



## Potency of Trona on Fungi Associated with Tinea Capitis from Children in Usmanu Danfodiyo University Sokoto (UDUS)

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### **Authors' contributions**

*This work was carried out in collaboration between all authors. All authors read and approved the final manuscript.*

### **Article Information**

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### **ABSTRACT**

**Aim:** The potency of trona against fungi associated with dermatophytes isolated from children in Usmanu Danfodiyo University Sokoto (UDUS) local farming community was investigated.

**Place and Duration of Study:** Department of Microbiology, Department of Pure and Applied Chemistry and Department of Pharmacognosy, Usmanu Danfodiyo University, Sokoto, Nigeria, between January 2017 and September 2017.

**Methodology:** The samples were collected from errand children within UDUS, and the organisms were isolated and identified microscopically using standard methods. Elemental analysis of the two types of trona (red and white) was also determined using standard Analytical methods. The sensitivity test was carried out using agar well diffusion method.

**Results:** In the two types of trona (red and white) Sodium was found to have the highest

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concentration of 9500 mg/kg and 8300 mg/kg, and the lowest was 0.15 and 0.10 mg/kg. Potassium was reported to have a concentration of 4400 mg/kg and 1800 mg/kg for the white and red trona respectively. Some of the organisms identified were *Microsporum canis*, *Trichophyton rubrum*, *Trichophyton mentagrophytes* etc. Highest mean zone of inhibition of 20.7 and 23.3 mm was recorded for the red and white trona respectively. The least zone of inhibition recorded was 2.7 and 4.7 mm for the red and white trona respectively. Increased activity was recorded when the concentration of the trona was increased.

**Conclusion:** The results revealed promising potentials of trona in the treatment of fungi associated with dermatophytoses. However, further studies should be done to determine the mechanism of action of trona on these organisms.

**Keywords:** Trona; dermatophytoses; fungi; antifungal.

## 1. INTRODUCTION

Dermatophytosis or ringworm infection is ranked as one of the most common cutaneous conditions in the world [1]. It is a fungal related infection of the stratum corneum of the epidermis and keratinised tissues such as hair, nails and skin of human and animals [2,1]. It has a worldwide distribution; the growth of the dermatophytes is facilitated by climate (warm and moist conditions), population, lifestyle, immune status etc. [3,4]. Fungi with the ability to colonise and infect stratum corneum of the skin, nails and hair, are the cause of dermatophytosis [5]. The dermatophytes include the members of the genus *Microsporum*, *Trichophyton* and *Epidermatophyton* [4]. They are grouped as Zoophilic, Geophilic and Anthrophilic [5]. Dermatophytosis results in different clinical syndromes base on the site of the body affected as; tinea corporis (body), tinea cruris (groin), tinea capitis (hair shaft and scalp), tinea unguum (hand) and tinea pedis (foot) [4,6].

Tinea capitis, which is the infection of the scalp and hair shaft, is caused by species of *Microsporum* and *Trichophyton* [6]. Tinea capitis is reported to be more prevalent in males than in females and as well as among children [7,4]. Different organisms are reported to be the causative agent of tinea capitis, example of which include; *Trichophyton rubrum*, *Microsporum audouinii*, *Trichophyton schoenleinii*, *Trichophyton mentagrophytes* and *Trichophyton tonsurans* among others [8,9,10 and 6]. Dogo et al. [5] reported *Trichophyton rubrum* and *Microsporum canis* to have a percentage frequency of occurrence of 28.8% and 22.7% when studying the prevalence of tinea capitis among school children of Nok community of Kaduna State, Nigeria.

Treatment of tinea capitis has proven to be complicated as it requires systemic treatment with oral agents, such as Griseofulvin, Terbinafine, Itraconazole, Fluconazole. Topical agents do not penetrate down to the hair follicle roots, so they are used as adjuvant therapy for systemic antifungals [11]. In Nigeria, different substances are used in treating tinea capitis. Example of which include, toothpaste, plants, Trona etc.

Trona also known as 'Kaun' in Yoruba and 'Kanwa' in Hausa is a dried lake salt that contains mainly of hydrated sodium carbonate ( $\text{Na}_2\text{CO}_3 \cdot \text{NaHCO}_3 \cdot 2\text{H}_2\text{O}$ ) [12]. It is the most abundant sodium alkali mineral [13]. It is an important table salt and the second most commonly used salt in Nigeria [14]. It is called potash despite having low amount of potassium, sometimes below detection level [12]. Two varieties of Trona are known in Nigeria, the whitish and the red-white (red) [12]. It is used as salt of tobacco to produces tobacco snuffs, as tenderizing agent, as laundering agent, in scouring of wood, in bath salts, in pharmaceuticals and to facilitate fermentation [13]. In this study, the potency of trona on the fungi associated with tinea capitis (dermatophytoses) will be evaluated.

