Physicochemical properties of two clay types (Termite mound clay and Potter wasp nests clay) that use in traditional medicine: A review

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Abstract

This review article contributes to clarify physical and chemical properties of termite mound clay (*Humbas meti*) and potter wasp nest clay (*Kumbal meti*) which are traditionally used medicaments in Sri Lanka. Clay types enriched with cations are widely used as major mineral ingredients in traditional pharmaceutical science of *Rasashastra* (alchemy), *Samhita grantha* and Ayurveda pharmacopeia. Pharmaceutical products containing these two clay types have been used for different kind of diseases in different types of prescriptions; specially in Charaka Samhita for the disease named *Urusthambha* and also hydrocele (*Mutraja vruddhi*) and various edemas (*Shotha*). The main objective of this literature review was to discuss about physical and chemical properties of these two soil types and special objective was elucidate whether there is a linking between these chemical properties and curing ability. For the data collection of this study the detailed literature review was done on the chemistry and scientific basis of termite mound clay, Potter wasp nest clay and pharmaceutical applications was carried out using published Ayurveda text books and research articles, available from Science Direct. Research articles showed that termite mounds are frequently enriched with soluble salts such as ammonium nitrate, exchangeable basic cations such as Ca^{2+}, Mg^{2+} and K^{+} and $CaCO_3$ compared to the adjacent topsoil. Spectroscopic data revealed the presence of SiO_2, and Al_2O_3 in appreciable quantities, while Fe_2O_3, CaO and MgO were in minor quantities in potter wasp nest clay. Infrared spectral analysis showed that nest clay samples are composite of quartz, feldspar and kaolinite. It is hard to find local research articles about physicochemical properties of these medicinally important clay types.

Keywords: Physicochemical properties, Potter wasp nest clay, Spectrophotometry, Termite mound clay

Introduction

Ethnopharmacological studies usually compacts with studies of various plant species and standardization and preparation of medicinal herbs. Additionally, some studies provide list of animals and their products that are useful in traditional medicine [1, 2]. Some articles have highlighted the medicinal use of animal products from the perception of historical literature, signifying the importance of these reports to traditional medicine [3, 4]. Few Literature have been recorded that the medicinal use of insects and derived products is very common in ancient practices[5, 6]. For an example honey and propolis, which products are derived from *Apis mellifera* are commonly used curative and preventive medicine. Nowadays scientific studies have confirmed its' antiseptic, anticancer and anti-HIV (Human immunodeficiency virus infection) effects [7, 8].

The use of medicinal clay in traditional medicine also goes back to ancient times. Indigenous peoples around the world are still using several types of clay that are products of some insects to cure diseases. Costa-Neto (2002) reported that bathing with the smoke from a burning nest of vespid wasp (*Protopolybia exigua*) prevents the "evil eye". The role of insect made clays in human health has experienced a revival in interest due to advances in modern instrumentation. According to literature termite mounds contain a wide range of minerals that are helpful for pregnant women, with high trace amounts of both iron and calcium. Aboriginal Pregnant women take termite mound soil 2 or 3 times per day during their pregnancies [9].

In Ayurveda medicine, termite mound clay and potter wasp nest clay have been used to cure hydrocele (*Mutraja vruddhi*), edema (*Shotha*) and rheumatoid arthritis (*Amavata*) (Ayurveda Aushada Sangrahaya) as well as for *Urusthambha* (spasticity of thigh muscles).

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The general objective of this study is to review the use of these two soil types in medicinal purposes and specific objective of this review is to elucidate whether there is a link between these chemical properties and curing ability.

Uses of potter wasp nest clay (*Kumbal meti*) and Termite mound clay (*Humbas meti*) in Ayurvedic Medicine

