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ANALYSIS OF LOCAL SALTS USING X-RAY SPECTROMETRIC TECHNIQUES

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ABSTRACT

Local salts namely: Mangul, Kantu and Manda have been analysed using x-ray diffraction and x-ray fluorescence techniques. X-ray diffraction has shown that Mangul and Kantu consist of mainly sodium chloride while Manda consists of mainly calcium potassium silicate. The major elements determined using x-ray fluorescence are: Si, P, S, Cl, K, Ca, Ti and Fe, while the trace-elements included V, Co, Ni, Cu, Zn, Br, Rb, Sr, Y and Zr. The Mangul samples were found to contain higher concentrations of Br while Manda had higher Fe concentrations. Toxic elements such as As, Pb, Sb, and Hg are non detectable, which may suggest that the salts may be safe as common salt subsititudes.

Keywords: Mineral metal Salts, Carbonates, Chlorides, Sulphates, Silicates.

INTRODUCTION

Variety of local salts are found in the North Eastern part of Nigeria and neighbouring Chad and Niger republics. The salts are largely sodium carbonates, chlorides or sulphate. The sodium carbonate group consisting of mainly trona and locally referred to as "Kanwa" have been earlier studied (Dustan, 1906, Ekanem,1977, Raeburn and Jones,1934, Umar et al 1992,1993). However, the group consisting of mainly sodium chloride has received very little attention (Umar et al,1993). Among these salts are: Mangul, Kantu and Manda.. This group of salts have been used mainly as medicinal salts. Mangul is normally taken as a substitute to common salt by local patients advised to reduce salt intake. Kantu apart from also being used as a common salt substitute which is given to animals as salt supplement while Manda is given to patients that have lost some blood such as: women that have just delivered and victims of accidents like fall and beating. It is also given to oxen that have been overworked on the fields (Dustan, 1906, Raeburn and Jones, 1934, Ekanem,1977)

The interest of this study is to analyse these materials in detail so as to find out whether they are really safe to be used as common salt substitutes.

MATERIAL AND METHOD

The samples were obtained from Sabon Gari market, Zaria, Nigeria, but originated from the North Eastern part of Nigeria. The samples were ground into fine powder using an agate mortar and sieved (125μm). The powdered samples were used for the analysis. For x-ray diffraction a Philips(PW1390) x-ray diffractometer was used with the following characteristics: radiation Cu, Kα, Wavelength 1.5418A, tube voltage 40kV, tube current 30mA, exposure 37 minutes and take off angle 3^{o}.

In the case of x-ray fluorescence analysis the samples were excited using 25mCi, Fe-55 and Cd-109 annular sources. The counting set up is made of a Canberra Si(Li) detector 7300 with the resolution of 170eVat the 5.9keV line. The detector is connected to a Canberra model 2022 spectroscopy amplifier and interfaced with an IBM PS/2 computer with an ORTEC MCA card operated by ORTEC Meastro II acquisition software. ORTEC Model 659, 5-kV detector bias supply provides voltage to the detector.

The spectral analysis and quantitative analysis were performed using the International Atomic Energy Agency's QXAS software. The sample quantitative method based on: direct comparison of count rates and concentration and regression of count rate versus concentration were used.. AGV-1, G-2, BHVO-1 and DNC-1 were used as geological standards.

RESULTS AND DISCUSSION

The major constituents of Mangul as shown in Tables 1 are: Si, K, Ca, P, S and Br. The white variety has higher concentrations of K, Cl. and S, while the black one has higher concentration of Ca and Si. The white variety may therefore contain mainly: NaCl, KCl and