## 2. METHODOLOGY

### 2.1 Elemental Analysis of the Red and White Trona

Some of the elements present in the trona were determined using standard methods, as follows: potassium, sodium [15], calcium, magnesium [15], chloride [16] and phosphorus [17].

## 2.2 Isolation and Characterization of the Fungi

### 2.2.1 Sample collection

The samples were collected from children (Yaro boys) that show symptoms of ringworm infection within UDUS, the university local farm working community. The best containing multiple lesions was chosen. The area was first prepared for scrapping by using an alcoholic wipe to the clean area to reduce the bacterial contamination and any traces of skin product or medication and the affected area was then allowed to dry. The edge of the affected area was scrapped using a sterile scalpel (held at a blunt angle) which was then transferred into a clean paper envelop or foil and closed [18].

### 2.2.2 Isolation of dermatophytes

The scrapings were cultured on an agar plate containing solidified Sabouroud dextrose agar (SDA). The plate was incubated for 2 weeks at 28°C. The plates were observed after two to three days interval for growth. After growth was observed and different species appear characterised by colour, type of growth and texture. Distinct colonies were sub-cultured and incubated for 2 weeks. The same procedure was repeated, until pure cultures of the organisms were obtained [18].

### 2.2.3 Characterization of the isolated fungi

The dermatophytes were identified base on their Macroscopic (growth characteristics and pigmentation) and Microscopic (formation of macroconidia, microconidia and other typical elements) as described by David et al. [19]. Thin preparation of the fungal culture was made with a drop of Lactophenol cotton blue solution on a glass slide. The glass slide was covered with a coverslip and observed under the microscope.

## 2.3 Test for Antifungal Activity of the Trona

The antifungal activity of the trona was carried out as described by Nata'ala et al. [20]. A sample portion of 0.1 ml aliquot of each of the standardized fungal cell suspension was transferred onto the surface of the dried plate containing SDA. The sample was spread evenly using a sterile swab stick. Holes of 5mm diameter were made using a sterilized cork borer. Small amount of plain agar was poured to

seal the bottom of the well. Different concentration of the trona was formulated and poured into the holes, then incubated at 28°C for 2 weeks.

## 3. RESULTS AND DISCUSSION

Table 1 shows the proximate and mineral analysis of trona. The trona used was analysed in the Agricultural laboratory for the elements present and their amount. The elements found in trona consist of Ca, Na, K, Mg, P, Cl at the different percentage for the white and red trona. This is in agreement with the findings of Inegbenebor and Inegbenebor, [21]. The results also indicate that the sodium level is higher than all the elements present and potassium level having quite a low concentration compared to that of sodium, this agreed with the findings of Omajali and Sanni, [22].

**Table 1. Elemental composition of Trona**

Element	Type of Trona	
	White	Red
Calcium (mg/kg)	1.20	1.00
Sodium (mg/kg)	8300	9500
Potassium (mg/kg)	4400	1800
Chloride (mg/kg)	1.44	0.36
Magnesium (mg/kg)	0.10	0.15
Phosphorous (mg/kg)	3.56	4.07

A total of six species of dermatophytes were isolated and identified. The result from this study shows that children from Usmanu Danfodiyo University local farm working community are infected with various species of dermatophyte fungi. This is evident in the fact that these children come from rural areas where they regularly come into contact with animals in their daily activities. They share their residential houses with these animals. This agrees with the findings of Dogo et al. [5] who reported that ringworm infections are caused by species of *Microsporum*, *Epidermophyton* and *Trichophyton*, which could be geophilic, anthropophilic and zoophilic. *Microsporum canis* and *Trichophyton mentagrophytes* which are zoophilic originated from cats, dogs and other domestic animals are among the organisms found and isolated. Similar findings were reported by Dike-Ndudim et al. [23], they reported the isolation of *M. canis* and *T. mentagrophytes* among children in Isu Local Government of Imo State, Nigeria. *Trichophyton rubrum* and *Microsporum audouinii* were also isolated from the children. These organisms are

**Table 2. Antifungal activity of white Trona against the dermatophytic fungi isolated (All Values are Means  $\pm$  Standard Deviation of Triplicate Measurement)**

Organism	Concentration of Trona (mg/100 ml)				
	100	80	60	40	20
<i>Microsporum canis</i>	22.7 $\pm$ 3.06	17.3 $\pm$ 1.15	12.0 $\pm$ 2.00	7.3 $\pm$ 1.15	4.7 $\pm$ 1.15
<i>Trichophyton rubrum</i>	23.3 $\pm$ 3.05	20.0 $\pm$ 2.00	16.7 $\pm$ 1.15	11.1 $\pm$ 1.15	6.0 $\pm$ 2.00
<i>Trichophyton harzianum Rifai</i>	16.7 $\pm$ 1.15	18.7 $\pm$ 1.15	13.3 $\pm$ 1.15	10.7 $\pm$ 1.15	6.00 $\pm$ 2.00
<i>Trichophyton mentagrophyte</i>	23.0 $\pm$ 2.00	18.0 $\pm$ 2.00	10.0 $\pm$ 1.29	8.7 $\pm$ 1.15	4.7 $\pm$ 1.15
<i>Epidermatophyton floccosum</i>	20.7 $\pm$ 2.31	18.7 $\pm$ 4.62	12.0 $\pm$ 1.50	11.3 $\pm$ 1.15	6.0 $\pm$ 2.00
<i>Microsporum audouinii</i>	23.3 $\pm$ 3.05	19.3 $\pm$ 1.15	15.3 $\pm$ 1.15	11.3 $\pm$ 1.15	6.0 $\pm$ 2.00

**Table 3. Antifungal activity of Red Trona against the Dermatophytic fungi isolated (All Values are Means  $\pm$  Standard Deviation of Triplicate Measurement)**

Organism	Concentration of Trona (mg/100 ml)				
	100	80	60	40	20
<i>Microsporum canis</i>	20.7 $\pm$ 1.15	16.7 $\pm$ 1.15	10.0 $\pm$ 2.00	8.0 $\pm$ 2.00	5.3 $\pm$ 3.06
<i>Trichophyton rubrum</i>	20.0 $\pm$ 2.00	14.7 $\pm$ 1.15	10.7 $\pm$ 1.15	6.7 $\pm$ 1.15	4.0 $\pm$ 2.00
<i>Trichophyton harzianum Rifai</i>	18.7 $\pm$ 1.15	8.7 $\pm$ 5.03	12.7 $\pm$ 1.15	6.7 $\pm$ 1.15	2.7 $\pm$ 1.15
<i>Trichophyton mentagrophyte</i>	20.0 $\pm$ 2.00	13.3 $\pm$ 1.15	9.3 $\pm$ 1.15	6.7 $\pm$ 1.15	5.3 $\pm$ 3.05
<i>Epidermatophyton floccosum</i>	20.7 $\pm$ 1.15	15.3 $\pm$ 2.31	12.0 $\pm$ 2.00	7.3 $\pm$ 1.15	6.0 $\pm$ 2.00
<i>Microsporum audouinii</i>	20.7 $\pm$ 2.31	16.7 $\pm$ 1.15	12.0 $\pm$ 2.00	10.0 $\pm$ 2.00	5.3 $\pm$ 1.15

anthropophilic species that are known to occur in Prepubertal children. A similar finding was reported by Oke et al. [24] and Dogo et al. [5].

Table 2 shows the sensitivity results of the sensitivity test carried out with White trona on the isolated ringworm species. The highest mean zone of inhibition, 23.3mm of 100mg/100ml trona concentration was recorded for the *Microsporum audouinii* and *Trichophyton rubrum*. This might be attributed to fact that these organisms thrive better in a neutral pH and in-turns make trona a more susceptible antifungal agent due to its alkali nature, this is in agreement with the findings of Jain and Sharma [25]. The lowest mean inhibition zone, 16.7 mm of 100 mg/100 ml of trona concentration was recorded for the for the *Trichoderma harzianum Rifai*. This might be attributed to the fact that this species of dermatophyte is hardly pathogenic and it is usually found in the soil, making them be more adaptive to the alkaline pH and subsequently the pH of trona.

Table 3 shows the results for the antifungal activity of Red trona on the isolated ringworm fungi. *Epidermatophyton floccosum*, *Microsporum canis* and *Microsporum audouinii* were shown to have the highest mean zone of inhibition of 20.7 mm in a concentration of 100 mg/100 ml and the lowest zone of inhibition of 18.7 mm on the same concentration was recorded against *Trichoderma harzianum Rifai*.

The result also shows decrease in activity when the concentration is decreased. This could also be attributed to the pH of the trona which is high, the low zone of inhibition recorded against *Trichoderma harzianum Rifai* could be attributed to the tolerance of high pH by the organism being found in the soil.

#### 4. CONCLUSION

Dermatophytosis is among the most common cutaneous infection with a worldwide distribution. The treatment of which is complicated, involving the use of oral drugs and topical agents. This study conducted to determine the potency of trona against the fungi associated with ringworm infections, reveal trona to have antifungal activity against the fungi associated with ringworm infections (dermatophytosis). Further studies are required to understand the mechanism of action of trona against these organisms as well as others.

#### ETHICAL APPROVAL

As per international standard or university standard, written ethical approval has been collected and preserved by authors.

#### COMPETING INTERESTS

Authors have declared that no competing interests exist.

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