Ayurveda prescriptions (*Vattoru*) use termite mound clay and potter wasp nest clay to cure edema (*Shotha*) and hydrocele (*Mutraja vruddhi*). According to Ayurveda Pharmacopeia (Ayurveda Aushada Sangrahaya), claimed earth from a fireplace (*lipa mada pasin* in Sinhala) and potter wasp nest clay (*Kumbal meti*), grind with ash plantain juice and mix with Honey and then apply for hydrocele (*Muta vruddhi*). *Anethum graveolens*, Termite mound clay (*Humbas meti*), paddy expands and puffs up when heated mixed and grind with water for edema (*Shotha*). As well as Termite mound clay (*Humbas meti*), mustard powder (*Aba kudu* in Sinhala), ginger powder (*Inguru kudu* in Sinhala) grind with *Cinnamomum camphora* leaf juice *(Kapuru atthana kola* in Sinhala) and then boil and apply for rheumatoid edema (*Amavata*). One portion of Termite mound clay (*Humbas mati*) and one portion of ginger powder grind with hot water for edema (*Shotha*). In Ayurveda medicine, these clay types mix with herbal materials and thermal treatments have been done to increase curing ability or to remove the toxic factors [10]. Acharya Charaka has mentioned the therapy named as *Valmīka mṛttikādyutsādana* in Sanskrit language, and it is contained within the mud of ant-hill (termite mound clay/ *Humbas meti*), the root, fruits and barks of *Pongamia pinnata* (*Karanja*) and bricks should be made to a powder. This should be used for dry rubbing frequently for spasticity of the thigh muscles [11]. *Śyonākādi pariṣka pralepa* (paste) prescribed by Acharya Charaka for spasticity of the thigh as follows. Root of *Withania somenifera (Ashvagandha), Calotropis gigantean (Arka), Azadirachta indica* (*Neem*) or *Cedrus deodara (Devadaru),* any one of these drugs may be mixed with honey, *Brassica campestris* Linn (*Rakta sarshapa*) and mud of ant hill (termite mound clay/*Humbas meti*) before being used as thick paste as external preparation for dry rubbing or massage[12]. Drug represent in Ola leaf manuscript in Sri Lanka (Books series of *Talpate piliyam)* stated that the paste of *Sulpha* (*Gandaka*), *cinnamon* bark (*Kurundu pothu*) and termite mound clay obtain from the top of the ant hill better to cure different types of abscess[13]. In addition to that it has mentioned purified mercury *(Rasadiya),* fruit of *Cinnamomum camphora (Karpura),* worm casts (*Panu pas*), powder of bricks grind with juice of *Caryota urens (Sreetala)* used for disease called yaws[14]. As per Acharya Suśṛta application of paste of black mud of ant hill (termite mound clay/ *Humbas meti*) made with cow urine acts as an antidote for bite by bees and mosquito[15].

Reason for using termite mound soil by Aboriginal communities

Aboriginal people also use termite mounds for many different reasons. The main applications of termite mound soil are gastro intestinal disorders and related to pregnancy. Some other uses are treatment as abdominal or menstrual pains, mineral deficiencies, lactation and to cure wounds. Sometimes they use termitaria (Termite mound nests) for cooking and as mosquito repellent. Aboriginals use these mounds in several different ways. Many families have their own recipes. One way is break off small pieces of mound and then drop it directly in to the mouth. Some communities, hand size piece of mound is ground finely and mix with water, milk or tea and then drunk. Some aboriginals use termite mound clay externally. Mud baths are recommended for the treatment of rheumatism and arthritis. According to Dextreit (1976), clay can be used to cure iron deficiency, because it contains catalysts that work in infinitesimal doses to stimulate failing organs [16]. When clay is exposed to sun, air and rain, it becomes more active.

The number of elements such as calcium, iron, magnesium, potassium and sodium in termite mounds may be important in traditional medicine. The clay and in particular the kaolin fraction, may act as an absorbent anti-diarrhoeal and may help to alleviate digestive disorders. The high concentrations of elements in the mounds provide a potential nutrient source, mainly during pregnancy when the needs for elements such as iron are increased.

According to Foti (1994), there are three factors that have been identified in this study which could contribute to an explanation as to the Aboriginal preference for termitaria over soils, they are a general increase in concentration of selected elements, a higher concentration of 'bioavailable' elements and soluble iron and ionisable iron were present in most mounds whereas not detected in soils.

Methods of analyzing physicochemical properties of these two clay types

Most elements were determined by using atomic absorption spectrophotometry. A number of elements (Co, Cu, Fe, Mn and Zn) were directly diluted with deionized water if necessary. Some elements (Al, Ca, Mg, K and Na) required ionization agent to avoid interference. Dhembare (2013) used atomic absorption spectrometry to determine Ca, Mg, Cu, Mn, Zn and Fe whereas Potassium was determined by using flame photometry [17]. Total carbon content was determined by dry combustion using an Eltra CS500- apparatus. Total nitrogen (N) was determined by the Kjeldahl method. Mujinya *et al* (2013) used X-ray diffraction method to determine soil texture [18].