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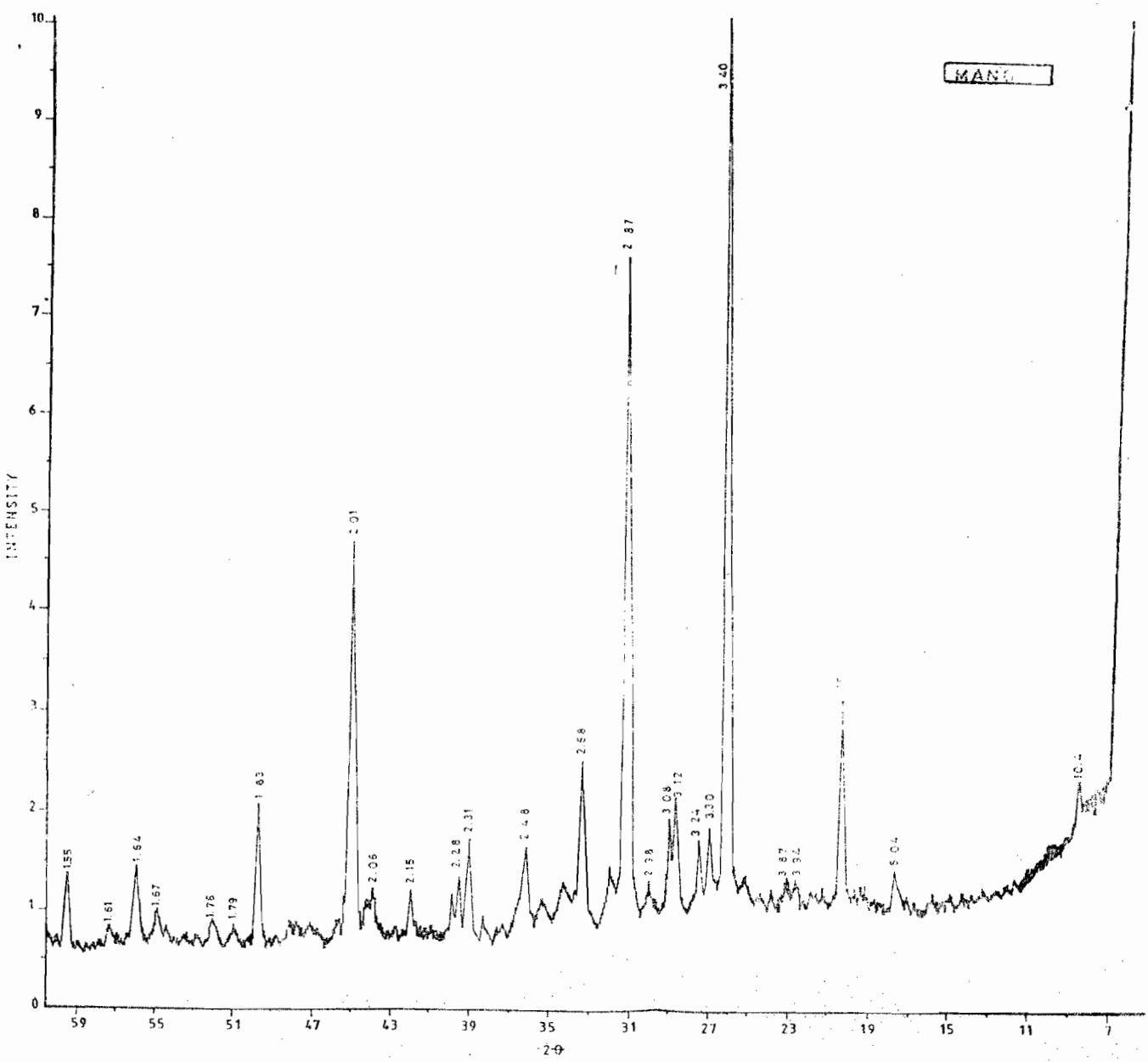

FIGURE 1. X-RAY DIFFRACTOGRAM OF MANGUL

Na_2SO_4. While the black samples may contain calcium silicate in addition to NaCl and KCl. The x-ray diffractogram of Mangul shown in figure 1, has major d-spacings 2..87 and 2.01 apart from those of silica. These d-spacing are those of NaCl suggesting that the major constituent of Mangul is NaCl. However, the fact that it has lower Na concentration than common salt might have been the reason for its use by local patients as a substitute to the common salt. The other interesting thing with this salt could be its high sulphur and bromine concentration that may have some medicinal functions.

