

ANALYSIS OF *LANISTER VARISCUS* AND *EGERIA RADIATA* SHELLS AS POSSIBLE RAW MATERIALS FOR CERAMIC GLAZE PRODUCTION

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ABSTRACT

Lanister variscus and *Egeria radiata* are two species of shellfish (called *Nko nko* and *Nkop* in Efik) widely eaten in Cross River State and other coastal settlements of Nigeria. The shells are usually thrown away as refuse after the internal flesh has been eaten. Since sustainability has become an unavoidable trend in global natural resource exploitation, this article reports an investigation conducted to ascertain the suitability of *Lanister variscus* and *Egeria radiata* shells as raw material for ceramic glaze production. Analysis indicates that the shells are composed of 95.45% calcium oxide (CaO), 2.52% magnesium oxide (MgO) and trace amounts of other metal oxides. Since calcium oxide is a chief constituent of ceramic glaze, the conclusion is that *Lanister variscus* and *Egeria radiata* shells are suitable raw materials for the production of ceramic glazes.

KEYWORDS: *Lanister variscus*, *Egeria radiata*, Analysis, Raw material, Ceramic glaze

INTRODUCTION

As a coastal settlement, Cross River state is endowed with enormous quantities of seashells. Seashells are hard coated coverings of small, soft-bodied, sea animals found on the shores of coastal regions. They are widely eaten for their nutritious value (Oyekan0, 1984; Avril and Rosss, 1999). In Nigeria, these seashells are found mainly in the southern coastal areas (Oyekan, 1984; Chang, 1991; Ogogo, 2004). Two popular shellfish eaten in Cross River State are *Lanister variscus* (*Nko nko*) and *Egeria radiata* (*Nkop*). However, after the soft flesh is consumed, empty shells are either discarded by roadsides or thrown away as refuse, in spite of their ostensible economic value (Sidney and Young, 1981; Chang, 1991; Claude, 2002). Although seashells are used for industrial and medicinal purposes in the Western world, their use is limited (in Nigeria) to domestic consumption (Oyekan, 1984; Avril and Ross, 1999). It is very usual to find these discarded shells along the roads in Calabar. However, some empty shells have been shown to contain high amounts of calcium carbonate (CaCO₃), which can be converted to lime for industrial purposes (Bames, 1980; Bajah, 1986; Chapman, 1997; Malu and Bassey, 2003; Kohl, 2005). In the United States of America, for instance, lime ranks among the 50th industrial chemical products with about \$32.3 million annual output (Chang, 1991). As one of the oldest materials known to mankind, lime composes an estimated 3.4% of the earth's crust by mass and has been used as building material since the 1500 BC (Sidney and Young, 1981; Bajah, 1986; Kosmatka and Williams, 1988).

Considering the large volume of shells thrown away in Calabar alone, it might seem that a unique financial resource is untapped and wasted, despite the growing need to exploit non-oil alternatives to reduce the pressure on oil (Apeh, 2004; Onyibe, 2005). In view of the fact that sustainability has become the unavoidable trend in today's global natural resource exploitation, it is clear that over-dependence on oil and reckless disposal of seashells are likely to have cumulative and negative environmental impacts. It is therefore desirable to not only investigate other ways of generating revenue, but also to explore more sustainable and beneficial

ways of utilising *Nko nko* and *Nkop* seashells. Also, since the establishment of the Visual Arts and Technology Department in the Cross River University of Technology, Calabar, there has been a rise in the study and practice of ceramic arts within the state. This has resulted in an increased demand for ceramic glazes. The ceramic glazes currently used in Calabar are either wholly imported or the oxides for compounding them are imported from Europe. There is then a need to also explore ways of making ceramic glazes in Nigeria (from local raw materials) for use by Nigerian ceramists. This research sets out to analyse and explore *Nko nko* and *Nkop* shells as alternative raw materials for ceramic glaze production. The objective is to analyse and determine the chemical composition of *Lanister variscus* and *Egeria radiata* shells with the intention of finding out if they can be used as raw materials for compounding and producing ceramic glazes for use by Nigerian ceramists.

MATERIALS AND METHODS

Lanister variscus and *Egeria radiata* shells were randomly collected from the Great Kwa River estuary and its environs (Osuala, 1990). The sampling was carried out between the months of September and December to reflect the late dry season periods when the influence of tidal waves on the estuary is at low level (Asuquo *et al.*, 1999). The collected seashell samples were sorted-out according to their species, put into sample bags (calico bags) and labelled "A" and "B" to distinguish them from each other as shown in Table 1 and plates 1 and 2.

Table 1: Seashell samples obtained from the Great Kwa River estuary and its environs.

Sample Code	Biological /Common name	Local name
A	<i>Lanister variscus</i> (concave body curve)	<i>Nko nko</i>
B	<i>Egeria radiata</i> (common galatea clam)	<i>Nkop</i>

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Plate 1: *Lanister variscus*



Plate 2: *Egeria radiata*

Treatment and Analysis

The seashell samples (80g) were pre-treated by beneficiation (to concentrate materials to be analyzed) prior to analyses. The shells of the samples were used while their fleshy parts were discarded. To purify them, the samples were thoroughly washed with warm water, rinsed in distilled water, air-dried for one week and further dried in an oven at 110°C for six hours, according to pre-treatment recommendations of the Association of Official Analytical Chemists (Harries, 1975). After drying, the samples were each homogenized by crushing them into fine grains using a crusher (Megan Model BB200). The crushed particles were then sieved using a 120 mm mesh. From the pre-treated samples, 10g each of the pulverized particles labelled "A" and "B" were taken and carefully placed in a clean crucible and weighed, using a Mettler analytical balance. The weighed samples were then placed in an electric muffle furnace and heated for 1 hour at 950°C to determine the loss on ignition. The ignited samples were allowed to cool to room temperature in a dessicator and then carefully poured into clean-dried, properly sealed and labelled sample bottles.

