# The pH of lye and no-lye hair relaxers, including those advertised for children, is at levels that are corrosive to the skin

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**Background.** Hair relaxers are used by up to 70% of females of black African ancestry. Occupational safety regulations list a pH ≥10.5 as irritant and a pH ≥11.50 as corrosive to the skin.

**Objectives.** To determine the pH of all relaxers sold on the South African market and whether it is lower in no-lye relaxers and those marketed for children.

**Methods.** Relaxers were purchased from retailers in Cape Town, but more than half (54%) of the 39 brands tested were international. The pH was determined using a benchtop pH meter with an electrode for emulsions. Three pH readings were done over 3 consecutive days for each sample, and the average was used for data analysis. Differences between relaxers were analysed using Kruskal-Wallis, Wilcoxon rank-sum (Mann-Whitney) and two-sample *t*-tests ($p<0.05$).

**Results.** The median pH of all relaxers (calcium hydroxide, lithium hydroxide and sodium hydroxide) was 12.36 (interquartile range 12.10 - 12.62). The active ingredient was sodium hydroxide (lye or caustic soda) in 63% of the total of 121 relaxers (6/76 (7.9%) of these marketed for children). Lithium hydroxide and calcium hydroxide (no-lye) relaxers comprised 17% and 20%, respectively. No difference in pH was found between relaxers marketed for adults and those for children (sodium hydroxide $p=0.2703$, lithium hydroxide $p=0.6787$ and calcium hydroxide $p=0.1048$) or between lye (sodium hydroxide) and no-lye (calcium hydroxide) relaxers ($p=0.2740$). Furthermore, 64/70 (91%) of sodium hydroxide relaxers for adults and 4/6 (67%) of those for children were sold packaged without a neutralising shampoo.

**Conclusions.** The pH of all the relaxers tested was at levels deemed corrosive to the skin and may contribute to the high prevalence of alopecia in females with afro-textured hair. A review of permissible safe pH levels for cosmetic use is warranted.

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The use of hair relaxers (chemical straighteners) is common among females with afro-textured hair.[1] Approximately 42% of African American girls (aged <15 years),[2] 78% of South African (SA) schoolgirls (median age 17.4 years, range 6 - 21)[3] and 49.2% of SA women (median age 38.3 years, range 18 - 86)[3] with afro-textured hair chemically straighten their hair.[3-5] Several studies have suggested that relaxer use is associated with an increased risk of traction alopecia (TA),[3-6] central centrifugal cicatricial alopecia (CCCA),[5-7] hair breakage, scalp irritation, burns, scarring[6,8,9] and allergic reactions.[10] The prevalence of TA is higher (22.1% v. 5.2%) in girls with relaxed compared with natural hair.[4] Similarly, adult females with relaxed hair (33.6%) and those with combined hairstyles (i.e. when braids are done on natural or relaxed hair with or without extensions, 40.6%) have an increased prevalence of TA. However, the prevalence of TA was found to be highest (48%) if hair extensions (braids and weaves) were attached to relaxed hair.[5] The prevalence of CCCA was 2.7% in females (>18 years) and was higher in females who had relaxed their hair for >5 years (4.9%) than in those who had <5 years' exposure to relaxing (1.3%).[5] This finding was consistent with a prevalence of CCCA that was highest in women aged >50 years.[5]

Relaxer use results in breaking of the hair's strong disulphide bond, allowing the hair to be straightened; however, the process also weakens the hair shaft.[11,12] Amino acid analysis of natural and relaxed hair shows that chemical hair relaxers result in a reduced cystine content, which is consistent with fragile, damaged hair such as that seen in trichothiodystrophy,[13] a genetic disorder characterised by short, brittle hair with an abnormally low sulphur content.[14]

The alkalis used in hair relaxers are sodium hydroxide (lye or caustic soda), lithium hydroxide, potassium hydroxide, calcium hydroxide/guanidine carbonate, or a combination of these. In the presence of alkali straighteners, permanent fission of disulphide bonds occurs and some bonds are converted into monosulphide cross-links (lanthionine).[15] Irreversible molecular transformation of the alpha-keratins to a less organised structure and super-contraction occur where the keratin fibre is fixed at a length less than its original one, providing permanence to hair straightening.[16] The rate and extent of human hair swelling by alkali hydroxides are pH-dependent and increase dramatically with increasing pH above neutral. A sodium hydroxide solution with a pH of 14 results in >40% hair swelling and 5.7% super-contraction, resulting in permanent hair straightening. The molecular conformational changes that accompany super-contraction are more important to hair straightening than the reduction reaction to the disulphide bonds and formation of lanthionine.[17]

