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Comparative analysis of hair care products (Relaxer) marketed in Mubi main market, Nigeria.

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ABSTRACT

The suitability of hair relaxers sold in Mubi main market, Adamawa State, Nigeria was assessed for its suitability for use by afro-haired persons. AAS was used for the determination of Pb and Cd content of the relaxers. Net relaxer content was assessed by difference in weight while the NaOH content was determined by titration of with HCl using Phenolphthalein indicator. The result revealed that all the relaxers complied with WHO and NAFDAC standards for hair relaxer. The pH of the samples were within the stipulated value and were all thermally stable. You will find that strand tests are recommended in most at home box hair colors and also found in relaxer instructions, but rarely do those using relaxers perform them. A strand test before a relaxer is important to perform because it helps avoid potentially dangerous allergic reactions of course but that aside, it also helps you figure out the strength of chemical required for your hair as well as how long you should keep it on to achieve the desired results.
Keywords: Comparative analysis, hair care and products (Relaxer)

INTRODUCTION

A hair relaxer is a cream-like mixture that is commonly used to chemically straighten/relax or curls hair hence the term hair relaxer [1,2,3]. For over a century, relaxers have played an intrinsic part of women's and some men's hair conditioning experience. However people have recently become aware of the huge health risks related to relaxer use and things have begun changing. Many people still love the look of hair that stays straight and there is a common misconception that relaxing your hair will make your hair grow faster [4]. However, straight hair tends to look longer than curly hair because of the difference between their shapes. This is why many think that relaxing your hair will make it grow even faster, when in fact, it's just that the hair growth is more visible. Relaxer is one of the hair styling gel commonly used by ladies. It is composed mainly of caustic alkalis as softening agent, Lanolin as emollient, sodium laurel sulphate as emulsifier, petroleum jelly and mineral oil as protective agent. It also contains considerable proportion of fatty alcohol which acts as a general base to blend other ingredients in the fatty phase [5]. In recent years, chemical methods for permanent straightening of hair have proved more popular. Relaxation of high curly hair is normally achieved by application of caustic-based hair strengtheners [6]. The development of hair relaxers and processes specifically designed for the treatment of hair, has allowed us to recognize that afro-hair is different from Caucasian hair and so, requires different chemical straightening formulations. Caucasian hair is straight while afro hair is tightly curled [7]. Different chemicals used in the treatment of hair ends up rupturing the bonds that link protein fibres and thus weakening the hair structure [6]. Products for preconditioning which ensures well-conditioned hair including chemical treatments, requires adequate

assessment which is the reason for this study.

Materials and methods

Twenty three (23) hair relaxer products were purchased from Mubi main market, Adamawa, Nigeria. The samples were documented as in Table 1.

Determination of the total content

The total content weight was assessed by difference in weight method. The container and the content were weighed and the weight recorded as W1. Thereafter, the container were emptied, dried and weighed as well (W2). The difference between W1 and W2 were noted as the net weight of the content. The non-volatile matter, percentage NaOH content, lanolin, Aloe vera, protein, alcohol, pH were determined using the standard operating procedure by the National Agency for Food Drug Administration and Control [6].

pH determination

About 5±0.01 g of the relaxer was weighed into a 100 mL beaker. 45 mL of water was added and agitated for about 10 min. The pH was then determined by inserting a calibrated Hanna (HI98107) pH meter at 25 ^{o}C.

Determination of thermal stability

Fresh unopened sample was placed in a thermostatically controlled oven at 37 ^{o}C for 48 h, making sure that the sample is securely sealed. The sample was assessed on removal from the oven, using the following indications of instability: (a) change of colour; (b) change of smell or odour; (c) phase separation; (d) formation of granules or crystal growth; and (e) shrinkage due to evaporation of water.

