

## Physicochemical and Elemental Analysis of Different Brands of Natron and Potash in Sokoto State

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**Abstract:** The physicochemical parameters (solubility, density, pH, conductivity, moisture content, hydrosorption and elemental analysis) of two different samples each of Natron (Balma and Kanwarbai-bai) and Potash (Jan kanwa and Fararkanwa) was conducted using standard procedures. The solubility values for Kanwar-bai-bai and Balma were 9.79 and 8.36 g/100g respectively which were higher compared to Fararkanwa and Jan kanwa having 6.82 and 3.52 g/100g respectively. The density ranges from 2.20-2.89 (gcm<sup>3</sup>) for all the four samples with Balma and Fararkanwa having the highest density. The samples were found to have a basic pH ranging from 9.30 – 12.83. The moisture content for Jan kanwa, Kanwarbai-bai and Fararkanwa (7.83, 7.67 and 3.17 %) was higher compared to that of Balma (1.17 %). The values for degree of hydrosorption ranges from 4.03 - 4.60 g for all the samples while that of conductivity was between the ranges of 19.39 – 19.89 (ohm). The sodium (Na) content was high in all the samples > 20750 mg/kg which was higher than the permissible limit (6065 mg/kg). The potassium content was > 1666 mg/kg. Copper was not detected in all the samples while manganese and iron were detected in moderate concentrations. The result of this study indicates that natron and potash may be a potential source of essential elements required for growth and development.

**Keywords:** Natron, Potash, Physicochemical parameters, AAS

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### I Introduction

Natron is a sesquicarbonate or hydrated carbonate of sodium commonly referred to as *Balma* in the northern part of Nigeria. It occurs naturally as a mixture of sodium carbonate (Na<sub>2</sub>CO<sub>3</sub>·10H<sub>2</sub>O) and about 17% sodium bicarbonate i.e. baking soda (NaHCO<sub>3</sub>) along with small quantities of sodium chloride (NaCl) and sodium sulfate (Na<sub>2</sub>SO<sub>4</sub>) (Sanderson *et al.*, 1979). There are different varieties of natron and the composition of each varies with respect to their locations (Ekanem, 1997). Natron is used for treatment of skin diseases, digestive problems, reproductive ailments, stomach ache (Alawaet *et al.*, 2000). It is also used in postnatal care and increases the quality of breast milk (Sanderson *et al.*, 1989).

Potash has been described as a white crystalline residue that remains after the evaporation of aqueous extract from ashes (Kevin, 2003). It is an impure form of potassium carbonate mixed with potassium salt. The production and use of potash date from the ancient times in several countries around the world. It was first used in crude ways as a domestic cleansing agent (Nwoko, 1980). Potash has found a considerable use in Africa and Nigeria in particular, from the primitive time till date (Onyegbadoet *et al.*, 2002). It is used in soap making (Stine, 1978), as food preservative, as an antacid (Jensus and Baleman, 1979), as a medicinal agent used in treatment of various diseases such as gonorrhoea, abdominal discomfort, cold, bladder irregularity, mouth diseases and enhances the production of milk for infants (Muhammad, 1991). This research was aimed at investigating the physicochemical parameters and elemental composition of two samples each of natron and potash.

### II Materials And Methods

#### Materials

The chemicals employed in this research work were of analytical grades and purity (98-99.9%). Major equipment's used were flame spectrophotometer and atomic absorption spectrometer (AAS).

#### Collection and Preparation of Samples

Two samples each of Natron and Potash were obtained from the Sokoto Central Market, Sokoto, Nigeria and they were identified as (Balma and Kanwarbai-bai); (Jan Kanwa and Fararkanwa) for natron and potash respectively.

#### Sample Treatment

Each sample was oven dried at 105° C to constant weight for 6 hours. The oven dried materials were crushed and sieved through 2.00 mm mesh to obtain a representative sample.

## **Methods**

### **Determination of Solubility**

Fifty gram (50 g) of each sample was separately added to 100 cm<sup>3</sup> of boiling water and stirred for some time till no more salt can dissolve. The solutions were allowed to cool at room temperature and filtered. 20 cm<sup>3</sup> of the saturated solution of each sample was evaporated to find the amount of salt that dissolved in it (BirninYauri and Abubakar, 1999).

### **Determination of Density**

Principle of Archimedes was used. 5 g of each previously dried sample was carefully placed into a 10 cm<sup>3</sup> measuring cylinder containing 5 cm<sup>3</sup> of kerosene and the differences in volume was recorded (BirninYauri and Abubakar, 1999).

### **Determination of pH**

One gram (1g) of the each sample was weighed and dissolved in 10cm<sup>3</sup> distilled water. The solution was properly mixed to allow complete dissolution and pH meter was used to determine the pH, after proper calibration of the electrode. The result obtained was the average of duplicate determination (AOAC, 2000).

