils/Fats: 10% stock solution of the soaps and detergents were pour into forty (40) beakers (four beakers for oils/fats and one (1) drop each of the oils/fats (vegetable oil, palm oil, clean engine oil and dirty engine oil). The solutions were stirred using magnetic stirrer so as to generate lather. After stirring for about 10 minutes, the content was allowed to stand for 20 seconds for the lather to stabilizer. The height of the lather in the solution was measured and recorded for CHS and was repeated for the other samples-CSS, CBS and CD respectively.

Water Hardness Test: 10% stock solution of the soaps and detergents were pour into thirty (30) beakers (three beakers for each metallic salts and 1ml each of the metallic salts ($cacl_2$, $mgcl_2$ and $fecl_{2)}$ was added to the solution. The solutions were stirred using magnetic stirrer so as to generate lather. After stirring for about 10 minutes, the content was allowed to stand for 20 seconds for the lather to stabilizer. The height of the lather in the solution was measured and recorded for CHS and the steps was repeated for the other samples-CSS, CBS and CD respectively.

Effectiveness in Cleaning Test: To determine the cleaning properties of the prepared soaps and detergent, a drop of oil was placed on forty (40) separate strips of filter paper. The filter papers with the oil spot were immersed in each of the forty (40) test tubes containing 10% stock solution of the soaps and detergents. The solutions were agitated using magnetic stirrer so as to generate lather. After stirring for about 10 minutes, the content was allowed to stand for 20 seconds for the lather to stabilizer. The height of the lather in the solution was measured and recorded for CHS and was repeated for the other samples-CSS, CBS and CD, respectively.

EXPERIMENTAL RESULTS

TABLE 1: PROPERTIES OF THE COMMERCIAL HARD SOAP IN VARIOUS AGENCIES

Samples	pH	Lathering (cm)	Interaction with oils				Hard water (Simulated)			Effectiveness in Cleaning			
			P/O (cm)	V/O (cm)	CEO(cm)	UEO (cm)	$CaCl_2$ (cm)	$MgCl_2$ (cm)	$FeCl_3$ (cm)	P/O	V/O	CEO	UEO
CHS_1	10.55	1.70	0.85	1.50	1.40	0.90	0.50	0.50	0.70	Effective	More effective	More Effective	Effective
CHS_2	10.52	1.60	0.60	1.70	1.45	0.55	0.20	0.30	0.60	Effective	Most effective	More Effective	Effective
CHS_3	10.83	1.80	0.40	1.65	0.35	1.35	1.70	1.45	1.60	Effective	Most effective	Effective	More effective
CHS_4	10.87	1.50	0.10	1.00	0.75	0.56	1.45	1.35	1.20	Effective	Most effective	More effective	More effective
CHS_5	10.75	1.80	0.40	1.45	1.75	1.20	1.60	1.75	1.70	Effective	Most effective	Most effective	More effective
CHS_6	11.00	1.60	0.30	1.45	1.34	1.25	1.45	1.50	1.55	Effective	More effective	More Effective	More effective
CHS_7	10.82	1.50	0.30	0.75	0.55	0.20	0.40	0.40	0.80	Effective	Most effective	More Effective	Effective
CHS_8	10.64	1.80	0.30	1.55	1.20	0.40	1.50	1.50	1.00	Effective	Most effective	More Effective	Effective
CHS_9	10.53	1.70	0.60	1.50	1.50	1.50	1.50	1.55	1.65	Effective	Most effective	Most effective	Most effective
CHS_{10}	12.36	0.50	0.15	0.35	0.35	0.40	0.14	0.25	0.30	More effective	Most effective	Most effective	More effective

KEY: CHS = Commercial Hard Soaps, P/O = Palm Oil, V/O = vegetable oil, CEO =Clean engine oil, UEO = Used engine oil.