Determination of total alkali content

The method consists of refluxing the sample in alcohol, and titrating with standard acid. 2 g of the sample was accurately weighed into a flask. 100 mL of the ethanol solution was added to the test portion. The flask was fitted to the reflux condenser, and gently heated until the sample was completely dissolved. 3.0 mL of hydrochloric acid solution was added and boiled gently for 10 min. After boiling and the pink colour reappears, more hydrochloric acid was added. It was then titrated at 70 °C, with the ethanolic potassium hydroxide solution in the presence of phenolphthalein indicator. The total alkali content was calculated as follows:

Total alkali content = $(V_o N_o V_1 N_1)/M$ X C

where C is a constant (C^o = 2.4 for LiOH, C = 4 for NaOH, C = 5.6 for KOH, C = 3.7 for $Ca(OH)_2$, C = 3.5 for NH_4OH) V_0 is the volume, in millilitres, of hydrochloric acid used; V_1 is the volume in millilitres of potassium hydroxide used in titration; N_0 is the exact normality of hydrochloric acid; and N_1 is the exact normality of the potassium hydroxide solution used. M is the mass, in grams, of the sample.

Heavy metal content

The heavy metals were determined using atomic absorption spectrophotometer (AAS).

RESULTS AND DISCUSSION

During a hair-relaxation treatment, the hair can be most easily penetrated by a cationic conditioner to present in the relaxer. The hair is swollen during relaxation, under the action of the alkali, and the cuticles on each hair shaft are sufficiently raised so that the conditioner can find entry between them into the hair shaft. In contrast, after the relaxer is rinsed off, the hair deswells and the cuticles flatten. Conditioners applied at this stage to the deswollen hair cannot penetrate the hair shafts to the same extent and are less effective in achieving conditioning. The samples net weights (Table 1) revealed that all the products complied with the WHO and NAFDAC limit (95%). The net weight shows how the stated amount of relaxer on the product's label and the actual content inside the container compared. The results also revealed that the products were thermally stable. Microstructural thermal stability determines the likelihood of a material to

undergo phase transitions in response to thermal stress, which may occur due to the manufacturing process or storage conditions. It is a critical metric in the formulation of complex solutions containing lipids such as relaxer. The level of hydroxide used in relaxers determines the strength.

Table 1: Percentage net weight compliance and thermal stability

Sample code	Stated net weight (g)	Gross weight (g)	Net weight (g)	% compliance	Thermal stability
A	150	188.2	156.4	104.27	Thermally stable
B	150	181.9	157.2	104.80	Thermally stable
C	170	205.2	179	105.29	Thermally stable
D	170	205.1	167.3	98.41	Thermally stable
E	200	221.1	201.2	100.60	Thermally stable
F	200	222	199	99.50	Thermally stable
G	200	221	201	100.50	Thermally stable
H	200	222	201	100.50	Thermally stable
I	200	222	201.7	100.85	Thermally stable
J	250	265.8	251.3	100.52	Thermally stable
K	220	241	230	104.55	Thermally stable
L	250	267.9	252.4	100.96	Thermally stable
M	200	221.4	202	101.00	Thermally stable
N	200	221.3	201.1	100.55	Thermally stable
O	200	221.5	201.1	100.55	Thermally stable
P	200	222.1	195.3	97.65	Thermally stable
Q	150	185.2	148	98.67	Thermally stable
R	150	182.6	151.4	100.93	Thermally stable
S	150	181.1	150.5	100.33	Thermally stable
T	200	223.1	192.5	96.25	Thermally stable
U	200	221.2	201.2	100.60	Thermally stable
V	200	222.1	199.4	99.70	Thermally stable
W	200	221.4	193.2	96.60	Thermally stable
WHO Limit				95% Min.	Thermally stable

The NaOH content of all the samples (Table 2), were within the acceptable limit (1.0 – 2.0%), indicating the suitability of the products for afro-hair. Lanolin, protein and aloe vera were detected in about 60% of the samples. The presence of these components improves the quality of the relaxers. The non-volatile matter was within the limit recommended by NAFDAC. The non-volatile matter refers to all co-emulsified ingredients, other than water. A relatively low amount means that the emulsion-forming ingredients and the alkaline material present as part or all of total hair-relaxing agent together make up not more than about 50 %on a dry solids basis of the total weight of the cream composition.

