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Ethno-entomological value and antimicrobial potency of termite (*Odontotermes obesus*) of Mayurbhanj district, Odisha

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Abstract: Insect are fascinating diversified group of organism in the nature. Researches have been conducting in 113 different countries of the world regarding the entomophagy practice in human society on nutritional evaluation and medicinal values with respect to health prospective measures. In view of current challenges regarding the food scarcity, demand of better medication sources and a hygienic environment for long live. In regards to the current approaches, an initiative study has conducted on ethno-entomological value and antimicrobial activity of edible termite (*Odontotermes obesus*) in Mayurbhanj district of Odisha. The questioner survey method was conducted to obtain the traditional claims of termite for different ailments. The agar well diffusion method was used to evaluate the antimicrobial activity of termite. The average and standard deviation methods are used during the data analysis. The use of termite among the tribes has 34.13% food value and 60.39% medicinal use. The termite extract shown significant activity against 7 bacteria stains and 1 *Candida sp.* strains, the high inhibitions were found in *Shigella flexineri* (14.030±0.04) and *Candida tropicalis* (9.023±0.070). The traditional knowledge of utilizing the termite as well as other natural resources has been transferred verbally from generation to generation since decades back. More research should be conducted in documenting traditional practice with a large spectrum of edible insect before vanishing from the society. The scientific evaluation of traditionally claimed insects should be studied to resolve nutritional and health challenges of society.

***Index Terms - O. obesus*, Mayurbhanj district, Traditional value, Antimicrobial property**

I. INTRODUCTON

The human are the most supreme species of the nature's creation and having potential to compete over all the species for their existence. The human population is increasing day by day and estimated to be 9.6 billion in 2050 [1] of total world population**.** The population explosion may leads to the initiation of food crisis and health hazards. The ethno-biological studies and zoo-therapeutic use of living organisms have been focused since eighteenth centaury [2-6]. The knowledge of utilizing plants and animals is traditionally conserved in the human society for a long period. Researchers of developing countries intensify to enlist traditionally used natural consumable bio-resources and their scientific evaluation to overcome the crisis concerned with food and health prospective. The traditional techniques of entomophagy practice for food, medicine and other economic use are an integral part of ancient cultures of Indigenous people inhabiting in different corner of the world. Presently the entomophagy practice of different ethnic tribes is found over 80% countries of the world [7-10]. Edible insects are serving as an alternative source for nutritive and medicinal supplements of endogenous tribal culture of the world [11-15]. As the early reports suggests there are about 1900 number of edible insects species are consumed by tribes of 113 countries for food and medicinal purpose [16-19]. As the early record suggests there are about 2000 edible insects are exist worldwide and being used in different culture until date [20]. In India, many edible insects exist in different cultures and some of them have been scientifically evaluated. A long history is lying behind in North and East India, which represents ethnic rural communities possessing techniques of utilizing a large numbers of edible insects in their culture. A total of 255 species of edible insects have reviewed from different regions of India out of which 158 species from Arunachal Pradesh, 16 to 40 species north-east states (Manipur, Assam, Nagaland and Meghalaya) and a few number insects southern region (Kerala, Madhya Pradesh, Odisha Tamil Nadu and Karnataka) [17]. Termite is one of the eusocial insect belong to termitidae family represents 2% of the total insects consumed in India [17]. However, few records exists related to entomophagy practice in Odisha. Macrotermes (Jharipoka) species is taken as traditional food and having a good nutritional value among the tribes of Mayurbhanj district [21-22]. Red weaver ant (*Oecophylla smaragdina*) and pupa of *Antheria myllita* are used for treating ailments by ethnic tribes [22]. The subterranean termites found in South Indian folk medicines have antimicrobial activity against some pathogenic bacteria [23]. The significant antibacterial activity of the subterranean termites of South Indian folk medicines has studied against 9 species of bacteria [23]. In this investigation, the traditional value and antimicrobial activity of the subterranean termite (*Odontotermes obesus*) has studied against pathogenic microbes to unlock the scientific mysteries of traditionally clamed information.