Table 2: PROPERTIES OF COMMERCIAL SOFT SOAPS IN VARIOUS AGENCIES

Samples	pH	lathering(cm)	Interaction with oils				Hard water (Simulated)			Effectiveness in Cleaning			
			P/O (cm)	V/O (cm)	CEO (cm)	UEO (cm)	$CaCl_2$ (cm)	$MgCl_2$(cm)	$FeCl_3$(cm)	P/O	V/O	CEO	UEO
CSS_1	10.54	3.00	0.75	2.55	0.25	0.75	2.50	1.50	0.50	More Effective	Most effective	Effective	More effective
CSS	10.66	2.10	0.75	1.65	1.60	1.60	1.80	1.95	0.50	More Effective	Most effective	Most effective	Most effective
CSS	10.73	1.80	0.55	1.45	1.40	0.55	0.50	0.50	1.70	Effective	Most Effective	Most effective	More effective
CSS_4	10.68	2.00	0.65	1.60	1.60	0.60	0.50	0.50	0.60	More effective	Most effective	Most effective	More effective
CSS_5	10.62	1.90	1.65	1.60	1.60	1.60	0.50	0.70	0.40	Effective	Most Effective	Most effective	Most effective
CSS_6	10.30	1.80	0.75	1.55	155	0.70	1.10	0.50	1.40	Effective	More Effective	More Effective	Effective
CSS_7	10.62	1.70	0.45	1.50	1.50	0.40	1.50	1.45	1.60	More effective	Most effective	Most Effective	Effective
CSS_8	10.67	1.50	1.35	1.30	1.35	0.85	1.95	0.70	1.20	Most effective	Most effective	Most Effective	More Effective
CSS_9	10.51	1.10	0.60	0.85	0.60	0.40	0.30	0.70	0.40	More effective	Most effective	More effective	Effective
CSS_{10}	10.38	1.50	1.00	1.00	1.00	0.90	0.40	0.21	0.30	More effective	More effective	More effective	Effective

KEY: CSS = Commercial soft soaps, P/O = Palm Oil, V/O = Vegetable Oil, CEO = Clean Engine oil, UEO = Used Engine Oil

Table 3: PROPERTIES OF THE COMMERCIAL BABY SOAPS IN VARIOUS AGENCIES

Samples	pH	Lathering (Foaming) (cm)	Interaction with oils				Hard water (Simulated)			Effectiveness in Cleaning			
			P/O (cm)	VO (cm)	OEO(cm)	UEO(cm)	$CaCl_2$ (cm)	$MgCl_2$(cm)	$FeCl_3$(cm)	P/O	V/O	CEO	UEO
CBS_1	10.14	1.60	1.20	1.50	0.60	1.20	1.00	0.30	0.70	More Effective	Most Effective	Effective	More Effective
CBS_2	10.21	1.50	0.60	145	1.30	0.60	1.25	1.40	1.15	Effective	Most Effective	More Effective	Most Effective
CBS_3	9.74	1.70	0.75	1.65	100	0.75	1.35	0.70	1.60	Effective	Most Effective	More Effective	Effective
CBS_4	10.46	1.00	0.65	0.85	0.85	0.66	1.25	1.50	1.60	More effective	Most Effective	Most effective	More effective
CBS_5	10.26	1.80	0.90	1.70	1.70	0.90	1.50	1.10	1.10	Effective	Most Effective	Most effective	Effective
CBS_6	10.44	1.70	0.40	1.50	0.75	0.75	0.20	0.20	0.10	Effective	Most Effective	More Effective	More effective
CBS_7	10.12	1.60	0.90	1.25	0.90	0.90	0.10	0.20	0.20	More effective	Most Effective	More Effective	More Effective
CBS_8	10.25	1.80	1.00	1.60	1.60	1.60	1.00	1.20	1.30	Effective	More Effective	More Effective	More Effective
CBS_9	10.61	1.60	0.85	1.45	1.00	0.85	0.00	0.30	0.20	More effective	Most Effective	Effective	More effective
CBS_{10}	10.51	1.70	075.	0.75	0.75	0.45	0.10	0.10	0.30	More effective	More effective	More effective	Effective

KEY: CBS = Commercial Baby Soaps, P/O = Palm Oil, V/O = Vegetable Oil, CEO = Original Engine Oil, UEO = Used Engine Oil