According to global and local occupational health and safety frameworks, a pH >11.5 is corrosive to the skin. Alkalis with a pH >11.5 produce severe tissue injury, causing deeper penetration of the chemical.[18] Alkali burns therefore tend to be more severe than acid burns.[19] In addition to relaxers, less commonly used products for chemical straightening and permanent waving are based on thioglycolic acid, which is the precursor to ammonium thioglycolate and is used at a pH of 9 - 9.5,[17] and low-pH products based on sulphite or bisulphite.[20] The permanent waving process involves the rearranging step and the fixing of the disulphide bonds using a neutralising solution based on sodium bromate or hydrogen peroxide.[17,21,22]

The high prevalence of relaxer use by women with afro-textured hair warrants an investigation into the chemical exposure experienced by users. Women who relax their hair have been reported as doing so a mean (standard deviation (SD)) of every 4.7 (1.3) weeks, or 11.1 times per year.[6] It is believed that the repeated application of relaxers contributes to common hair and scalp disorders.[11,12,23] There are anecdotal reports of relaxers that are sold without being packaged with (or packaged with too little) neutralising shampoo. There is therefore also a possibility that inadequate neutralisation of the pH at the end of relaxer application may contribute to over-processing of hair, scalp irritation, damage and hair loss.

## Objectives

The primary objective of the study was to generate a pH profile of all hair relaxers sold on the SA market. The secondary objectives were: (*i*) to identify the number of relaxers that are sold packaged with a neutralising shampoo and record the quantity of shampoo in terms of adequacy to neutralise a head of hair; and (*ii*) to compare the pH of lye v. no-lye relaxers, relaxers marketed for adults v. those for children, and regular v. super-strength relaxers, to evaluate the marketing claims that no-lye relaxers, relaxers for children and lower-activity relaxers are mild, not damaging to the skin, and safe.

## Methods

### Sample collection

Care was taken to identify all products available on the market. The process of identifying and purchasing products took 6 months. However, most of the hair relaxers and straighteners were bought from three large retailers in Cape Town, SA. All products were tested within 1 month of purchase. Each product was given a unique identifier code and placed in a 125 mL clear glass container in a cool, dark, locked cupboard (at room temperature) for the duration of the study.

### Chemical composition of hair relaxers

A total of 121 chemical hair relaxers were purchased across 39 brands (18 local and 21 international). Manufacturers market different strengths of relaxers, namely regular and super strength. All available strengths for each brand were purchased. Manufacturers also market different categories for adults and children. Different categories for each brand were purchased.

To determine the pH of no-lye relaxers after mixing their two components, a further 19 no-lye relaxer kits from 9 brands (8 international and 1 local) were purchased later in addition to the 121 products initially purchased. The 19 products comprised 3 children's relaxers and super- and regular-strength relaxers.

### Measurement of pH

The pH of the chemical hair relaxers was measured using a SevenCompact benchtop pH/ion meter S220 (Mettler Toledo, USA) fitted with a pH electrode InLab Expert Pro-ISM (Mettler Toledo, USA) with an integrated temperature probe. This electrode is specifically designed to directly measure the pH of highly viscous, oily samples and emulsions.

Samples were transferred from the 125 mL clear glass storage container into a 50 mL beaker and the pH was read. Three separate pH readings were acquired over 3 consecutive days for each sample by one assessor. Two additional assessors conducted a validation study and repeated the pH readings. The average of the three pH results was used for data analysis.

No-lye calcium hydroxide relaxers are the only products with a two-component system, comprising a cream relaxer and a liquid or cream activator. The pH was first measured for the two separate components of the product. Samples were mixed for 5 minutes using the wooden spatulas supplied, after which the pH was read again, with a follow-up reading after 24 hours. All the relaxer kits were supplied with instruction sheets, but none specified the mixing time. A mixing time for all the kits was set by the researcher for consistency of results.