The Kantu salt contained mainly: Cl and P as shown in Tables 1. The x-ray diffractogram of the salt shown in figure 2 also has the major d-spacings at 2.87 and 2.01 due to NaCl. Kantu like Mangul has also lower Na concentration than common salt and hence its use also a substitute to the common salt. Apart from Na and Cl Kantu has fairly high concentrations of P, and will therefore be very useful as salt supplement to animals.

The major elements in Manda are: Si, Ca, K, Fe and P as shown in Table 1. The salt could be said to be calcium potassium silicate with

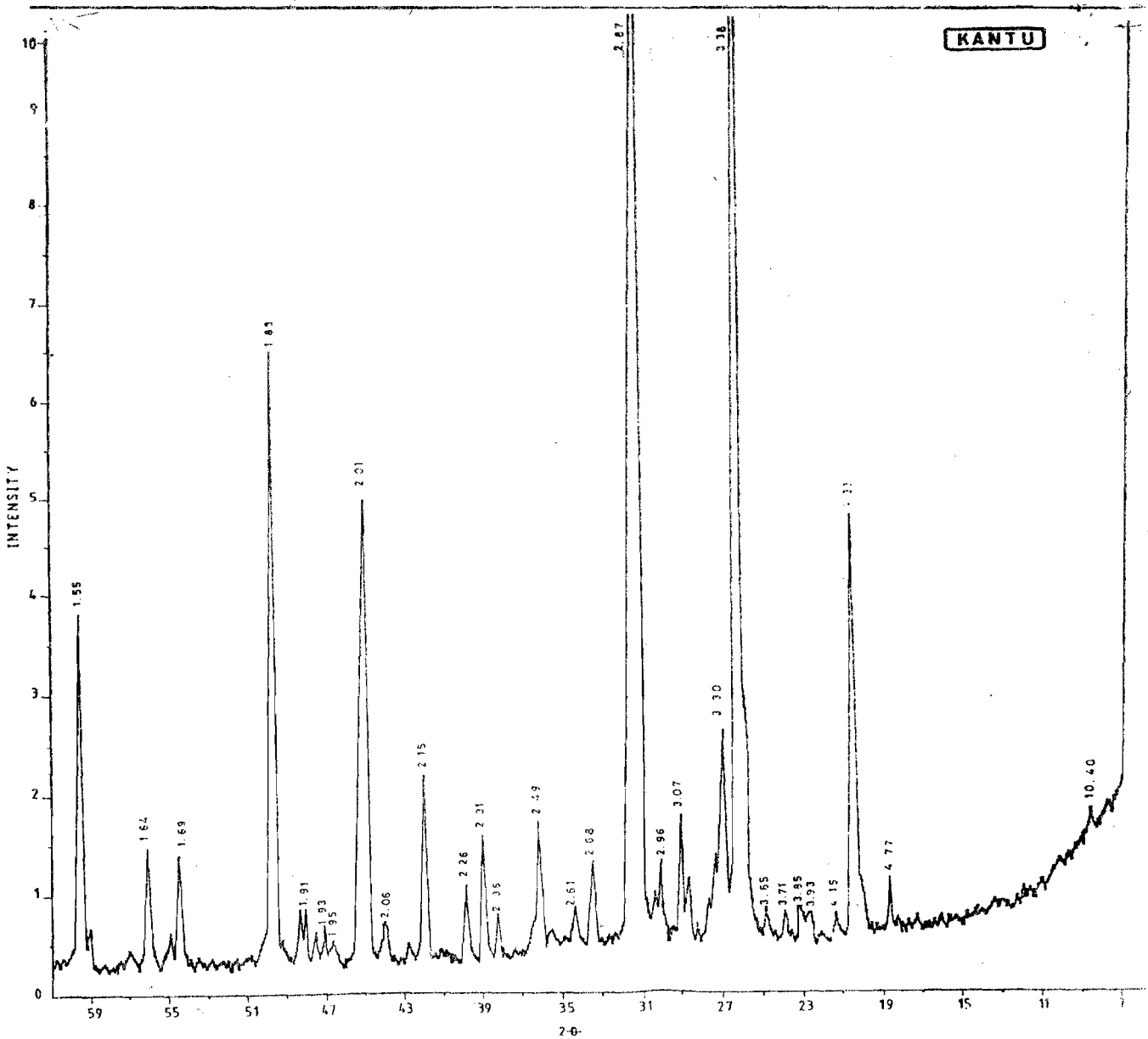

FIGURE 2. X-RAY DIFFRACTOGRAM OF KANTU.

Table 1:Elemental Concentrations in ppm of local Salts using X-ray Fluorescence

Element	Mangul Black	Mangul White	Kantu White	Kantu Red(Balma)	Manda
