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Evaluating The Molluscicidal Activity Of Ethanolic Extracts Of *Allium sativum* Against *Bulinus wrighti*, A Bilharzia Vector

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ABSTRACT
This study evaluated the molluscicidal properties of ethanolic extracts of *Allium sativum* (garlic) against the freshwater snail *Bulinus wrighti*, a vector for parasitic infections. The research was conducted in the Parasitology Laboratory of the Biological Sciences Department, Usmanu Danfodiyo University, Sokoto, Nigeria. Snails were collected from local freshwater sources, identified, and acclimatized in laboratory conditions. Ethanolic extracts of *A. sativum* were prepared using standard procedures and tested at various concentrations over a 96-hour period. Toxicity assays were also performed on *Oreochromis niloticus* (Tilapia) to assess the impact on non-target aquatic organisms. Results indicated that the ethanolic extract of *A. sativum* exhibited significantly molluscicidal activity. The 96-hour LC50 for ethanolic extracts was 21.70 mg/L, highlighting a time- and dose-dependent response. The study concludes that ethanolic *A. sativum* extracts are highly effective as a molluscicide, suggesting potential applications in controlling snail populations in freshwater ecosystems. Statistical analysis using probit models confirmed the reliability of these findings.
Keywords: - *Alliumsativum* extract; Molluscicidal activity; *Bulinus wrighti* and Lc50 toxicity

INTRODUCTION

Snails act as intermediate hosts for various trematode parasites, presenting significant public health risks and impacting livestock and poultry productivity. These parasites are linked to a range of diseases, causing economic losses from treatment costs, morbidity, mortality, and the condemnation of infected animal products (WHO, 2002). A notable parasitic disease is schistosomiasis, caused by the digenetic trematode *Schistosoma*, which inhabits the blood vessels of humans and animals. Transmitted by snail species such as *Bulinus*, *Biomphalaria*, *Planorbis*, *Oncomelania*, and *Indoplanorbis* (John, 2004), schistosomiasis manifests primarily in intestinal and urinary forms, with the latter caused by *Schistosoma haematobium*. The disease affects rural communities, particularly those involved in agriculture, fishing, and domestic activities in infested water, with children and women at high risk (WHO, 2010).

Urinary schistosomiasis, due to *S. haematobium*, is a major health concern in tropical and subtropical regions, with endemicity in 53 countries across the Middle East and much of Africa (Michaud *et al*., 2003; Chitsulo *et al*., 2000). Over 90% of chistosomiasis infection occurs in sub-saharan Africa and almost 300,000 people died annually(Huw*et al*., 2014). The highest privalance of this infection is seen in Nigeria (29 million), which is closely followed by United Republic of Tanzania (19 million) then Ghana

and Democratic Republic of Congo (15 million) making up the top five countries in Africa with schistosomal infection (WHO 2013). Approximately 200 million people are infected globally, with around 70% of cases in sub-Saharan Africa (Jukes *et al*., 2002). Children, in particular, face high infection rates and suffer severe morbidity and mortality (WHO, 2002). Studies in Nigeria demonstrate high prevalence rates: Ugbomoiko *et al.* (2010) found 62% prevalence in Southwestern Nigeria, Biu *et al.* (2009) reported a 24.3% infection rate in Northeastern Nigeria, and Adeyeba and Ojeaga (2002) observed a 57.5% rate in schoolchildren in Ibadan. Similar high prevalence rates have been recorded in other regions of Nigeria (Mbata *et al.*, 2009; Ekpo *et al.*, 2010; Ladan *et al.*, 2011).

Chemical molluscicides, including organophosphates, organosulfur compounds, calcium cyanide, and sodium pentachlorophenate, have been used globally to control vector snails. However, while highly toxic to snails, these chemicals pose environmental and health risks, causing dermatitis in humans and animals, harming aquatic life, and being prone to deactivation by UV light (Malek and Cheng, 1974).