Table 4: PROPERTIES OF THE COMMERCIAL DETERGENTS IN VARIOUS AGENCIES

Samples	pH	Foaming (lathering) (cm)	Interaction with oils				Hard water (Simulated)			Effectiveness in Cleaning			
			P/O (cm)	V/oil (cm)	CEO (cm)	UEO (cm)	$CaCl_2$(cm)	$MgCl_2$(cm)	$FeCl_3$(cm)	P/O	V/O	CEO	UEO
CD_1	10.80	2.00	1.40	1.85	0.65	1.40	1.50	1.60	1.80	More Effective	Most Effective	Effective	More Effective
CD_2	10.98	1.50	0.75	1.75	0.40	0.75	1.20	1.35	1.45	Effective	Most Effective	Most Effective	Effective
CD_3	11.32	1.00	0.90	0.70	0.70	0.70	0.75	0.65	0.95	Most effective	More Effective	More Effective	More effective
CD_4	10.97	1.00	0.85	0.85	0.55	0.85	0.70	0.80	0.80	Most effective	Most Effective	More effective	Most effective
CD_5	11.08	1.00	0.75	0.75	0.75	0.20	0.65	0.95	0.77	More effective	More Effective	More effective	Effective
CD_6	11.09	1.00	0.50	0.90	0.55	0.50	0.66	0.75	0.83	Effective	Most Effective	More Effective	Effective
CD_7	10.39	2.00	0.75	0.75	0.75	1.50	1.70	1.65	1.75	Effective	Effective	Effective	More Effective
CD_8	10.49	1.50	1.25	1.35	0.65	1.25	1.45	1.35	1.45	More effective	Most Effective	Effective	More Effective
CD_9	10.63	1.00	0.55	0.75	0.55	0.75	0.65	0.75	0.90	Effective	More Effective	Effective	More effective
CD_{10}	10.24	1.00	0.55	0.85	0.30	0.30	0.85	0.75	0.77	More Effective	Most effective	Effective	Effective

KEY: CD = Commercial Detergents, P/O = Palm Oil, V/O = Vegetable Oil, CEO = Clean Engine Oil, UEO = Used Engine Oil

RESULTS AND DISCUSSION

From the Table I, it is seen that the p^H of the samples are within the range except CH_6 and CH_{10} which have a p^H of 11.00 and 12.36 respectively. These p^H ranges can cause skin and eye irritation. For interaction with oils/fats (emulsification), CH_1 had the best property performance of 1.4cm followed by CH_2 with 1.00cm. In the case of water hardness CH_3, CH_5, CH_9, CH_2 had the best property performance while for $Cacl_2$, CH_5, CH_9, CH_6, CH_3, CH_4 had the best property performance for $Mgcl_2$ and CH_5, CH_9, CH_3, and CH_6 had the best property performance for $Fecl_3$ respectively. However, for effectiveness in cleaning, the property performances were moderate. In table 2, the p^H values were within the range for all the samples. This is expected because it is a bathing soap the consideration for p^H values is very important to avoid skin and eye irritation. For the interaction with oils/fats, the performances of the samples were average which is quiet alright for a bathing soap. In the case of hard water, the best property performance was fair enough for bathing while in the case of effectiveness in cleaning, the property performances were moderate. In table 3, the p^H of the samples is within the range CBS_3 had the best p^H of 9.74. For the interaction with oils/fats (emulsification) CBS_3 had the best property performance while for the water hardness CB_3, CB_4 and CB_2 had the best property performance. However, for effectiveness in cleaning, the property performances were moderate. In table 4, the results show that the p^H values for CD_3, CD_5 and CD_6 were above the limit. However, CD_7, CD_8, CD_{10} had the best P^H values.

CONCLUSION

The results from the experimental work indicated that not all soaps and detergents can be used for bathing and washing. This is because most of the soaps and detergents have p^H values outside the limit hence they will have effect such as skin peel and burns, irritation as well as eye irritation which can lead to blindness. In the case of washing, the water hardness has pronounced effect on the samples CSS and CBS forming mostly scum instead of lather, but detergent performs better due to the presence of builders which can" lock up" the metallic ions that form water hardness.

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