Si	109000±8000	26000±3000	44000±5000	40000±4000	187000±13000
P	3713±917	2846±713	5339±1327	4852±1198	3501±1093
S	4658±1266	10000±3000	2066±584	1754±498	1058±291
Cl	12000±2000	29000±5000	64000±10000	63000±10000	1681±263
K	32000±2000	38000±2000	1984±112	1906±103	17000±1000
Ca	29000±2000	3340±179	2553±139	2283±122	102000±5000
Sc	6.8±1.4	1.5±0.3	<1.3	1.8±0.5	16.4±3.7
Ti	620±33	91.6±5.2	62.7±5.8	149±10	16664±87
V	7.2±2.1	<0.8	<1.5	<1.6	12.9±3.9
Fe	6003±396	819±192	1168±208	1748±362	38000±2000
Co	<4.4	<5.7	<4.6	<6.8	8.0±3.3
Ni	<6.0	<6.1	<6.6	<8.4	<4.0
Cu	7.2±2.6	<6.9	<7.6	12.2±4.0	<4.3
Zn	<37.8	<42.9	<42.6	<58.3	30.3±8.4
Br	162.6±42.9	281±74.0	32.7±9.0	22.2±6.8	19.8±5.4
Rb	71.2±11.9	48.7±10.7	30.7±6.0	<29.1	33.2±4.0
Sr	239.9±14.1	46.4±4.9	27.1±5.7	29.1±6.0	539.4±28.8
Y	6.0	<5.4	<6.7	<8.9	<7.1
Zr	118.8±7.7	50.6±3.8	20.1±2.6	57.9±5.5	265±14.0