### Statistical analysis

Statistical differences between the lye (sodium hydroxide) and no-lye (calcium/lithium) relaxers were analysed using the Kruskal-Wallis test (level of significance $p<0.05$). Statistical differences between relaxers for children and those for adults were analysed using the Wilcoxon rank-sum (Mann-Whitney) test ($p<0.05$). Statistical differences between regular and super-strength relaxers were analysed using the two-sample *t*-test ($p<0.05$). Summary statistics of the average pH for the initial and validation study were performed using Stata version 14.0 (StataCorp, USA).

## Results

All the 121 relaxers from the 39 brands initially purchased were based on alkali hydroxides (Table 1). Of the brands, 18/39 (46%) were local and 21/39 (54%) international (Fig. 1). Of the no-lye relaxers, including those purchased later, 3/43 (7%) were from local brands and 40/43 (93%) from international brands (Fig. 1). Sodium hydroxide was the most common active ingredient, found in 63% of relaxers; 6/76 (8%) of these relaxers were targeted at children. Seventeen percent (21/121) of the relaxers were lithium hydroxide based and 20% (24/121) were calcium hydroxide based. Of these, 8/21 (38%) and 4/24 (17%), respectively, were marketed for children.

Eighty-nine percent (68/76) of sodium hydroxide relaxers (of which 4/6 were for children) and 52% (11/21) of lithium hydroxide relaxers (of which 3/8 were for children) were sold without being packaged with a neutralising shampoo. All the calcium hydroxide relaxers were sold in a box to incorporate the two-part system of the product, and in all cases the neutralising shampoo was present in the box. Of the sodium hydroxide relaxers sold with a neutralising agent (11%, 8/76), 3 had a shelf configuration of relaxer to neutralising shampoo of 450 mL + 60 mL, 3 had 250 mL + 60 mL and 2 had 225 mL + 30 mL. For the 48% (10/21) of lithium relaxers sold with a neutralising shampoo, the respective quantities were 225 mL + 30 mL for 7 products, 255 mL + 60 mL for 1, 250 mL + 50 mL for 1, and 114 g + 44 mL for 1 (Table 1). The instructions on the packaging state that 225 mL and 250 mL are intended for two relaxer applications and that the hair should be shampooed twice after each application. A simulation of shampoo use by the authors indicated that the quantity of neutralising shampoo supplied could be insufficient.

The pH values for all hydroxide relaxers (sodium-calcium-lithium), initial and validation studies combined, were minimum 11.75, maximum 13.17 and median 12.36 (interquartile range (IQR) 12.10 - 12.62) (Table 2). The results for the validation study, in which the relaxer pH was measured a second time by two different assessors 3 months after the initial study, are compared with the initial results in Table 3 (A and B). Sodium hydroxide relaxers had the highest average pH values. The maximum measured pH values were also highest for the sodium hydroxide relaxers, 13.17/13.04 for adult and 12.82/12.73 for children's products in the initial and validation studies, respectively. All maximum measured pH results were >12.00.

