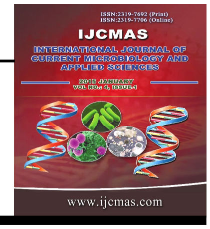

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Original Research Article

Microorganisms associated with clay (NZU) consumption (Geophagy) in some parts of Imo State, Nigeria

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A B S T R A C T

Crave for earth/clay eating (Geophagy) mostly found among pregnant women and children have been in existence for thousands of years since prehistoric times. Human beings eat clay for various reasons, yet the very many possible health benefits/defects of its consumption remains under studied and very much debated. A study on the microorganisms associated with clay consumption was carried out between June and September 2013 in Eastern part of Nigeria. A total of 500 pieces of salted baked clay were randomly bought from five different markets in Imo state and were examined using standard methods of bacteriological and parasitological examination of samples. Result obtained showed that the clays were contaminated externally by both bacteria and parasites (STHs) while the internal parts were not contaminated by either of the groups of organisms. Bacteria isolates encountered were predominately, *Bacillus subtilis* 37.7%, Staphylococcus *aureus* 30.4%, *Escherichia coli* 20.3% and *Klebsiellae* 12.0%. Helminthes isolated were *Ascaris lumbricodies* 82.8% and Hookworm17.2%, with overall prevalence of 12.8%. Total bacteria count ranged from 2.1x10cfu/ml to 6.9×10^2 cfu/ml while total coli form count ranged from 1.0×10^2 cfu/ml to 3.1×10^2 cfu/ml. Evidently, addition of salt and super heat treatment applied during ready to eat clay processing destroyed microorganisms present in the clay. However, poor handling and exposure to environmental organisms may have led to the contaminations observed since organisms were found only on the outer part of the clay. Therefore, proper hygiene should be maintained during packaging and further handling of the clay to reduce microbial contamination.

Keywords

Geophagy, Clay, Microorganisms, Bacteriological and Parasitological

Introduction

Geophagy is a deliberate or abnormal practice of eating soil or its substance (clay or chalk) for reasons or benefits yet not fully unfolded. This practice mostly found among the rural dwellers or pre-industrial societies is somehow related to pica, a classified eating disorder characterized by abnormal craving for non food items (Callahan *et al.*, 2003). It could also be considered a deviant eating disorder a sequel to poverty and famine which could also be observed in the absence of both, (Bisi *et al* .,2010).Earth eating generally emanates and spreads as doubtless watch their mothers or close relations eat earth, (Cooper, 2000; Mcloughlin,1987).

In most countries of the world ,especially in Africa, geophagy is a phenomenon that has become a day to day habit among members of all races, sexes, ages and social classes particularly among pregnant women and children,(Wiley Andrea,2003). However, in some countries, places and times clay eating is culturally a sanctioned practice which is stigmatized and studied as pathology, but the attitude is seen in most developing nations as practice very much less stigmatized, and as an adaptive behavior. It is believed to supplements the diets with essential nutrients or to treats disorders such as diarrhea, swollen legs and absorbs dangerous toxins. Most importantly, it is believed to ensure fetal development and giving birth to beautiful babies, hence, earth to eat is widely available, (Cooper, 2000, Rosa *et al.*, 2001, Miazzo *et al.*, 2005 and Dominy *et al.,* 2004).

Several soil types are preferred and consumed by geophagic individuals, however, what really matters is the treatment given to the soil types and the form they are consumed. For instance, kaolin which is mostly consumed is used in the production of anti diarrhea remedy and formed basis for other digestive and antibiotics production usage,(Williams *et al.*,2008 ;Klein, *et al.*,2007;Boucher and Corey,2008; Rubery,2002; Lamp *et al*,2003 ; Smith *et al*,2000). Aside individual consumption of earth, there are some wider benefits accruing from the practice of geophagy, since Vermeer and Ferrell (1985) revealed that a single village in Nigeria produces over 500 tons of soil yearly for consumption across West Africa, hence scavenging for geophagic material as source of income by many rural dwellers still persists However, various risk are associated with soil eating because its harboring of pathogenic microorganisms is no mere speculation but a fact proven. These pathogenic organisms include *Sporotrichum schenckii, Histiplasma capsulatum, Cryptococcus neoformans Actinomycetes Clostridium tetanum* and *occasionally Escherichia coli* and *Klebsiellae* from fecaelly contaminated soil, (De Beurman and Gougerot, 1908; Aghamirian and Ghiasian, 2009). Approximately 3.5 billion infections with parasitic geohelminths, (*Ascaris*, hookworm and *Trichuris)* exist and their eggs can be consumed with ingestion of soil (Nwoke,2009 ; Abrahams, 2002). Several studies have linked geohelminths infection with soil consumption and iron deficiency was observed among pregnant and HIV infected women who indulge in geophagia (kawai.*et al.*,2009). In his work, Saathoff *et al*.(2002) observed that social pattern of soil eating was less frequent among young boys than in girls where no age trend was apparent.

