

Pathogenic Organisms Associated with Commonly Consumed Kaolin in Southern Nigeria

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Abstract: Pathogenic organisms associated with commonly consumed kaolin were investigated with the intention of determining the degree of bacterial and fungal contamination of the samples. Three different kaolin samples namely; raw kaolin, sundried kaolin and baked kaolin obtained from different parts of Southern Nigeria were employed in the experiment. Total bacterial and fungal count was determined using plate count techniques. Results obtained from the study revealed mean bacterial count of 6.23×10^8 cfu/g, 10.5×10^8 cfu/g and 7.0×10^8 cfu/g for raw, sundried and baked kaolin, respectively. The total fungal count was 3.1×10^2 cfu/g, 2.4×10^2 cfu/g and 1.5×10^2 cfu/g for raw, sundried and baked kaolin, respectively. The commonly isolated organisms were *Staphylococcus* sp, *Bacillus* sp, *Proteus* sp, *Pseudomonas*, *Micrococcus*, *Aspergillus* sp, *Penicillium* sp, *Fusarium* sp, *Mucor* sp and yeast.

[Okereke, Fidelia and Okereke, Victor C. **Pathogenic Organisms Associated with Commonly Consumed Kaolin in Southern Nigeria**. *N Y Sci J* 2016;9(4):58-61]. ISSN 1554-0200 (print); ISSN 2375-723X (online). <http://www.sciencepub.net/newyork>. 9. doi: [10.7537/marsnys09041609](https://doi.org/10.7537/marsnys09041609).

Key words: Geophagia, Kaolin, Bacterial, Fungal, Colonies, Pathogenic.

Introduction

Soil or clay serves as tank of chemical and biological agents (Bisi-Johnson *et al.*, 2010). These chemical agents include; heavy metals, radioactive gases and organic chemicals. The soil also is the habitat of numerous microorganisms and other higher living organisms and they include beneficial microorganisms such as *Rhizobium* spp (nitrogen fixing microorganism) and other pathogens and parasitic worms. Soil, its usage, consumption, impact on health is of grave importance. Kaolin or china clay is commonly ingested clay, rich in the mineral kaolinite, a common hydrous aluminum silicate mineral found in sediments, soils hydrothermal deposits and sedimentary rocks (Beliotto, 1995). Kaolin consumption is a form of pica which is the desire to ingest non-food substances such as rock powder, chalk, dirt, and other materials by some humans. This habit of deliberately eating earthy substances is referred to as geophagia (Chukwu *et al.*, 2005) and is considered to be a deviant eating disorder, a sequel to poverty and famine but could also be observed in the absence of hunger and in both scenarios may be associated with high degree of mortality and morbidity (Bisi-Johnson *et al.*, 2010). It has also been reported to be common among pregnant women, lactating women, school children and people with psychiatric disorders. It is a poorly understood behaviour and cuts across gender socio economics status as well as urban and rural landscape but its practice in humans is variously regarded as a global health issue (Simon, 1998). The underlying cause for the ingestion of non-food substances such as kaolin is not known, however, several theories have been

advanced to explain reasons for it including minerals nutrients supplementation, adsorption of plant secondary metabolites such as tannins and alkaloids (Nathaniel *et al.*, 2004). Wilson (2003) reported an advanced hypothesis to explain geophagia behavior which includes detoxification of noxious or unpalatable compounds in the diet, alleviation of excess acidity in the digestive tract. Other reasons such as craving, the fact that it smells good, tastes good have been related to this phenomenon. The taste and flavour of moistened kaolin seasoned with salt before baking could be very exciting and appears to be the most important and significant factor influencing geophagia (Chukwu *et al.*, 2005).

Despite the widespread geophagia, it remains a little known phenomenon. As much as these vital issues are concerned, widespread reviews of the soil in relation to health, particularly those which concern deliberate or purposeful eating of soil and the microbiology involved are scarce. It has been necessary to investigate the safety of eating kaolin. Kaolin mined and processed for consumption are not usually treated and processed with care to ensure wholesomeness and safety of the product since it will be ingested into the body. Kaolin is prone to contamination by pathogenic mycobacterium from surface water, dust, soil and other constituent of the environment during extraction, processing and storage (Wilson, 2003). Kaolin processed for consumption is usually done by rural women who do not take into cognizance the wholesomeness of the product during preparation. The habit of eating kaolin-15 common in most areas despite the fact that most consumers know little or nothing in terms of nutritional values and

microbial load of the product. In south eastern Nigeria, geophagia is a phenomenon that has become a common habit mostly among females, yet the microbiology studies and health implication of this practice have not been well researched. The aim of this investigation was to determine the pathogenic organisms associated with commonly consumed kaolin in some areas of Southern of Nigeria.

Materials and methods

Source of sample

The raw kaolin samples were obtained from kaolin deposit at Ozanogogo, Delta State, Nigeria. The sun dried and baked samples were purchased from Abakpa market in Abakaliki, Ebonyi State, Nigeria. Preparation of sample involved the use of a wooden roller to crush the kaolin which was then sieved through a 1mm test sieve to obtain powdered samples and this was used for the analysis.

Microbial analysis

Microbial analysis of the kaolin samples involves determination of the load and flora with respect to bacteria and fungi. The types of microbes present in the kaolin samples were determined by isolation, characterization and subsequent identification of the isolates.