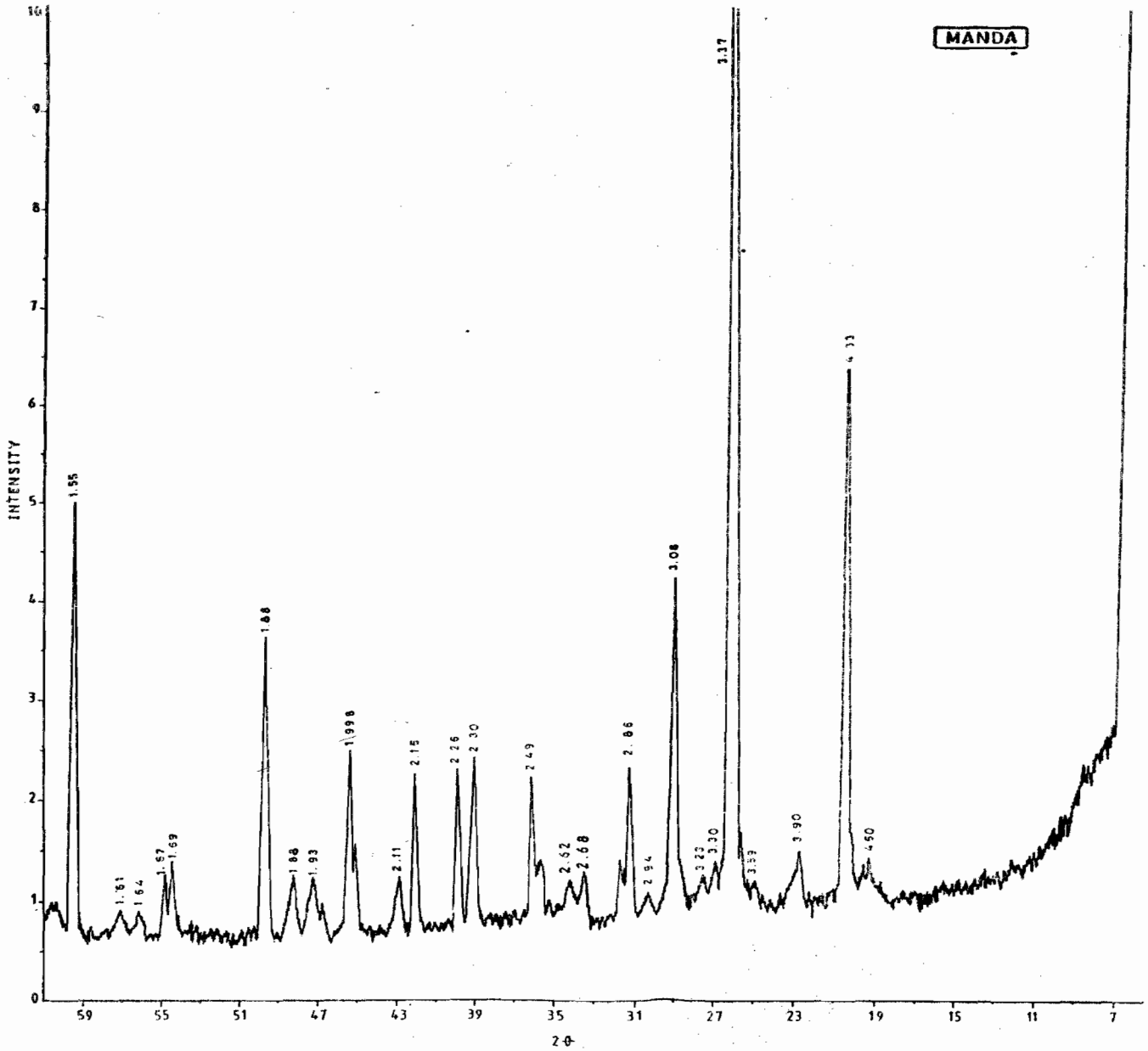

FIGURE 3. X-RAY DIFFRACTOGRAM OF MANDA

some traces of iron and phosphate. The x-ray diffractogram of the salt shown in figure 3 with major d-spacings at 2.87 and 3.07 tends to confirm that the salt is calcium potassium aluminum silicate sulphate. The salt contains much less Na concentration than Mangul and Kantu. The use of this salt by women that have just delivered and accident victims may be due to its high Fe content.

From the results there is no indication that any of the salts contains high concentration of the toxic elements such as: As, Pb, Ag, Cd, Sb and Hg. However, the high concentration of S and Br in Mangul is of immediate concern as they have not been shown to be essential elements. However, they might perform some medical functions that should require additional investigations. The Ti concentrations in Manda and the black Mangul are also at the high side. Therefore, the use of these salts for medicinal, purpose might still need some purification, to reduce the non-essential elements. When the results from the x-ray fluorescence analysis are compared with those earlier obtained using instrumental neutron activation analysis they tend to compare favourably(Umar and Rabiu, 1993). The variation in some cases like Ca in Manda and Br in mangul might be due to the level of impurities present in different samples. Even in the case of two elements the same trend was observed by using two different analytical methods.

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