Plant-based molluscicides present a promising alternative due to their selective effectiveness, biodegradability, cost efficiency, and local availability in endemic regions (WHO, 1983). Research into plant-derived molluscicides began in the 1930s, aiming to identify sustainable, community-friendly control measures (Mozley, 1952; Kloos & McCullough, 1982). Numerous plants have since been tested, with Kloos and McCullough (1987) documenting studies on 571 species globally, alongside additional plants tested in China (Kuo, 1987) and Brazil (Jurberg , 1985).

Nigeria is one of the country's most affected by urinary schistosomiasis, with an estimated 22 million people, including over 16 million children, infected (Carter Center, 2010). This study, titled "Evaluating the Molluscicidal Activity of Ethanolic Extracts of *Allium sativum* against *Bulinus wrighti*, a Bilharzia Vector," examines the potential of garlic (*Allium sativum*) ethanolic extracts as a natural molluscicide. The research aims to assess the efficacy of garlic extracts in reducing *B. wrighti* populations, offering an eco-friendly, sustainable alternative to chemical molluscicides and contributing to schistosomiasis control efforts.

MATERIALS AND METHOD

Study Area

This study was carried out in Parasitology laboratory of Biological Sciences, Usmanu Danfodiyo University Sokoto, Sokoto state. Sokoto is the capital city of Sokoto State, lies between latitude 13° 3' 490N, longitude 5°14' 890E and at an altitude of 272m the sea level above. It is located in the extreme North Western part of Sokoto North and South local government areas and also some parts of Kware LGA from the North, Dange Shuni LGA from South and Wamakko LGA to the West. Sokoto metropolis is estimated to have a population of 427,760 people (NPC/FRN,2007) and by the virtue of its origin, the state comprises mostly Hausa/Fulani and other groups such as Gobirawa, Zabarmawa, Kabawa, Adarawa, Arawa, Nupes, Yorubas, Ibos and others. Occupation of city inhabitants include trading, commerce, with a reasonable proportion of the population working in private and public sectors (MOI, 2008). The Sokoto township is in dry Sahel surrounded by sandy terrain and isolated hills. Rainfall starts late that is in June and ends early, in September but may sometimes extend into october. The average annual rainfall is 550 mm with peak in the month August. The highest temperatures of 45°C during the hot season are experienced in the months of March and April. Harmattan, a dry cold and dusty condition is experienced between the months of November and February (Abdullahi *et al*., 2009).Modern Sokoto city is a major commerce centre in leather crafts and agricultural products (MOI, 2008).

Collection of Snails

Adult *Bulinus wrighti* were collected from their natural habitat from kwalkwalawa local fresh water river in sokoto metropolis. The snails were identified by Head of Zoological Museum of Natural History, Biological Science Department, A. B. U. Zaria, Nigeria. Size of the shell was ±2.00cm. pH of the dechlorinated tap water was 7.2 and the temperature was 32.2^{o} C. Snails were acclimatized in the laboratory conditions for 72 hours in the Plastic aquaria containing dechlorinated tap water before being

used for molluscicidal tests. Dead animals were removed quickly to avoid contermination of aquarium water.

Plant Materials Used in the Research

The plant species were purchased from market during the period of March to July, identified and confirmed by a senior plant taxonomist from Biological Sciences Department, Usmanu Danfodiyo University Sokoto.

Preparation of Plant Extracts

Powder of *A. sativum* bulbs was prepared by peeling and slicing healthy cloves into 3mm thick, air dried and pulverizing into a mortar and pestle. The powder was kept dry, stored in air tight container in refrigerator and tested for molluscicide activity.

Ethanolic Extraction

Five hundred grams (500g) of air-dried *A. sativum* (bulbs), was extracted with 1.5 litres of ethanol. The extraction was kept in orbital shaker for 30 mins. The extract was filtered, using muslin cloth and concentrated to dry under reduced pressure in a rotary evaporator at 40^{o}C which yielded ethanolic extract of *A. sativum* . The extracts were kept in fridge in Laboratory for further use.