Determination of total bacterial counts

The pour plate technique method described by Fawole and Oso (1988) was used. One gram of the powdered kaolin samples was diluted serially in the ten-fold to ensure that the number of colonies per plate would lie between 30-300 colonies (Collins and Lyne, 1976). In this procedure, 1 ml of the first diluents was aseptically pipetted and transferred into the next 9.0 ml diluents. Subsequent dilutions were made by pipetting 1 ml of the 10^{-1} dilution into fresh 9.0 ml diluents and continuing in this manner. 1 ml aliquots of the 10^{-4} dilution was pipetted into sterile Petri dishes and about 15-20 ml of sterilized nutrient agar that has been cooled to 45°C was poured into the plates, swirled gently and allowed to set. After solidification the plates were incubated at 37°C in inverted position for 24 to 48 hours. The bacteria colonies that developed on the plates were enumerated using an electron colony counter and reported as colony forming units per gram (cfu/g).

Total count per gram = Reciprocal of dilution x colonies counted.

The bacterial isolates were characterized and identified based on their responses to the following tests: gram stain, catalase test and oxidase, motility, coagulase and reference were made to identification scheme for bacteria.

Determination of total fungal counts

Fungal counts per gram of kaolin samples were carried out using the plate count technique. A tenfold serial dilution was carried out and milliliter aliquots of the 10^{-4} sample diluents was pipetted into sterile Petri dishes and about 15-20 ml of sterilized potato dextrose agar that has been cooled to 45°C was poured into the plates, swirled gently and allowed to set. After solidification, the plates were incubated at room temperature in inverted position for two to five days. The fungal colonies that developed were enumerated and multiplied by the reciprocal of the dilution and reported as colony forming units per gram. The fungal isolates were examined microscopically and were characterized on the basis of their colony pigmentation and morphological features. The observed structural features were compared to those available in identification scheme for fungi.

Results and Discussion

The result of the microbial analysis of the-kaolin samples as presented in Table 1 shows that the total bacterial counts were higher than the mycological counts. The average total bacterial counts of the raw kaolin, sun dried kaolin and baked kaolin were 6.33×10^8 cfu/g, 10.67×10^8 cfu/g, 8.0×10^8 cfu/g respectively and the mycological counts, 3.3×10^8 cfu/g, 2.6×10^7 cfu/g and 1.6×10^7 cfu/g respectively. The morphological and biochemical characteristics of the bacterial isolates confirmed the presence of the organisms presented on Table 1. The result of the microbiological analysis shows that the kaolin samples were contaminated with micro organisms which are of public health significance. *Staphylococcus* spp cause staphylococcal food poisoning when its toxin is consumed; the illness is characterized by nausea, a diarrhea and stomach cramp within two to four hours after consumption (Ihekoronye and Ngoddy, 1985). In severe cases as much as 6.8 to 8.2 kilogram of body weight may be lost due to loss of body fluid through the intestine (Okaka and Ene, 2005). If the present of *Bacillus cereus* is greater than 10^6 organisms per gram in a food is an indication of active growth and proliferation of the organism and constitutes potential health hazard since a number of its species have been associated with food borne illness (Cowan and Talaro, 2006). The illness is characterized by abdominal pain and profuse watery diarrhea appearing 8 -16 hours consumption of infested food substance (Adams and Moses, 1995). The genus *proteus* has been reported as an opportunist pathogen if consumed in high concentrations. It frequently causes urinary tract infections (Frazier *et al*, 1988). *Pseudomonas* species have also been reported as opportunist pathogen of human causing infection involving urinary tract, soft

tissues, bones and joints and gastrointestinal infections (Cowan and Talaro, 2006). Pathogenic level of contamination by different organisms ranges from plate counts of zero to 10^8 microorganisms per gram for standard plate counts depending on the product (Cowan and Talaro, 2006). The fungi isolates in the kaolin samples were far less than the bacteria isolates and as such the fungal isolates were not present in concentration to result in mycotoxicosis.

Table 1: Average values of total microbial counts in kaolin samples

Sample	Bacterial count (10^8 cfu/g)	Fungal count (10^2 cfu/g)
Raw kaolin	6.23	3.1
Sundried kaolin	10.47	2.4
Baked kaolin	7.0	1.5

TABLE 2: Pathogenic organisms isolated from the kaolin samples

Organism	Raw Kaolin	Sundried Kaolin	Baked Kaolin
<i>Staphylococcus</i> sp	+	+	+
<i>Bacillus</i> sp	+	+	+
<i>Proteus</i> sp	+	+	+
<i>Pseudomonas</i> sp	+	+	+
<i>Micrococcus</i> sp	+	+	+
<i>Aspergillus</i> sp	+	+	+
<i>Penicillium</i> sp	+	+	+
<i>Fusarium</i> sp	+	+	+
<i>Mucor</i> sp	+	+	-
Yeast	+	+	+

Key = + present; - absent

Conclusion and Recommendation

The kaolin samples analyzed during this work contained a number of pathogenic microorganisms and these were mainly bacteria which were at a pathogenic level. This implies that they are not wholesome. Contamination of kaolin intended for consumption can be reduced by;

- i. Using potable water for processing instead of surface water such as well and streams.
- ii. Observing personal hygiene during processing
- iii. Packaging after processing to avoid contamination from the environment and handling.

Considering the pathogenic effects of these organisms, it is advisable to eat kaolin with caution. Since kaolin consumption has been found to have some benefits, the problems associated with its consumption needs to be looked into. There is therefore need for research approach involving nutritionists and pathologist to study the health implications arising from the consumption of kaolin, as regular consumption could result in health problems.

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4/19/2016