Irrespective of the benefits of clay consumption, several microorganisms have been found to inhabit the soil playing either beneficial or harmful role due to conflicting opinions about geophagia. While some beneficial roles have been described for earth consumption practice, others still frown at its detrimental and aberrant role. Geophagy, therefore, is a practice worth attention. This study, therefore, aimed to assess the microbial quality of salted clay/unsalted consumed in parts of Imo state.

Materials and Methods

The Eastern part of Nigeria is endowed with soil mostly preferred for geophagic materials which are persistently tapped and consumed in almost all African countries and even beyond, (Vermeer and Ferrell, 1985).

Sample collection

A total of 500 pieces of baked ready to eat clay samples were randomly obtained from five markets in Imoe State using sterile containers. These markets include; Ekeukwu Owerri, Ekeziachi in Orlu, Eke Okigwe, Amaraku market in Mbano and Nkwogwo market in Mbaise.

Sample analysis

Enumeration of microbes associated with ready to eat clay samples was carried out using pour plate method of Ogbulie and Ojiako (2000). Ten fold serial dilution of each baked clay was done using 0.85% normal saline as diluents and aliquot of appropriate dilution were inoculated on duplicate plates of sterile plate count agar, MacConkey agar and Sabourad dextrose agar. The plates were incubated at 37^0C for period of 24 to 48 hours for bacteria growth and a period of 96 to 120 hours (5 days) for fungi.

Representatives of each colony were counted, purified by sub culturing using plate streaking method. The isolates were identified and characterized using morphological and biochemical appearances and reactions according to Bailey and Scott's (1994). Normal saline and iodine wet mounts of Ukaga *et al*. (2007) were adopted for the examination and identification of parasites in and outside of the clay

Result and Discussion

The result of the examination of the ready to eat clay showed that the inner part of the clay does not contain any organism since there were no growths on the media used while the external parts showed the presents of microorganisms. The predominant bacterial species include; *Bacillus subtilis* 37.7%, *Staphylococcus aureus*, 30.4%, *Escherichia coli* 20.3% and *Klebsiellea*, 12.0 % (Table.2). Total bacterial count ranged from 2.1 x 10^2 cfu/ml to 6.9 x 10^2 cfu/ml and total coliform count ranged from $1.0x10^2$cfu/ml to $3.1x10^2$cfu/ (table1). The predominant helminthes isolated were *Ascaris lumbricoides*, 82.8%and hookworm, 17.19% (table3).There were no record of fungi growth on the sabourad agar plates after incubation.

Geophagia to some extent is a naturally, traditionally religiously accepted adaptive behavior in most parts of Africa and other countries of the world mostly seen among pregnant women and children (BISI ,2010). Indeed there are many preferred soil as far as soil eating is concerned and as such several soil types (Red, white, yellow brown etc) are consumed by geophagic individuals for several reasons, either as adaptive trait, or as medicine etc. Evidently soil is a habitat for several microorganisms some of which are beneficial while others are harmful. However, the amount of microorganism consumed with clay depends on the soil type, site of collection, processing technique before consumption and personal hygiene of the handlers.