**Table 1. Classification and chemical composition of the relaxers**

| Active ingredient (market names) | Target market, *n* products | Products without neutralising shampoo, *n* | Products with neutralising shampoo, *n* | Shelf configuration (relaxer + shampoo), *n* products |
|---|---|---|---|---|
| Sodium hydroxide (lye) | Adults 70 | 64 (37 local, 27 international) | 6 (6 local, 0 international) | 3 (450 mL + 60 mL)<br>2 (225 mL + 30 mL)<br>1 (250 mL + 50 mL) |
| | Children 6 | 4 (4 local, 0 international) | 2 (2 local, 0 international) | 2 (250 mL + 60 mL) |
| Calcium hydroxide (no lye) | Adults 20 | 0 | 20 (1 local, 19 international) | 4 (255 mL relaxer + (2 × 10 mL) activator + 60 mL neutralising shampoo)<br>1 (200 mL relaxer + (2 × 50 mL) activator + 90 mL neutralising shampoo)<br>1 (213 g relaxer + 59 mL activator + 59 mL neutralising shampoo)<br>2 (185 g relaxer + 45.8 mL activator + 45 mL neutralising shampoo)<br>2 (185 g relaxer + 50 mL activator + 45 mL neutralising shampoo)<br>1 (240 g relaxer + 60 mL activator + 100 mL neutralising shampoo)<br>3 ((2 × 69 g) relaxer + (2 × 69 g) activator + (2 × 59 mL) neutralising shampoo)<br>2 (200 g relaxer + 59 mL activator + 59 mL neutralising shampoo)<br>2 (198 g relaxer + 49.38 mL activator + 53 mL neutralising shampoo)<br>1 (184 g relaxer + 51.7 mL activator + 51.7 mL neutralising shampoo)<br>1 (220 g relaxer + 53 mL activator + 59 mL neutralising shampoo) |
| | Children 4 | 0 | 4 (1 local, 3 international) | 3 (236 mL relaxer + (2 × 10 mL) activator + 60 mL neutralising shampoo)<br>1 (201 g relaxer + 54 mL activator + 45 mL neutralising shampoo) |
| Lithium hydroxide (no lye, no mixing) | Adults 13 | 8 (1 local, 7 international) | 5 (2 local, 3 international) | 1 (255 mL + 60 mL)<br>1 (250 mL + 50 mL)<br>1 (114 g + 44 mL)<br>2 (225 mL + 30 mL) |
| | Children 8 | 3 (3 local, 0 international) | 5 (5 local, 0 international) | 5 (225 mL + 30 mL) |
| Total | 121 | 79 | 42 | |

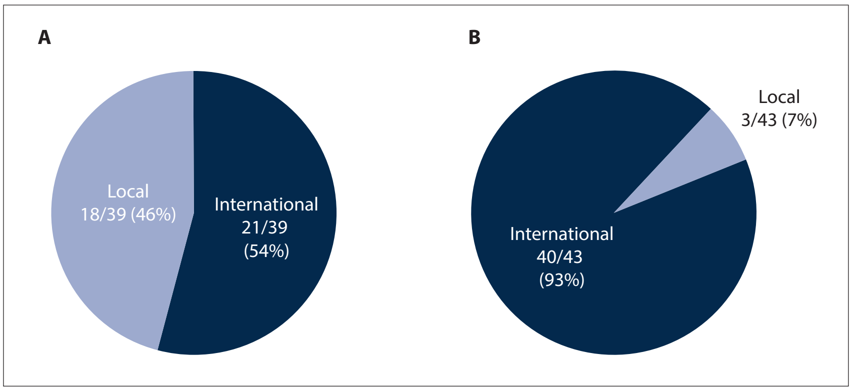


*Fig. 1. Chemical hair relaxers sold on the South African market, local v. international market share. (A = total relaxer market share (brands); B = no-lye relaxer market share (products).)*

**Table 2. Statistical data for the initial and validation studies combined (*N*=121 products)**

| Average pH | Results |
|---|---|
| Minimum | 11.75 |
| Maximum | 13.17 |
| Mean | 12.34 |
| Median | 12.36 |
| SD | 0.36 |
| 25th percentile | 12.10 |
| 75th percentile | 12.62 |

SD = standard deviation.

Over 80% of pH measurements were within the range 12.00 - 13.00.

The pH results for the later-purchased no-lye calcium hydroxide relaxers were minimum 10.69, maximum 13.74 and median 13.04 (IQR 12.89 - 13.17). The pH results for the guanidine carbonate-based activators were minimum 10.79, maximum 13.04 and median 11.03 (IQR 10.91 - 11.20). The median pH (IQR) after mixing the two components (guanidine hydroxide) was 13.77 (IQR 13.71 - 13.87), with the figure rising to 13.82 (IQR 13.75 - 14.00) after 24 hours (Table 4).

A relaxer targeted at children was supplied with a conditioner sachet, and instructions required mixing of the conditioner with the two components of the relaxer before use. The relaxer and conditioner mixture had a pH of 13.80.

When the results based on chemical composition were compared, there was no significant difference between the pH of the three relaxer active ingredients ($p$=0.2568), or between the pH of calcium hydroxide and lithium hydroxide ($p$=0.1217), calcium hydroxide and sodium hydroxide ($p$=0.2740) or lithium hydroxide and sodium hydroxide

Table 3. pH results of hair relaxers categorised by chemical composition

| | All relaxers | Adults | | | Children | | |
|---|---|---|---|---|---|---|---|
| | | Sodium hydroxide | Calcium hydroxide | Lithium hydroxide | Sodium hydroxide | Calcium hydroxide | Lithium hydroxide |
| A. Initial study | | | | | | | |
| *n* | 121 | 70 | 20 | 13 | 6 | 4 | 8 |
| pH, median (IQR) | 12.50 (12.27 - 12.66) | 12.63 (12.51 - 12.80) | 12.25 (12.12 - 12.37) | 12.33 (12.02 - 12.36) | 12.55 (12.46 - 12.64) | 12.27 (12.05 - 12.32) | 12.02 (11.93 - 12.06) |
| pH, range | 11.81 - 13.10 | 11.81 - 13.10 | 11.95 - 12.52 | 11.96 - 12.49 | 12.26 - 12.69 | 11.85 - 12.36 | 11.81 - 12.15 |
| Max. measured pH | 13.17 | 13.17 | 12.82 | 12.62 | 12.82 | 12.52 | 12.38 |
| B. Validation study | | | | | | | |
| *n* | 121 | 70 | 20 | 13 | 6 | 4 | 8 |
| pH, median (IQR) | 12.23 (11.96 - 12.48) | 12.40 (12.19 - 12.62) | 12.13 (11.95 - 12.33) | 11.81 (11.67 - 11.99) | 12.47 (12.20 - 12.52) | 11.93 (11.68 - 12.19) | 11.88 (11.80 - 11.95) |
| pH, range | 11.53 - 12.84 | 11.63 - 12.84 | 11.66 - 12.36 | 11.53 - 12.15 | 12.16 - 12.61 | 11.64 - 12.24 | 11.56 - 12.02 |
| Max. measured pH | 13.04 | 13.04 | 12.42 | 12.38 | 12.73 | 12.28 | 12.14 |

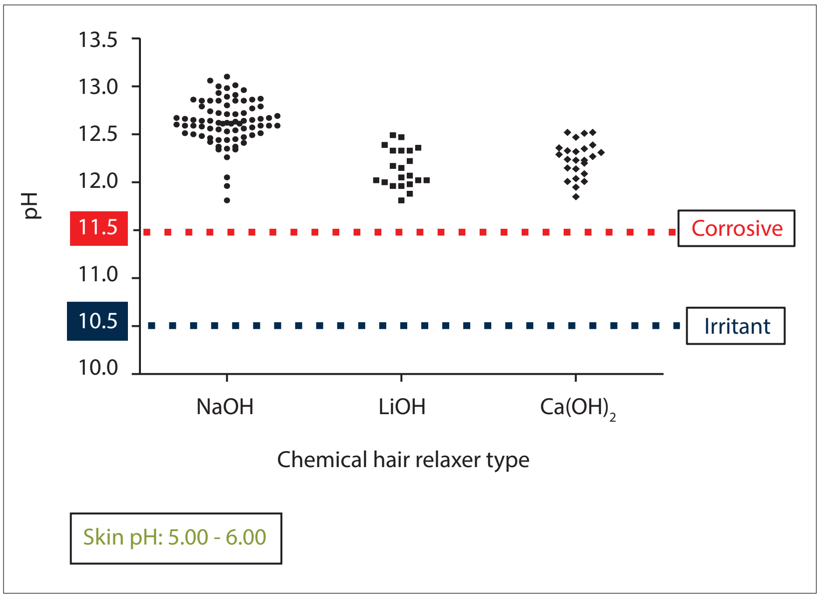


*Fig. 2. Graphical illustration of the pH distribution of all the chemical hair relaxers tested (N=121), also showing occupational health-recommended levels and potential skin effects. (NaOH = sodium hydroxide (lye or caustic soda); LiOH = lithium hydroxide (no lye, no mixing); $Ca(OH)_2$ = calcium hydroxide (no lye).)*

($p$=0.3095) relaxers. Results are presented according to the active ingredients, but within the product ranges there were relaxers of different strengths (super/regular). There was no significant difference in pH between relaxers of different strengths for sodium hydroxide ($p$=0.8956) or lithium hydroxide products ($p$=0.4849). However, there was a significant difference between super and regular relaxers for calcium hydroxide ($p$=0.0081) products. There was no significant difference between relaxers for adults and those for children for sodium hydroxide ($p$=0.2703), lithium hydroxide ($p$=0.6787) or calcium hydroxide products ($p$=0.1048).

## Discussion

Alkali-based relaxers with sodium hydroxide as the active ingredient have been used to chemically straighten hair since their chance discovery more than 100 years ago. However, occupational health studies have reported that sodium hydroxide is irritating to human skin at concentrations as low as 0.5%.[24] Calcium hydroxide- and lithium hydroxide-based relaxers were therefore introduced as safer alternatives to sodium hydroxide. However, relaxers containing different alkali hydroxides have similar and overlapping pH values.

We found no difference between relaxers marketed for adults and those for children. Regular and super-strength relaxers are classified and marketed as such for safety reasons, but we found no difference between the pH values of the relaxers of different strengths. Safety assessment has found sodium hydroxide to be corrosive at concentrations as low as 1% and calcium hydroxide to be irritating from a pH of 9.00.[24]

Toxicity is affected by pH, with greater toxicity associated with increasing pH values.[24] Products with a high pH are viewed as potentially dangerous owing to their corrosive nature.[25] High pHs can cause deep burns and readily denature keratin (the major protein in human skin and scalp), and the durations of contact with the skin and eyes are important determinants of the eventual clinical outcome.[24]

Although sodium hydroxide relaxers had the highest pH, 89% were not packaged with a neutralising shampoo. Lithium hydroxide is primarily targeted at children (38% of lithium relaxers), but 52% of the relaxers (38% of those for children) were not sold with a neutralising shampoo (Table 1). Among the relaxers sold with a neutralising shampoo, a 225 mL relaxer was accompanied by a 30 mL neutralising shampoo and a 450 mL relaxer by a 60 mL shampoo. According to the instructions on the packaging, 225 mL is intended for two relaxer applications, and the hair should be shampooed twice after each application. A simulation of shampoo use indicated that 20 mL is enough for a single application, so the supplied neutralising shampoo could be insufficient.

**Table 4. pH results of calcium hydroxide (no lye) hair relaxers**

| | Calcium hydroxide relaxer (*n*=19) | Guanidine carbonate activator (*n*=19) | Guanidine hydroxide relaxer* (*n*=19) | Guanidine hydroxide relaxer* (after 24 h) (*n*=19) |
|---|---|---|---|---|
| pH, median (IQR) | 13.04 (12.89 - 13.17) | 11.03 (10.91 - 11.20) | 13.77 (13.71 - 13.87) | 13.82 (13.75 - 14.00) |
| pH, range | 10.69 - 13.74 | 10.79 - 13.04 | 13.50 - 14.00 | 13.66 - 14.00 |
| Max. measured pH | 13.74 | 13.04 | 14.00 | 14.00 |

*Calcium hydroxide + guanidine carbonate.

**Table 5. Foodstuffs, Cosmetics and Disinfectants Act 54 of 1972**

| Substance identification (name and Chemical Abstracts Service (CAS) number) | pH restrictions (hair straightener) | Concentration restrictions (hair straightener) |
|---|---|---|
| Sodium hydroxide/potassium hydroxide<br>1310-73-2/1310-58-3 | General use: no pH restrictions mentioned<br>Professional use: no pH restrictions mentioned | General use: 2%<br>Professional use: 4.5% |
| Lithium hydroxide<br>1310-65-2 | General use: no pH restrictions mentioned<br>Professional use: no pH restrictions mentioned | General use: 2%<br>Professional use: 4.5% |
| Calcium hydroxide<br>1305-62-0 | No pH restrictions mentioned | 7% (as calcium hydroxide)<br>Hair straightener containing two components: calcium hydroxide and a guanidine salt |

**Table 6. Global comparisons of pH and concentration of chemicals classified as corrosive with SA's Occupational Health and Safety Act 85 of 1993/Hazardous Chemical Substances Regulations of 1995**

| Country | pH | Concentration | Described effect |
|---|---|---|---|
| Occupational Health and Safety Act/Hazardous Chemical Substances Regulations of 1995 (SA)[27] | ≤2 or ≥11.5 | ≥1% | Corrosive |
| Occupational Safety and Health Act of 1970 (USA), Safety and Health Standards clause A.3.4.1[28] | ≤2 or ≥11.5 | ≥1% | Corrosive |
| Regulation (EC) No. 1272/2008 of the European Parliament on Classification, Labelling and Packaging of Substances and Mixtures[29] | ≤2 or ≥11.5 | ≥1% and <5% | Corrosive |
| Occupational Health and Safety Act of 2004 (Australia), Approved Criteria for Classifying Hazardous Substances (NOHSC: 1008 (2004))[30] | ≤2 or ≥11.5 | ≥1% | Corrosive |
| A Guide to the Globally Harmonized System of Classification and Labeling of Chemicals[31] | ≤2 or ≥11.5 | ≥1% | Corrosive |

SA = South Africa; NOHSC = National Occupational Health and Safety Commission; EC = European Commission.

Analysis of the ingredients lists revealed that petrolatum is an ingredient in all relaxers. Based on the cosmetic products ingredient listing standards, petrolatum's position on the list indicates that it is a primary ingredient in the formulation. Directions for use of all relaxers recommend applying petrolatum or pomade, which is petrolatum based, on the hairline, ears, neckline and forehead for protection. The final pH of the product of all relaxers was >12.00 with the presence of the petrolatum in the formulation.

Relating hair relaxers to household products, bleach has a pH of about 11.00, oven cleaners about 12.00 and drain cleaners 12.00 - 13.00. The pH of products used by women with afro-textured hair, and on children, is therefore equivalent to that of drain cleaners.

The Foodstuffs, Cosmetics and Disinfectants Act 54 of 1972,[26] which regulates the SA cosmetics industry, has no pH restriction for sodium, calcium and lithium hydroxide relaxers. The Act does restrict the concentration of the active ingredients. The concentrations of the active ingredients in tested relaxers comply with the Act (Table 5).

According to SA's Occupational Health and Safety Act 85 of 1993 (OHSA)[27] and global comparisons with the Act (Table 6), a pH ≥11.5 is classified as hazardous and corrosive. Concentrations of the active ingredients in the present study were within the regulatory framework, but the final pH was ≥11.5 (Fig. 2). The regulatory framework contrasts with the OHSA, which stipulates that a concentration of 1% with a pH ≥11.50 is corrosive. All the relaxers purchased and tested can therefore be classified as hazardous and corrosive.

It is of concern that the most common active ingredient for hair relaxers is sodium hydroxide. Sodium hydroxide is classified as toxic, hazardous and corrosive. It is primarily used as a drain cleaner. Lithium hydroxide and calcium hydroxide do not appear on the list of toxic chemicals in the OHSA. However, it was noteworthy that despite industry recommendations of safer options, the pH of no-lye relaxers was similar to that of sodium hydroxide. A recommendation of mixing a conditioner with the relaxer mixture to protect the scalp yielded a pH of 13.80. The conditioner was not protective to the scalp.

Most relaxers recommend a period of 6 - 8 weeks between applications, referred to as 'retouch applications'. Based on the manufacturers' advice, a woman would apply a hair relaxer 6.5 - 8.7 times a year on average. A study found that of women who had a relaxer frequency of >7 weeks, 27% and 0%, respectively, had moderate or severe scores for TA, whereas of women who relaxed their hair every 5 - 7 weeks, 32.6% and 4.7% had moderate and severe scores.[3]

## Conclusions

During the hair relaxing process, consumers are exposed to pHs in the hazardous and corrosive range. The relaxers on the SA market have a median pH of 12.36 (IQR 12.10 - 12.62).

Eighty-four percent of sodium hydroxide relaxers and 52% of lithium hydroxide relaxers are sold as stand-alone products and not packaged with a neutralising shampoo. Manufacturers market 'safer' relaxer options, including no-lye relaxers, lower-strength relaxers and relaxers marketed for children. However, we found no significant difference between lye v. no-lye relaxers, regular v. super-strength relaxers, or relaxers for adults v. children. Overall, there was no difference between any of the hydroxide-based relaxers. All hydroxide-based relaxers have pH levels that are hazardous and corrosive.

The cosmetics regulatory framework has no pH restrictions for relaxers. There is a need for this framework to be revised for chemical hair relaxers.

**Declaration.** None.

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