### **Determination of Moisture Content**

Four grams (4g) of each sample was placed into a weighed petri dish and it was dried in an oven at 105°C for 4 hours. The dried samples were placed in a desiccator, allowed to cool and weighed again. The weight loss expressed as a percentage was taken as percent moisture. The result was obtained as the average of two independent determinations (AOAC, 2000).

$$\text{Moisture Content (\%)} = \left( \frac{W_1 - W_2}{W_1 - W_0} \right) \times 100$$

W<sub>0</sub>= weight of Petri dish before

W<sub>1</sub>=Weight of sample + Petri dish before drying

W<sub>2</sub>=Weight of sample + Petri dish after drying

### **Determination of Degree of Hydrosorption**

Four grams (4g) of each sample was placed in dried and weighed porcelain crucibles of identical sizes. The crucibles containing the samples were kept above water in a desiccator (to provide saturated atmosphere). The increase in weight (due to absorption of water) was recorded each day until constant weight (Abubakar and BirininYauri, 1999).

### **Determination of Conductivity**

For each sample, 50 cm<sup>3</sup> of distilled water was taken in a beaker at room temperature. The sample was added to the water step-wise; 1 g in each step from 0 -10 g and 2 g in the subsequent steps from 10 – 20 g with continuous stirring after each addition to ensure complete dissolution. The electrodes were kept 4.5 cm apart; the resistance (R) and conductance (C) of the solutions were recorded after every addition (BirninYauri and Abubakar, 1999).

### **Mineral and Heavy Metal Analysis**

One gram (1.00 g) of each sample was digested using 5 cm<sup>3</sup> conc. HNO<sub>3</sub> and 2 cm<sup>3</sup> of conc. HClO<sub>4</sub>. After digestion, the samples were filtered and the filtrate was diluted to 100 cm<sup>3</sup> with deionized water. The solution was digested in a fume cupboard by heating to a final volume of 3 - 5cm<sup>3</sup>. 10 – 15cm<sup>3</sup> of water was added and filtered through an acid washed filter paper into a 50 cm<sup>3</sup> volumetric flask. The filter paper was washed with water and diluted to volume with deionized water.

Flame photometer was set up according to the instructions in the instrument manual. The instrument was calibrated for each determination using appropriate standard solutions. Distilled water was aspirated in order to set the meter at zero. The highest concentration of the standard solutions was aspirated in order to set the meter to 100 % deflection. % deflection reading of all the intermediate standard solutions was recorded. The sample solution was aspirated and the reading (%) was recorded. (0 and 100 % reading with 0 and top standard after every 10 - 20 sample determination was checked). The concentration of the element in sample solution was noted and K and Na contents in salt samples was measured (AOAC, 1970).

### **Determination of Cu, Fe and Mn using Atomic Absorption Spectroscopy**

Atomic absorption spectrophotometer was set up according to the instructions in the manual. The digested sample solution was placed in a 100cm<sup>3</sup> volumetric flask and make up to 100cm<sup>3</sup>. Three concentrations of standard solution of a particular metal to be analyzed were selected; blank solution was aspirated and adjusted to zero. Each standard solution was aspirated into flame, calibration curve for absorbance versus concentration of each standard solution was prepared and the reading of the prepared samples solution was obtained directly from the instrument (AOAC, 1970).

**Test for Sulphate**

To the portion of each sample extract, acetic acid was added, and boiled to expel CO<sub>2</sub> gas. Barium chloride solution was added. Appearance of a white precipitate insoluble in nitric acid was taken as positive test for sulphate ions (AOAC, 2000).

**Test for Chloride**

A portion of each sample extract in a test tube was acidified with dilute nitric acid and boiled to expel CO<sub>2</sub> gas; Silver nitrate solution was added, appearance of white precipitates was taken as an indication for the presence of chloride ions (AOAC, 2000).

**Test for Iodide**

Equal portion of the sample extracts each in a test tubes was acidified with dilute nitric acid and boiled to expel CO<sub>2</sub> gas, silver nitrate solution was added, yellow precipitates was produced insoluble in dilute nitric acid and ammonium hydroxide solution indicates the presence of iodide ions (AOAC, 2000).

**Determination of iodine content**

Ten gram (10 g) of each sample was dissolved in approximately 100 cm<sup>3</sup> of distilled water. The pH was adjusted to 2.8 using 0.6% HCl. 30 mg of potassium iodide powder was added to convert all the iodate present to elemental iodine. The liberated iodine was titrated with freshly prepared 0.004 M sodium thiosulphate solution in the presence of starch as an indicator. Iodine content was calculated using standard conversion table for iodine determination (AOAC, 2000).