Determination of metal oxides concentration in the samples

For each of the representative pre-treated samples, 0.2g was carefully weighed and placed in a clean, dried crucible. 10cm³ of concentrated hydrochloric acid (HCl) was then added to release the metal oxide contents into the solution (Rantalla and Loring, 1992). The acid used was of analytical grade. The mixture was placed on a hot plate in a fume cupboard and heated slowly to about 50°-60°C for 2 hours. 2cm³ of concentrated HCl acid was added once more

and the heating continued until a clear digest solution was obtained.

The clear digest solution was cooled to room temperature, carefully filtered into a plastic volumetric flask and made up to 100cm³ with de-ionised water. All glassware and specimen bottles used were initially thoroughly washed with HNO₃ and rinsed with de-ionised water (Sinex *et al.*, 1980). The solution was allowed to stay for three days before analysis using atomic absorption spectrophotometer (AAS, Unicam Model 969) equipped with absorption and flame emission modes. The absorption mode was used to determine Fe₂O₃, CaO, MgO, MnO, TiO₂, NiO, CuO and PbO, while the emission mode was used for the determination of K₂O and Na₂O. Working-standard solutions of the elements were prepared for each metal. The standard solutions and aliquots of the diluted clear digest were used for the determination. Also, standard curves were used to establish the relationship between absorption and concentration (Underwood and Day, 1988). To overcome matrix interferences, all reagents used to treat the samples were added to the working standard in the same proportion (Bilos *et al.*, 1998), while the detection limit of the AAS was <0.001mg/l.

RESULTS AND DISCUSSION

Figures 1 & 2 show the mean concentrations of the various metal oxides present in the seashell samples. The result reveals that calcium oxide (CaO) is the predominant metal oxide, with 95.54 ± 0.05 percent in samples "A" and "B". Magnesium oxide is the next dominant oxide with 2.52 ± 0.02 percent. The percentage mean concentrations of the other metal oxides were found to be below one percent and, therefore, are of no commercial significance in ceramic glaze production.

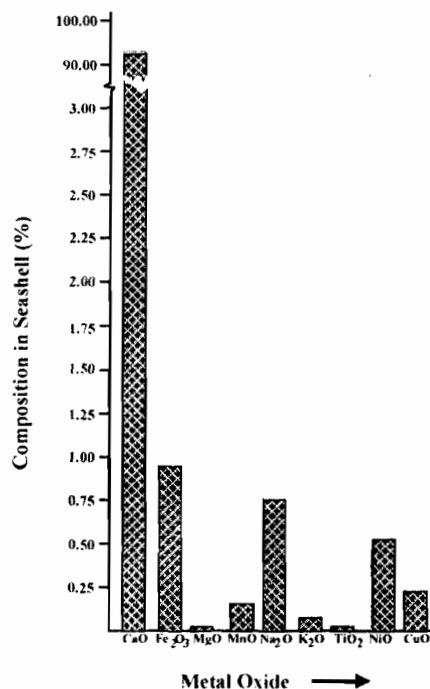


Fig. 1: Bar chart showing mean concentrations of various metal oxides in seashell Sample A

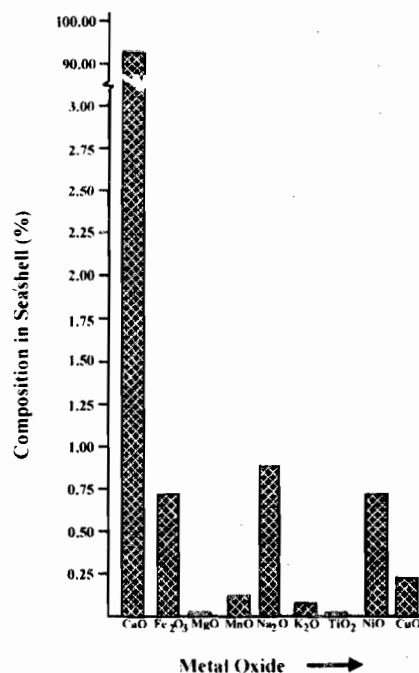


Fig. 2: Bar chart showing mean concentrations of various metal oxides in seashell sample B.

A = *Lanister variscus*, B = *Egeria radiata*

In conclusion, this study reveals that lime and magnesium exist in commercial quantities in *Lanister variscus* and *Egeria radiata* shells. Most ores or solid minerals do not contain such high concentrations before exploitation is embarked upon (Sell, 1981). Furthermore, analysis indicates that, as raw material, *Lanister variscus* and *Egeria radiata* shells generally fulfil the three basic requirements of glass/glazemaking substances (Shand, 1958; Charles, 1974; Manson, 1978):

From the foregoing discussion, it is conclusive that *Lanister variscus* and *Egeria radiata* shells thrown away as waste in Calabar, contain enough calcium oxide to make them exploitable as raw material in the compounding and production of ceramic glaze batches. Since the shells meet the three basic requirements of glass/glaze materials, it is clear that *Lanister variscus* and *Egeria radiata* shells are viable sources of local raw material, from which ceramic artists in Nigeria can obtain oxides for glaze-making. The proper harnessing of the shells can provide employment opportunities for the unemployed, serve as a source of non-oil foreign exchange, and accelerate Nigeria's natural resource and technological development.

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