Physicochemical composition in termite mound clay

There was significant differentiation between physical and chemical properties of mound and adjacent soil. According to Dhembare (2013) when comparing with termite mound soil with adjacent soil the clay content of the termite mound was significantly higher than the surrounding soil (Table 1) pH of termite mound soil and surrounding soil was 7.17 and 7.67 respectively. Termites modified this pH up to 12.5 and Changes of mound pH depends according to the termite species and soil type. Electrical Conductivity of the mound soil was 0.29 dS/m in surrounding soil and 0.31 dS/m in mound soil.

Dhembare, 2013 showed that the test parameters such as organic carbon, phosphorus, K, Mg, Fe, Zn and Cu were inclining while N, Ca, S and Mn were decline in mound soil. This study highlights that termite mound soil properties are generally more than the surrounding.

Table 1: Soil properties of termite mound soil and surrounding soil

	Sand	**Clay**
Surrounding Soil	61.1%	29.5%
Mound Soil	38.9%	70.5%

X-ray diffraction reveals that the termite-mound materials are enriched in 2:1 clay, especially mica and expandable clay minerals. Selective dissolution analyses show that mound soil contain greater relative amounts of Manganese oxides and poorly crystalline Iron oxides, relative to the surrounding. Macro termite mounds are frequently enriched in soluble salts (e.g. ammonium nitrate), exchangeable basic cations (Ca^{2+}, Mg^{2+}, and K^{+}), and CaCO3 compared to the adjacent topsoil. According to Sarcinelli, et al, 2009 soil samples were collected from the walls and inner parts of termite mounds and also from adjacent soil. Chemical analyses showed that pH and the contents of organic C and N, P, Ca and Mg were significantly higher in termite mounds compared with adjacent areas [19].

Physicochemical composition in potter wasp nest clay

There are no any evidences of physical and chemical properties of potter wasp nest clay in Sri Lanka. According to foreign literature it was shown that there are significant differences in chemical composition of potter wasp nest clay and surrounding soil.

Wasps belong to order hymenoptera and suborder Apocrita. They make a mixture adhesively stronger and lighter than clay which is their source of building material. Clay soils are hydrous aluminum polysaccharides and it contains variable amount of iron magnesium, alkali metals and other cations. Wasps gather mud, moisten it and add their saliva which acts as cement to the mixture. Researchers said that saliva of the mud douber wasp contains phosphorus, Magnesium, Sulfur, Chlorine, Potassium, Calcium and unidentified elements.

According to Kamalu *et al* (2015) Calcium, Magnesium, Total iron, Chloride, Sulfate and phosphates are present significantly high amount in wasp nest clay. Potassium and Aluminum are slightly small amount when compare with adjacent soil [20].

Rodrigues et al., 2018 showed that ten major chemical elements were present in the wasp nests. They analyze that using fluorescence spectrometer. Silica is the most abundant element and major oxide that present, then aluminium oxide and iron oxide. Chemical elements were derived from mineral quarts (Silicon dioxide), laolinite ($Al_2Si_2O_5(OH)_5$), illite (K,H_3O) (AL, Mg, $Fe)_2$(Si, $Al)_4O_{10}((OH)_2,H_2O)$ and gibbsite $Al(OH)_3$.

Discussion

The role of clays in human health has experienced a revival in interest due to advances in modern instrumentation such as transmission electron microscopes (TEM), atomic force microscopy (AFM), and spectrophotometers that allow us to study surfaces of minerals within their natural environmental. Recent reviews regarding uses of clay in maintaining human health have focused on the ancient practice of eating

earth materials containing clay minerals, e. g. Aboriginal communities. Alternatively, clays have been used topically in mud spas to adsorb toxins from skin and provide heat to stimulate circulation for rheumatism treatment. Healing practices of ancient cultures may depend on clay minerals with powerful adsorptive and absorptive properties to treat a variety of tropical diseases. The high adsorption and absorption capacities, cation exchange capacity and extremely fine particle size of certain clays, e. g. kaolin group minerals are important reasons why these minerals are used to remove secretions, toxins, and contaminants from the skin. Thus, absorption or adsorption capacity may be the reason for using termite mound clay and potter wasp nest clay (which contain kaolin group minerals) for curing edema and hydrocele by Sri Lankan traditional practitioners.

Conclusion

It is unable to find research articles about the reason of using potter wasp nest clay and termite mound clay by Sri Lankan traditional physicians and Ayurvedic medical practitioners. Traditional physicians use these recipes on the basis of their indigenous knowledge and clinical practices in Sri Lanka. Occasionally they not aware of scientific theories behind these valuable medicines. Therefore, this is a better area to scientifically study the properties and medicinal value of these clay types.

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