**Determination of Sulphate**

Fifty (50) cm<sup>3</sup> of each sample was taken into a measuring cylinder; 2 cm<sup>3</sup> each of 50 % HCl and barium chloride solution was added, mixed thoroughly and allowed to stand for 10 minutes. The precipitate formed for each sample was washed and filtered off thoroughly on ash less filter paper with distilled water, oven dried and weighed. The weight of SO<sub>4</sub><sup>2-</sup> was calculated from the weight of precipitates (AOAC, 2000).

**Determination of Chloride**

Fifty (50) cm<sup>3</sup> of each sample was measured, 1.0 cm<sup>3</sup> of potassium chromate indicator solution was added and titrated against 0.014 M standard silver nitrate titrate solution to a pinkish-yellow endpoint; also reagent blank was established by the titration method outlined above (AOAC, 2000).

**III Results**

The results of physicochemical parameters and elemental analysis of Balma, Kanwarbai-bai, Jan kanwa and Fararkanwa are presented in Tables 1-2.

**Table 1: Physical Parameters**

S/NO	Parameter	Balma	Kanwarbai-bai	Jan kanwa	Fararkanwa
1.	Solubility (g/100g)	8.36	9.79	3.52	6.82
2.	Density (g/cm <sup>3</sup> )	2.89	2.30	2.20	2.50
3.	pH	9.30	9.33	9.50	12.83
4.	Moisture content (%)	1.17	7.67	7.83	3.17
5.	Ash content (%)	97.50	78.33	93.83	99.33
6.	Degree of hydrosorption (g)	4.30	4.60	4.03	4.12
7.	Conductivity (ohm)	19.39	19.86	19.89	19.88

**Table 2: Amount of Mineral elements in natron and potash samples**

Element (mg/kg)	Balma	Kanwarbai-bai	Jan kanwa	Fararkanwa
Na	20750	21916.67	23416.67	96666.67
K	10833	1666.67	4083.33	70.83
Ca	1.10	1.02	1.03	0.37
Fe	19.95	17.51	29.95	8.75
Mn	0.12	0.12	0.17	0.70
Cu	ND	ND	ND	ND
PO <sub>4</sub>	3.54	4.33	4.07	3.92
CO <sub>3</sub>	4.03	31.37	30.70	105.3
HCO <sub>3</sub>	4.23	65.33	39.60	109.4
Cl <sup>-</sup>	1.44	0.54	0.34	0.83
SO <sub>4</sub>	97.37	66.23	59.67	56.24

Data are expressed as mean±SD (n=3); ND= not detected

**IV Discussion**

The solubility values for Balma and Kanwarbai-bai were 8.36 and 9.79 in 100g of water solubility. The values were higher than that of Fararkanwa and Jan kanwa with 6.82 and 3.52 g/100g respectively. Jan kanwahad the lowest solubility value probably due to the absence of particles with weak intermolecular bonds that can be easily broken by water molecule (Ferrar and Coleman, 2001). The density range from 2.20-2.89

gcm<sup>3</sup> for all the four samples with Balma and Farar-Kanwa having the highest density. Jan kanwa had the least value which might be attributable to the presence of least amount of heavy particles in the sample (Van, 1991). The results obtained indicated the pH of the samples to be basic 9.30 -12.83. The moisture content for Jan kanwa, Kanwarbai-bai and Fararkanwa (7.83, 7.67 and 3.52 %) was generally higher when compared to that of Balma (1.17 %) which might be linked to the high percentage of water content absorbing molecules present within the sample (Nielsin, 1998). The values for degree of hydrosorption ranges from 4.03-4.60 g for all the samples while that of conductivity was between the ranges of 19.39 – 19.89 g/cm<sup>3</sup>. This is an indication that all the samples can conduct electricity and have equal degree of conductance. The sodium content was high in all the samples > 20,000 mg/kg which was higher than the permissible limit (6065 mg/kg). The potassium content was > 1600 mg/kg in all the samples indicating the content to be higher than the permissible limit (100 mg/kg) except for Fararkanwa having 70.83 mg/kg. The amount of manganese detected varies in all the samples and falls within the range 0.12 – 0.70 mg/kg; hence the concentration is within the permissible limit (10 mg/kg). The allowable limit for iron as per WHO guidelines is 30.0 mg/kg and the concentration of Fe in all the samples falls within range 8.75 – 29.95 mg/kg. Copper was not detected in all the samples and manganese and iron were detected in moderate concentrations. The results indicated the presence of PO<sub>4</sub>, CO<sub>3</sub>, HCO<sub>3</sub>, Cl<sup>-</sup> and SO<sub>4</sub> in all the samples.

## V Conclusion

The potash and natron samples employed in this study were shown to be basic samples with acceptable degree of solubility and close to equal degree of conductance. The samples had excessive sodium content and can be a potential source of essential elements required for growth and development.

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