Study of Toxicity of Preparation of Plant Derived Molluscicide

Toxicity experiments were performed by the method of Singh and Singh (1997). Ten experimental animals were kept in each aquarium containing 3 litres of dechlorinated tap water, and exposed continuously for 96h to different concentrations of plant materials and preparations. Control animals were kept in similar conditions without treatment. During experimental period snails were kept in starved condition. As it was periodic sampling the mortality was recorded after every 24 hours interval up to 96 hours during exposure of the snails. Each experiment was replicated six times.

The toxic effect of the molluscicides was also studied against fish *Oreochromis niloticus* (Tilapia). In these experiments a group of 10 Tilapiawere exposed in 6 litres of dechlorinated tap water. The fishes were exposed to 24 hours LC_{90} (of snail) to 96 hours.

No response to a needle probe in case of snails, and no response against touch in case of fish (Tilapia) were taken as evidence of death. Dead animals were removed on each observation during exposure period to avoid any contamination of the aquarium water.

Statistical Analysis

Lethal concentration (LC_{50}) value, lower (LCL) and upper (UCL) confidence limits, and slope value were calculated according to the method of POLO (probit or logit) computer programme of Russell *et al.*, (1977).

RESULTS

This part of the result deals with study of molluscicidal properties of different preparation of *A. sativum* against *B. wrighti*. The Snails were exposed to different concentrations of preparations (Table-1). Mortality was recorded after 24h, 48h, 72h, and 96h during the exposure period. Tilapia Fishwere exposed to (24h LC_{90} against *B. wrighti*) of molluscicidal formulation for 96h to observe any toxic effect against non target animals in aquatic environment. Toxicity evaluation of all the plant derived formulations and their combinations showed that the molluscicidal activity of these preparations against *B. wrighti* was time and dose dependent.

Table 2, showed the toxicity of ethanolic extract of *A. sativum* against *B. wrighti*. The ethanolic extracts of *A. sativum* that killed 50% *B. wrighti* (LC_{50}) decreased from 97.07 mg/l (24h) to 21.70 mg/l (96h) indicating the molluscicidal activity of this extract against *B. wrighti* was time and dose dependent.

Table 1: Doses of various Plant extracts Tested on *B. wrighti* for Toxicity.

Name of Treatment	Concentration (mg/L)
Ethanolic extraction of *A. sativum*	15, 30, 40, 50

Table 2: Toxicity of Ethanolic Extraction of *Allium sativum* (garlic) against *B. wrighti*

Exposure Time	LC_{50} mg/l	LCL	UCL	Slope Value	t-ratio	g-.Value	Heterogeneity
24hr.	97.07	63.78	419.18	1.90±0.56	2.58	0.33	0.28
48hr.	58.51	44.98	113.60	1.84±0.47	3.84	0.26	0.20
72hr.	25.80	22.13	29.23	3.18±0.46	6.88	0.08	0.35
96hr.	21.70	18.92	24.26	5.25±0.57	9.20	0.06	1.31

Batches of ten snails were exposed to different concentrations of ethanolic extract of *A. sativum* powder. Mortality was recorded at every 24hr. Each set of experiment was replicated six times. Concentrations given are the final concentration (w/v) in the aquarium water.

A value of t-ratio greater than 1.96 indicate that regression is significant.

Value of heterogeneity factor was less than 1.0 denotes that in the replication test of random samples, the concentration response line would fall within 95% confidence limits and thus the model fits the data adequately.

The indexes of significance of potency estimation ‘g value’ indicate that the value of mean was within the limits at all probability levels (90, 95, 99) as it was less than 0.5.

DISCUSSION

The present study showed that ethanolic extract of *Allium sativum*possess molluscicidal properties. Their activities are time and concentration- dependent. As this report was inline with the report of Suleiman J. e*t al*., (2020) on efficacy of *Allium sativum* against *Bulinus globosus* and report of Khanchan (2012), on characterization of the molluscicidal activity of *Bauhinia variegata* and *Mimusops elengi* plant extracts against the *Fasciola* vector *Lymnae acuminata*. The molluscicidal action of *A. sativum*, has toxicity of 21.70mg/l at 96hr.