In those areas where soil eating is not stigmatized, the soil type usually used for production or baking clay(Nzu) are the white (kaolin)and the red soil .These preferred soil are usually collected far deep down the soil surface, hence the choice of soil and quality of treatment given may have contributed to the result obtained in this study ,whereby the inner part of the baked clay was found to contain no microbes On the other hand, the external/outer parts are contaminated with bacteria such as *Bacillu subtilis 37.7% Klebsiellae (*12.0%) *Escherichia coil* 20.3% and *Staph aureus* 30.4% table2. Also encountered are two helminthes, *A lumbricoides* 82.8% and Hookworm 17.3% with overall prevalence of12.8%, table 3. The level of contamination observed on the outer part of the clay samples which ranged from 2.1 to $6.9x10^2$ cfu/ml for total bacteria count, 1.0 to 3.1x10cfu/ml observed in coliform count and the helminthes prevalence showed that *contamination* could be as a result of unhygienic handling of the product after processing. This assumption could be true since all the isolates are of fecal and environmental origin and may have been introduced by humans handling the product up to consumption level (Abraham, 2000).

The non isolation of any microbe from the inner part of the clay could be as a result of proper processing of clay- rich soil usually collected far below the soil surface and by super heat treatment. This super heat treatment naturally renders the clay free from microbes and safe for consumption by the destruction of the inhabiting microorganisms(Bisi *et al.*,2010) However, some spore formers may survive certain exposure to heat as was the case of Pederson *et al.*(2000) were spore former *Desuolomaculum nigerican* and *Bacillus Subtilis* survived exposure to 50c to 70c in bentonite clay, but the addition of salt before heat treatment may have aided in the destruction of the organisms and protects them from further contamination .The isolation of A *lumbricoides* and Hookworm is line with works of Abraham (2000), and Carpenter(2008) who also isolated these geohelminths. It also agreed with Kawai *et al*. (2009) who suggested that geohelminths infections are related to geophagia practices. The highest prevalence of Ascaris, 82.8% against 17.2% of Hookworm could be as a result of high survival strategies conferred on the Ascaris by its possession of chitinous egg shell, which may have protected it from environmental destructions.

This observation also showed that those who eat clay could be more prone to worm infestation than those who do not eat earth due to poor handling and exposure to the environment by the dealers.

In conclusion, since geophagia has multivariate factors ranging from cultural to religious and even to some disorders (Pica) ,it is therefore, paramount that every ready to eat clay (NZU) for any of the above reasons should be properly processed and hygienically handled to avoid contaminations.

Table.1 Total bacteria and Coliform counts.

Sample Source	Total bacterial, count, cfu/ml	Total coliform count cfu/ml
MBANO	2.1 to $3.5x10^2$	1.0 to $1.7x10^2$
MBAISE	3.4 to $4.5x10^2$	1.3 to $2.2x10^2$
OKIGWE	3.7 to $6.1x10^2$	1.7 to $3.0x10^2$
ORLU	3.0 to $5.6x10^2$	2.0 to $3.1x10^2$
OWERRI	2.7 to $6.9x10^2$	1.2 to $2.9x10^2$

Table.2 Biochemical characteristics of the isolated organisms

Grams Reaction	Endospore	Catalase.	Citrate utilization	Motility test.	Oxidase test	Coagulase test	Indole test.	Methyl red test	Voges-prokauer	H_2S products	Urea hydrolysis	Oxidation/ fermentation	Sugar fermentation Glucose	Sucrose	Lactose	Maltose	Mannitol	Innositol	Xylose	Organisms
Gram –ve small rods		+	-	+	-	ND	+	+	-	-	-	F	A/G	A	A	A	A	-	-	*E. coli*
Gram –ve small rods		+	+	-	-	ND	-	-	+	-	+	F	A/G	A	A	A	A	A	A	*Klebsiellae*
Gram +ve in clusters		+	-	-	-	+	-	+	-	-	+	F	A	A	A	A	A	-		*Staph aureus*
Gram +ve rods in chains		+	+	+	+	ND	-	-	+	-	+	O	A	A	A	A	A	A	A	Bacillus *subtilis*

Key -ve=Negative F= Fermentative; +ve=positive O= Oxidative; ND=Not done; A=Acid; A/G=Acid and Gas

Table.3 Overall prevalence of geohelminths encountered

Sample Source	No.Examined	No.infected(%)	Ascaris(%)	Hookworm(%)
Mbano	100	12(12)	9(75)	3(25)
Mbaise	100	15(15)	14 (93.3)	1(6.7)
Okigwe	100	13(13)	13 (100)	0(0.0)
Orlu	100	13(13)	9 (69)	4(30.8
Owerri	100	11(11)	8 (72.7)	3(27.3)
TOTAL	500	64(12.8)	53 (82.80)	11(17.2)

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