II. RESEARCH METHODOLOGY

2.1 Documentation of traditional use

The traditional information was obtained through questioner survey (Figure 1) in different localities of the Mayurbhanj district (lies between 21º 17' and 22º 34'North latitude and 85º 40' and 87º East longitude, [24]). The study area is divided into six selective zones, which are Rairangpur with hilly areas (North Zone 22º 16' 11.32'' N and 86º 10' 12.01'' E), Baripada the center place of Mayurbhanj district (North-East zone 21º 55' 49.69'' N and 86º 45' 6.72'' E), Betnoti (East zone 21º 44' 23.21'' N and 86º 50' 35.56'' E), Udala (South-East zone 21º 34' 36.05'' N and 86º 33' 55.27'' E), Karanjia (West zone 21º 34' 36.05'' N and 86º 33' 55.42'' E) and Similipal periphery villages with full of forest and village areas (central zone 22º 8' 41.28'' N and 86º 24' 50.32'' E).

Figure 1. Local interaction in study area

The percentage of use of different traditional parameters were determined by the following formula [25]: Percentage (%) of use = [(No. of positive informant of each aliment or use) / (Total no. of positive informants)] × 100

2.2 Specimen collection and processing

The samples were collected by hand picking method during the field survey. The species was identified by using the appropriate identification manual [26]. The sample was processed through 70% alcohol and then allowed to dry for 1 hour at room temperature. The crude homogenate extract at a concentration of 0.1gm/ml was prepared in aqueous medium [27]. The homogenate extract was centrifuged (Cooling Ultra Centrifuge, REMI Company) at 5000 rpm and supernatant was collected for further use.

2.3 Maintenance of microbes

The selected bacterial and *Candida sp.* cultures were maintained on nutrient agar (NA) and Yeast Pepton Dextrose (YPD) slants respectively, which was stored at 4ºC. Activation of the bacteria and *Candida sp*. cultures, were carried out by streak plate culture and single viable colony was picked up and transferred to 2ml of nutrient broth (NB) and yeast peptone dextrose broth (YPDB) medium accordingly. Then the test tubes were incubated at their respective temperature (37 ºC for bacteria and 28 ºC for *Candida sp.*) to get pure overnight broth culture of each strains.

2.4 Antimicrobial activity

The agar cup well diffusion method [28] was used to study the antimicrobial activity against selected microbes. The termite aqueous extract (0.1gm/ml, [27]) was administrated in the cultured agar plate of each strain along with the control antibiotic Vancomycin. The plate was incubated at their respective temperature i.e. 37°C for bacteria and 28°C for candida strains. After the incubation time is over the plates were observed properly and zone of inhibitions were measured by using digital slide clippers.

III. RESULTS AND DISCUSSION

The *Odondotermes obesus* species belong to the family termitidae and mostly called, as the subterranean micro termite due to its small body size. This white ants are named as Wee in different localities of Mayurbhanj district of Odisha. 822 no of positive respondent shared their traditional knowledge and skill of utilizing this species, which revels that this species is used as food by 34.13% of the total informant (Table 1). As we studied this species of termite serves as a source of delicacy and tribes are taking this species in the fried form and mixed with fried rice. Most preferably, about $^{a+b+c}$60.39% of the total informants use this species in the traditional treatment to get rid of different aliments (Table 1).

Table 1. Traditional use of termite (*Odontotermes obesus*) in Mayurbhanj district			
Purpose of use	**Used as**	**Mode of preparation**	**Results**
Food value	Dietary substance	Fried and mixed with rice	Provide nutrition to body
Appetizer	Medicine	Making juice or chutney	Feel hungry within 15-20 minutes
Increases the lactation in women and ulcer	Medicine	Fried and directly taken	Long processes
Pain relief	Medicine	Fried and then crushed to make powder	Heal pain within 2-3 hours
Bronchial problem and diuretic	Medicine	Making juice or Chutney	Periodically used to cure completely within an interval of 1 day

The techniques of utilizing the species in their traditional Indian medicinal system have evolved from their fore fathers and are inherited until the present generation. The tribes use the crude raw extract of this termite for the treatment of diseases like poor lactation in women after childbirth, gastric ulcer, pain relief, bronchial infection like problems and diuretic disorder (Table 2).

Table 2. Percentage of use of termite in Mayurbhanj district			
Sl. No.	**Ailment/use**	**Positive informants**	**Percentage (%) of Use**
1	Food value	256	34.13
2	Appetizer	113	15.06
3	Poor lactation and ulcer	72	[a] 9.6
4	Healing and pain relief	287	[b]38.26
5	Bronchial problem and diuretic	94	[c]12.53

About 15.06% of the total informants are consuming its extract as appetizer to increase the hungriness (Table 1). The significance of this species is that it is available in all season and can be consumed or administered orally either in fried condition or in the form of crude aqueous extract.

Table 3. Antibacterial activity of termite extract		
Test pathogens	**Zone of inhibition in mm (Avg. ±SD)**	
	Vancomycin	**Termite extract (0.1gm/ml)**
Salmonella typhi (MTCC S23)	11.6±0.079	7.956±0.076
Escherichia coli (0157:H7) (MTCC S20)	9.31±0.020	ND
Shigella sonnei (MTCC S8)	10.13±0.087	9.056±0.077
Shigella flexineri (MTCC S25)	12.05±0.601	14.030±0.04
Leuconostoc mesenteroides (MTCC 107)	8.5±0.4	ND
Bacillus brevis (MTCC S22)	9.98±0.088	7.963±0.064
Shigella dysenteriae (MTCC S21)	10.92±0.147	9.220±0.036
Staphylococcus aureus (MTCC 29737)	9.49±0.238	7.370±0.345
Bacillus lichenifermis (MTCC S6/10341)	10.72±0.030	8.693±0.248
*MTCC: Microbial Type Culture Collection, Chandigarh, ND: Not detected, Avg.: Average, SD: Standard deviation		

The antibacterial activity (Table 3, Figure 2&3) was most apparent in seven bacterial strains and not effective in case of *Escherichia coli (0157:H7)* and *Leuconostoc mesenteries*. The extract was found to be highly active against *Shigella flexineri* (14.030±0.04) followed by *Shigella sonnei* (9.056±0.077), *Shigella dysenteriae* (9.220±0.036) and *Bacillus lichenifermis* (8.693±0.248). Approximately similar level of activity was found in *Salmonella typhi* (7.956±0.076) and *Bacillus brevis* (7.963±0.064). The least zone of inhibition was formed in *Staphylococcus aureus* (7.370±0.345). The zone of inhibition of termite extract in comparison to the commercial antibiotic (Vancomycin) is quite less in all the bacteria species except *S. flexineri* but the effectiveness in case of *S. sonnei* and *S. dysenteriae* can be comparable. The significant anticandidal activity (Table 4, Figure 2&4) was found only in *Candida tropicalis* (9.023±0.070) and no activity was observed in *C. albicans, C. parapsilosis and C. krusei.*

Table 4. Antifungal (anticandida) activity of termite extract		
Test pathogens	**Zone of inhibition in mm (Avg. ±SD)**	
	Vancomycin	**Termite extract (100mg/ml)**
Candida tropicalis (MTCC S13)	12.286±0.090	9.023±0.070
Candida albicans (MTCC 9215)	ND	ND
Candida parapsilosis (MTCC S12)	ND	ND
Candida krusei (MTCC 227)	ND	ND
*MTCC: Microbial Type Culture Collection, Chandigarh, ND: Not detected, Avg.:Average, SD: Standard deviation		

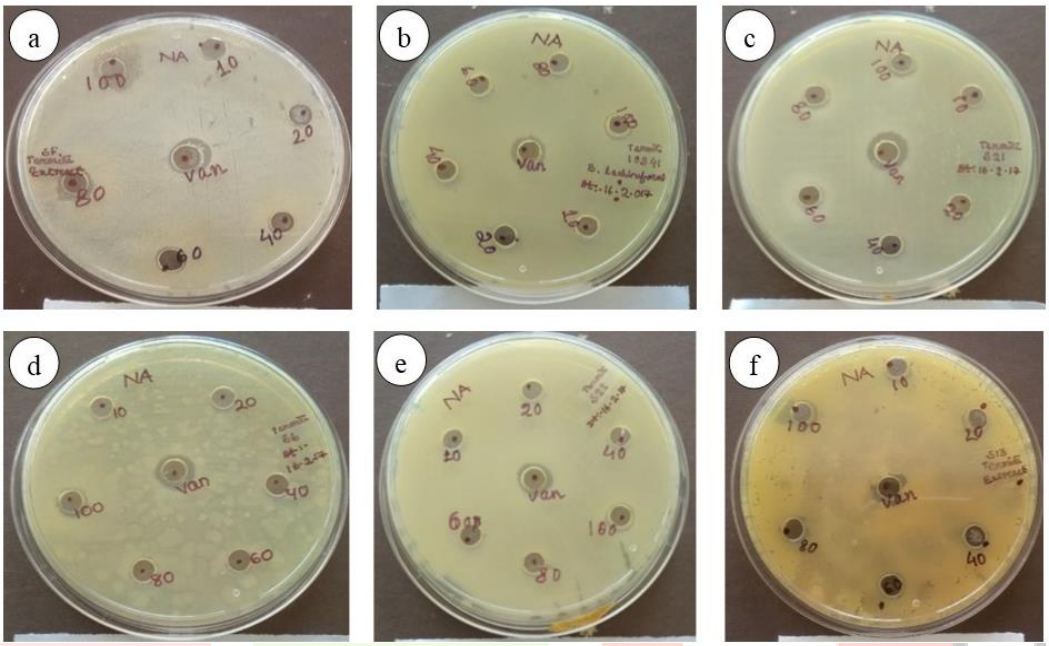

Figure 2. Antibacterial activit and anticandida activity of termite (*O. obesus*) extract (a). *S. flexineri*, (b & d) *B. licheniformis* (c). *S. dysenteriae* (e). *B. brevis* (f) *C. tropicalis*

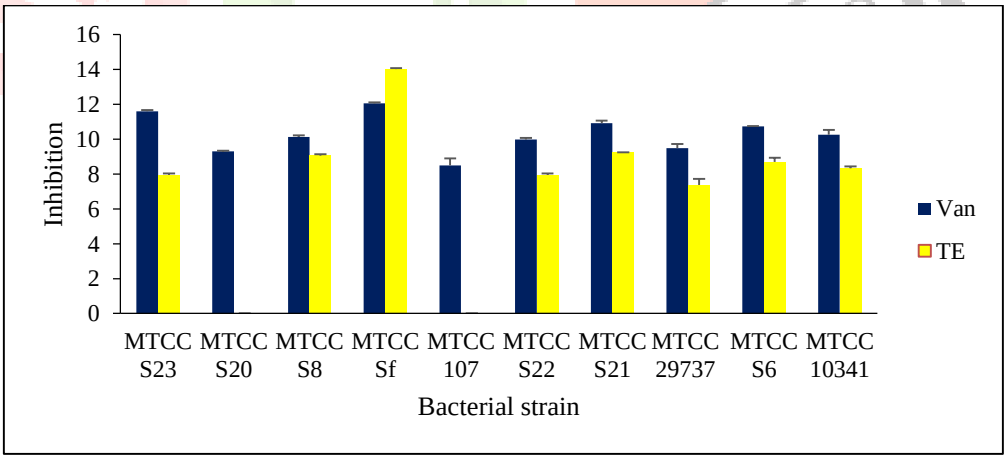

Figure 3. Antibacterial activity of termite extract (Van = Vancomycin, TE = Termite extract)

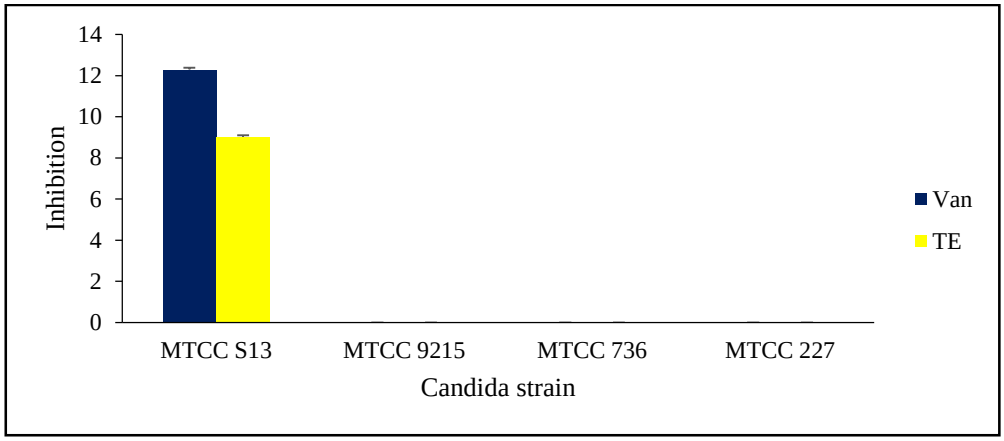

Figure 4. Anticandidal activity of termite extract (Van = Vancomycin, TE = Termite extract)

The termite has greater food and medicinal values mostly among the different tribes in Mayurbhanj district. The antimicrobial activity is found in the termite extract may be due to the presence of metabolites, which are synthesized inside the termite gut in response to the exposure towards microbes. Early report reveals the presence of antimicrobial peptides like termicin, cysteine and spingerin in fugal species isolated from a termite species named as *Pseudacanthotermes spiniger* [29-30]. Moreover, the traditional value and antimicrobial potency signifies the scientific value of this species. Interestingly this termite extract involved in therapeutic practice of the tribes for treating respiratory and enteric infections. The information regarding the use of termite in poor lactation and ulcer problems are mostly lacking in the population from places to places in the Mayurbhanj district, which indicates that the traditional knowledge intact with different tribal culture is vanishing over the time and it will be completely disappeared in coming 10 years as expected. The medicinal values of this species claimed by the informants is putting a baseline of expectation that the termite species could be a reservoir of many significant metabolites.

The antimicrobial potency of termite extract clearly indicates that whenever the arthropods come in close association with the microbes from its surrounding environment, they defend themselves by secretes metabolites to minimize the infection level [31]. However, the mystery behind its antimicrobial activity is still lacking and to be focused more deeply. May be the isolation and enumeration of compounds or metabolites present in the extract will be an effective one and have bio-pharmacological properties, which can be helpful to discover the biomedical drugs of antiviral, antifungal and anticancer use.

IV. CONCLUSION

The study provides basic information on antimicrobial potency of the subterranean termite *O. obesus* used as folk medicine in the Mayurbhanj district. Since the traditional knowledge of endogenous tribes inhabiting in different parts of the world playing an important role in the identifying natural resources worthy of commercial exploitation and pharmacological values. The documentation of this ethno-biological information will helpful to conserve the traditional knowledge and techniques of utilizing edible insects. In forth coming days, the study should be carried out on more number of edible insects with respect to ethno-entomological values. As scientific studies like bioprospecting evaluation of this tiny creature, require more and more sample, which may affect the population of this species leads to the loss of nature's integrity. So that the researchers should conduct the experiments in a sustainable manner for the betterment of nature as well as for the future of humankind.

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