The penetration of the toxicants also have a greater significant for the aquatic environment, because their whole body is bathed in a diluted solution of toxicants. To have maximum effect the plant must penetrate the organism and transported to active site rapidly. It seems the high titre of plant extract in snails may be due to rapid penetration of the plant molluscicide through soft foot of snails body and / or it may be possible the plant active component may changed into more toxic form in the aquarium water in snail body which is triggered by different enzymes and cause differential mortality.

CONCLUSION

The study evaluated the molluscicidal activity of ethanolic extracts of *Allium sativum* (garlic) against *Bulinus wrighti*, a vector for bilharzia (schistosomiasis). The results indicate that ethanolic extracts of *Allium sativum* exhibit promising molluscicidal effects, with a significant mortality rate observed at varying concentrations and exposure times. This suggests that garlic-based extracts could serve as an effective, natural molluscicide to control populations of *Bulinus wrighti*, reducing the spread of bilharzia. Additionally, the bioactive compounds in *Allium sativum*, such as allicin, may play a crucial role in the observed molluscicidal activity, providing a natural alternative to synthetic chemicals, which often pose environmental and health risks. It was recommended that additional studies focus on optimizing dosage levels and application techniques to enhance the efficacy of *Allium sativum* extracts while minimizing any potential adverse effects on non-target organisms.

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REFERENCES

Abdullahi M.K., Bassey, S.E., and Oyeyi, T.I. (2011). The Epidemiology of *Schistosoma haematobium* Infections in the 44 Local Government of Kano State, Nigeria. *Nigerian Journal of Parasitology*. ISSN 11174145 **32**(1):19-24

Abdullahi. K, Abubakar. U., Adamu. T., Daneji, A. I., Aliyu, R. U., Jiya, N., Ibraheem, M. T. O. and Nata'ala. S. U. (2009). Malaria in Sokoto, North Westen Nigeria. *African Journal of Biotechnology* **8** (24), Pp. 7101-7105

Adewunmi, C.O. and Marquis, V. (1980). Molluscicidal Evaluation of Some *Jatropha* Species. *Journal of Crude DrugResearch*. **18**:141-145.

Adeyeba, O.A. and Ojeaga, S.G. (2002). Urinary Schistosomiasis and Concomitant urinary tract pathogens among school children in Ibadan, Nigeria. *African Journal of Biomedical Research.* **5**:103-107

Biu, A. A., Kolo, A. B. and Agbadu, E. T. (2009). Prevalence of *Schistosoma haematobium* infection in School age Children of Konduga Local Government Area, North Eastern Nigeria. *International. Journal of Biomedical Health Science.*, **5**:181-184

Carter, C. (2010). Citing online sources: Schistosomiasis control Program [online]. Available from http:www.cartercenter.org/heath/schistosomiasis

Chitsulo, L., Engel, D., Montresor, A., and Savioli, L. (2000). The Global Status of *S*chistosomiasis and its Control. *Acta tropical journa*l. **77:** 41-51.

Ekpo, U.F., Laja – Deile, A. Oluwole, A.S., Sam-Wobo, S.O., and Mafiana, C.F., (2010). Urinary Schistosomiasis among Preschool Children in a Rural Community near Abeokuta, Nigeria. *Parasite Vectors* Vol.**3** 10.1186/1756-3305-3-58.

Huw, T., Brindly, P.J., MicMinus, D. P., Feng, Z. and Han, Z. G. (2014). Schistosome transcriptions : new insights into the parasites and Schistosomiasis. Trends of Molecular Medicine. 10: 217 - 225.

John, A.O. and Ojewole, F. (2004). "Indigenous Plants and Schistosomiasis Control in South Africa: Molluscicidal Activity of Some Zulu Medicinal Plants. *Boletin latinoamericano Y delcaribe de plantas medicinales Y Aromaticas. ISSN (Version impresa)*: **3**: (1): 0717-7917 CHILE.

Jukes, M.C.H., Nokes, C.A. and Alcock, K.J. (2002). Heavy Schistosomiasis Associated with poor short-term memory and slower reaction times in Tanzanian School Children. *Tropical Medicine and International Health,* **7**(2):104-117.

Jurberg, P., Neto, J.C.B. and Schall, V.T. (1985). Mollucicidal Activity of 'Avelos' Plant (*Euphorbia tirucalli*, L.) on *Biomphalaria grabrata*, the mollusc vector for Schistosomiasis. *Mem. Inst. Oswaldo Cruz*. **80** :423-427.

Khanchan, L., Singh, D. K. and Singh, V. K., (2012). Characterization of the molluscicidal activity of *Bauhinia variegata* and *Mimosops elengi* plant extracts against the *Fasciola* vector *Lymnae acuminate.* Review Institute of medicine and tropical diseases. 54: 3.

Kloos, H. and McCullough, F.S. (1987). Plant Molluscicides. *Journal of Medicinal Plant Research*; **46**: 195-209

Kloos H., and McCullough, F. S (1982). Plant Molluscicides. *Planta Medica*, **46**: 195-209.

Kuo, Y.H. (1987). Plant Molluscicidal Studies in the People's Republic of China. *In: Mott, K.E. ed. Plant Molluscicides*. New York. UNDP/World Bank/WHO. 228-299.

Ladan, M.U., Abubakar, U., Abdullahi, K., Bunza, M.D.A., Nasiru, M. and Ladan, M.J. (2011). Gender and Age Specific Prevalence of Urinary Schistosomiasis in selected villages near a Dam site in Gusau Local Government Area. Zamfara State *Nigerian Journal of Parasitology* **32**(1):55-60.

Malek E.A. and Cheng, T. C. (1974). Medical and Malacology, *Academic Press Inc*. London. pp.285-319.

Mbata, T. I., Orji, M. U. and Oguoma, V. M. (2009). High Prevalence of Urinary Schistosomiasis in a Nigerian community. *Africa Journal of Biomedical Research.* **12**, (2)101-105.

Michaud, C. M., Gorden, W.S. and Reich, M.R. (2003). The Global Burden of Diseases Due to Schistosomiasis. *Dcpp working paper* **19**,Cambridge, *Pp* 1-40

MOI (2008).Ministry of Information, Sokoto, Nigeria. *Diary*, p. 12.

Mozley A. (1952). Molluscicides. *Lewis & Co*., London.

NPC/FRN (2007). Nigeria Population Commission, Federal Rep. of Nigeria. Special FGN *Gazette* 23.

Russell, R. M., Robertson, J.L and Savin, N.E. Polo, I. (1977). A New Computer Program for Probit Analysis. *Bull Entomological Society of America*. **23**:209-213.

Singh, K. and Singh, D.K. (1997). Molluscicidal Activity of Plant Derived Molluscicides. *Journal of Herbs, Spices and medicinal Plants.* 5 (2): 67-72.

Suleiman, J., Kiran Singh, A. Y. Bala., Mohammed, A. A., Lema, S.Y., Rabi'atu, M. S. and Yakubu, M. S.(2020). Phytochemical Constituents and Molluscicidal efficacy of *Allium sativum* (LINN.) against *Bulinus globosus* in Sokoto, Nigeria. European Journal of Pharmaceutical and Medical Research. Ejpmr, 2020, 7(3). ISSN 2394 - 3211.

Ugomoiko, U.S., Ofoezi, I.E., Okoye, I.C. and Heukelbach, J. (2010). Factors Associated with Urinary Schistosomiasis in two peri-urban Communities in South-western Nigeria. *Annual Tropical Medical Parasitology*, **104**:409-419.

WHO, (2013). The control of Schistosomiasis,' Tech. Rep. 830, WHO Geneva, Switzerland.

WHO, (2002). Schistosomiasis. World Health Organization: Prevention and Control of Schistosomiasis and soil-Transmitted Helminthiasis. In Report of a WHO Expert committee. *WHO Technical report series* No.912.

WHO, (2010). Intermediate Hosts of Schistosomiasis and Food Borne Trematode Infections. Freshwater Snails retrieved on 20thof January,

WHO. (1983). Report of Scientific Working Group on Plant Molluscicide and Guidelines for Evaluation of Plant Molluscicide. Geneva; *TDR/SCH-SWE* **(4)**/83.3).