Table 2: Percentage NaOH, non-volatile matter and pH

Sample code	NaOH (%)	pH	Non-volatile matter (%)	Lanolin	Protein	Aloe vera	Pb	Cd
A	1.7	11.9	38	+	+	+	0.01	0.002
B	1.9	12.2	40	-	+	-	BDL	0.01
C	1.8	12.4	39	+	-	+	BDL	BDL
D	2.0	11.2	42	+	+	+	0.01	BDL
E	1.9	11.4	58	+	+	+	BDL	0.01
F	1.8	11.4	39	+	+	+	BDL	BDL
G	1.9	11.4	48	+	+	-	BDL	BDL
H	1.9	12.4	53	-	+	+	DBL	BDL
I	1.7	11.2	53	+	-	-	BDL	BDL
J	1.8	11.6	45	-	+	+	0.01	0.01
K	1.8	11.9	35	+	+	+	0.01	0.02
L	1.7	11.9	35	+	+	+	0.01	0.01
M	1.9	12.5	36	+	-	+	0.01	BDL
N	2.0	12.4	38	+	+	+	0.01	BDL
O	2.0	12.1	37	+	+	-	0.01	BDL
P	1.9	12.4	37	-	+	+	BDL	DBL
Q	2.0	11.4	39	+	+	+	BDL	BDL
R	2.0	12.3	48	+	+	+	BDL	0.01
S	1.7	11.4	39	+	-	+	DBL	BDL
T	1.4	11.9	47	+	+	+	BDL	BDL
U	1.5	11.8	39	+	+	-	0.01	BDL
V	1.4	11.7	46	-	-	+	BDL	DBL
W	1.6	12.1	46	+	+	+	BDL	BDL
WHO Limit	1.0 – 2.0	9 – 12.5						
NAFDAC Limit	1.0 – 2.5	9 – 12.5	≥ 10%					

+ = present, - = absent, BDL = below detection level

The Pb and Cd content (Table 2) of the relaxers were within the recommended limits by [3]. This indicates that the relaxers are of good quality having complied with most of the set standards (Table 3).

Table 3: Chemical requirements for lye and no lye chemical hair relaxers (EAS 338: 2013)

Characteristic	Requirements
pH range	11- 13
Free alkali content % by mass	2.5
Total alkali content:	
Potassium hydroxide, KOH, % by mass, max.	2.5
Sodium hydroxide, NaOH, % by mass, max.	2.5
Lithium hydroxide, LiOH, % by mass, max	2.5
Calcium hydroxide, $Ca(OH)_2$, % by mass, max	7.0
Ammonium hydroxide, NH_4OH, % by mass, max.	6.0
Pb (ppm max)	20
As (ppm max)	2

CONCLUSION

The suitability of hair relaxers sold in Mubi main market, Adamawa State, Nigeria was assessed for its suitability for use by afro-hair. AAS was used for the determination of Pb and Cd content of the relaxers. Net relaxer content was assessed by difference in weight while the NaOH content was determined by titration of HCl using Phenolphthalein indicator. The result revealed that all the relaxers complied with WHO and NAFDAC standards for hair relaxer. The pH of the samples were within the stipulated value and were all thermally stable.

REFERENCES

1. Elexander, P. (1990). The structure of the hair. Manufacturing chemist, 6(2): 20 – 22
2. Balsam, M. S. and Sagarin, E. (1974). Cosmetic scienc and technology,second edition. Jonly wiley and son new York, 3: 176 – 178
3. Denavame, M. G. (1975). The chemistry and manufacture of cometics. 2nd edition, continental press, Orlando, florida, 4: 1159 – 1165
4. Harry, R. J. (1982). Harry's cosmology, 7th edition, Longmann, 282 – 300
5. Knott, A. Daykin, K. and Ryan, J. (1993). In vivo procedure for assessment of Hair Greasiness. Int. Journal of Cosmetics Sciences, 5(3): 77 – 78
6. National agency for food drug administration and control, NAFDAC (2006). Standard operating procedure.
7. East African Standard, EAS (2013). Chemical hair relaxers and hair waving products — Specification. EAS 338: