TITRIMETRIC ANALYSIS OF COMMERCIAL BLEACH A GAMBIA CASE STUDY

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ABSTRACT

Ten brands of bleach were analyzed for their sodium hypochlorite (NaOCl) levels using titrimetric method. The levels of NaOCl found in the bleach samples were generally higher than the levels indicated on the respective labels. Only one out of the ten samples had a NaOCl level of below 5% indicating that it is a safe and noncorrosive household bleach. *[African Journal of Chemical Education—AJCE 10(1), January 2020]*

INTRODUCTION

Bleach is widely used in The Gambia, mostly in every household. A bleach is a strong oxidizing agent with a myriad of applications in industries [1]. The most active ingredient in commercial bleach is sodium hypochlorite (NaOCl) [2]. NaOCl has outstanding disinfecting properties. It is also very toxic. Exposure to NaOCl is associated with significant risks due to its strong oxidizing properties. Although NaOCl is a strong alkaline, the ingestion of bleach containing NaOCl causes damage to the esophagus which may lead to burns with hyperemia and edema of the mucosa [3].

The toxicity of bleach depends on where it is applied. It causes significant eye irritation and irritates the mouth and throat but is fairly benign when ingested [4]. A dangerous problem with bleach occurs if it is mixed with other household cleaners and ammonia. These mixtures result in the release of chlorine gas, an asphyxiant. When chlorine gas contacts moist tissues, such as eyes or lungs, it results to the release of hydrochloric acid (HCl).

This research aims to: determine the levels of NaOCl in commercial bleach sold in The Gambia using the Titrimetric method, find out if these levels can lead to NaOCl linked health implications. Since bleach is widely-used in The Gambia and there are several brands; each differing from the other because of the percentage indicated on its label. Do the amounts indicated on the labels agree with what is actually inside the bleach itself? This study intends to ascertain this.

The titrimetric method used in this study is well-suited to an under-resourced laboratory. Furthermore, it is simple and cost-effective. Other methods of analyzing bleach exist, namely, coulometric titrations, spectrophotometry, chemiluminescence, chromatography, voltammetry and flow analysis. However, bleach is analyzed, the concentration of NaOCl and pH are the

main quality parameters used to assess the disinfectant efficiency of the bleach. However, standard procedures have been established to determine the levels of OCl^- in commercial bleaches, based on the reaction between NaOCl with iodide, followed by volumetric titration of the generated iodine with a thiosulfate standard solution, using colorimetric detection [5].

METHODOLOGY

Samples and Sample selection

Ten different commercial bleach samples were bought and analyzed using the titrimetric method. Samples were purchased from big supermarkets known to stock household products. This study was carried out in the urban area of The Gambia where all the big supermarkets are located. These supermarkets stock virtually all what is sold in the country, because supermarkets in the rural/provincial areas buy their stock from the urban area. Furthermore, there are rare cases of smuggling across border from Senegal; this implies that it may be possible to find a bleach smuggled thus and sold in the rural areas. For the most part, the bleach samples used are representative of what exists in the country – a small country.

Below is a table of bleach samples purchased.

S/N	Brand
1	Madar
2	Harpic
3	Domestos
4	Clean and Fresh
5	Dorran
6	Sumo
7	Ernet
8	Savers thin bleach
9	Tesco
10	Easy

All the bleach samples bought indicated the levels of NaOCl present on the labeling. Titrimetric used was simple. Bleach samples were diluted and analyzed by conversion to an equivalent amount of iodine which was titrated with standardized sodium thiosulphate ($Na_2S_2O_3$).

$$NaOCl + 2KI + H_2SO_4 \longrightarrow I_2 + H_2O + NaCl + K_2SO_4$$

$$I_2 + 2Na_2S_2O_3 \longrightarrow 2NaI + Na_2S_4O_6$$

Stoichiometric relationships as indicated in the chemical equations above were used to calculate the amount of NaOCl.

The following steps were carried out for each bleach sample:

1. 0.05ml of bleach was measured and diluted with 20ml distilled water.
2. 5ml of 0.5M KI was added followed by 5ml of 2M H_2SO_4. The solution turned orange after adding these reagents.
3. The solution obtained from step 2 was titrated with standard 0.1M $Na_2S_2O_3$ until the color turned yellow indicating only a small quantity of iodine left in the solution.
4. Starch solution was also added which turned the solution to a dark blue after the starch was added.
5. The titration was continued until the color faded away which indicated the end point of the titration.

Reagents

0.1M $Na_2S_2O_3$, 0.05ml of each bleach sample, 0.5M KI, 2M H_2SO_4 and starch solution.

RESULTS AND DISCUSSIONS

The weight percent (w/w%) of NaOCl obtained from the analysis of each purchased bleach samples is listed in the table below:

S/N	BRAND	% of NaOCl obtained	% of NaOCl on label
1	Madarr	27.27	N/A
2	Harpic	12.06	Less than 5%
3	Domestos	17.73	Less than 5%
4	Clean and fresh	30.50	Less than 5%
5	Dorran	28.10	N/A
6	Sumo	23.30	Less than 5%
7	Ernet	10.40	2.5%
8	Savers thin bleach	12.10	Less than 5%
9	Tesco	0.18	Less than 5%
10	Easy	7.32	Less than 5%

As shown in the results above, the commercial bleach with the highest levels of NaOCl sold in The Gambia is Clean and Fresh while the one with the lowest NaOCl levels is Tesco. Although out of the ten bleach samples analyzed, only one had a NaOCl level of below 5% indicating that it is a safe and noncorrosive household bleach which is in line with a similar research conducted in New Zealand. The New Zealand Environmental Protection Authority (EPA) describes noncorrosive household bleach to have 3% to 5% NaOCl concentration and corrosive bleach to contain more than 25% NaOCl concentration.

However, the levels of NaOCl in most of the bleach samples in The Gambia are above 5%. Therefore, one could consider the bleach samples to be unsafe since more than half of the ones purchased have NaOCl levels above 5%.

RECOMMENDATIONS AND IMPLICATIONS FOR CHEMICAL EDUCATION

With special reference to the values of the NaOCl obtained from the titrations, the researchers in this study question the safety of the bleach sold in The Gambia. Chemical education in this regard implies that students should be taught that everyday chemical reagents like bleach is dangerous and should be treated with care. The following recommendation are made:

- The government should create standard laboratories that determine the levels of NaOCl found in imported bleach in The Gambia.
- Routine monitoring should be conducted in ensuring that the correct amount of NaOCl is indicated on the labels. Students should be made aware of the fact that fraud exists in the Chemical Industry; not all labels are honest; what is written on the label does not always correspond with what is inside.

Users should be sensitized on the health effects associated with the abuse of bleach containing high levels of NaOCl. The effect on health, of everyday chemicals like bleach should be taught in schools; such could form a seminar paper for students to investigate and present to their mates in a chemistry class.

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