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MYCOTIC INFECTIONS OF CABBAGE HEAD: ATTENDANT NUTRITIONAL EFFECTS AND EFFECTS OF LEAF, BARK AND ROOT EXTRACTS OF CINAMOMUM CASSI, AZADIRACHTA INDICA AND GMELINA ARBOREA ON ROT PATHOGENS OF CABBAGE (*Brassica oleracea*) HEADS

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ABSTRACT

The present study investigated fungal infection on cabbage heads, nutritional effects of infections on cabbage and antifungal effects of root, bark and leaf aqueous and methanolic extracts of *A. indica*, *G. arborea* and *C. cassia on fungal isolates viz: Aspergillus flavus*, *Rhizopus stolonifer, Aspergillus niger, Mucor sp.* and *Penicillium* sp. from cabbage heads. These fungi affected nutritional values of infected cabbage heads. This result revealed that *Mucor* sp (41.18%) was the most frequently occurred as fungal pathogen of cabbage head; this was distantly followed by *Aspergillus niger* (29.41%). Aqueous and methanolic root extracts of the test plants were most potent compared with bark, leaf aqueous and methanolic extracts. Aqueous root extract of *A. indica* was most effective compared with bark and leaf aqueous extracts. The antifungal activities of *A. indica* aqueous root extract ranged from 16.20 mm (*A. niger*) to 18.50 mm (R. stolonifer), bark aqueous extract ranged from 14.20 mm (A. flavus) to 17.50 mm (*R. stolonifer*)

Methanolic root extract of *A. indica* was most effective compared with bark and leaf aqueous extracts. The antifungal activities of *A. indica* aqueous root extract ranged from 23.10 mm (*A. niger*) to 35.10 mm (*Mucor* sp.), aqueous root extract of *G. arborea* was most effective compared with bark and leaf aqueous extracts respectively. The antifungal activities of G. arborea aqueous root extract ranged from 10.00 mm (Mucor sp.) to 14.50 mm (A. flavus), methanolic root extract of *G. arborea* was most effective compared with bark and leaf aqueous extracts. Antifungal activities of *G. arborea* methanol root extract ranged from 10.00 mm (*Mucor* sp.) to 23.00 mm (*Penicillium* sp.). Aqueous root extract of C. cassia was most effective compared with bark and leaf aqueous extracts. Antifungal activities of *G. arborea* aqueous root extract ranged from 12.00mm (Penicillium sp) to 15.00 mm (Mucor sp).

Methanolic root extract of C. cassia was most potent compared with bark and leaf aqueous extracts. Antifungal activities of C. cassia methanol root extract ranged from 22.00 mm (*R. stolonifer*) to 26.00 mm (*A. niger*). *A. niger* (97.09%) and *Mucor* sp (96.13%) infected cabbage had most moisture content, most dry matter was observed in cabbage infected with *R. stolonifer* (7.98%), this was closely followed by *A. niger* (7.85%), *A. niger* (1.06%) and *Mucor* sp (1.00%) infected cabbage heads respectively had highest ash value. *A. flavus* (3.00%), *A. niger* (2.92%) and *R. stolonifer* (2.89%) infected cabbage heads respectively caused the highest crude fibre, there was generally low fat on cabbage infected with all the fungal isolates, Penicillium sp. (1.98%) and *R. stolonifer* (1.90%) infected cabbage heads had the highest crude protein, cabbage infected with *R. stolonifer* (7.61%), *Mucor* sp (7.55%) and *A. flavus* (7.01%) had the highest carbohydrate. The variations in fungal infection of cabbage heads observed in this study can be attributed to both pre and post-harvest events. The results of the effects of test plant extracts using different solvent indicated that all the test plants can serve as alternatives to synthetic fungicide.

Keywords: Cabbage Heads, Mycotic Infections, Nutritional Effects, Leaf, Bark And Root Extracts.

1. INTRODUCTION

Cabbage is a famous cultivar of the species *Brassica oleracea* of the family Brassicaceae (cruciferae). It is an herbaceous, biennial dicotyledonous flowering and leafy vegetable. Cabbage is rich in nutrients, very low in calorie and fat free. It is a good source of potassium, quarcitin, beta carotene, vitamins K, C, A, and E; these vitamins boost the immune system, fight bacteria and improve complexion, reducing the signs of ageing and more Kumar *et al* (2023). Food production has been facing huge challenge as a result of the destructive activities of numerous diseases such as fungi, weeds and insects from time immemorial and also attendant effects of climate change, culminating in radical decrease in yields and this portends great threat to food security globally. Plant diseases are constantly being introduced to new areas either naturally or accidentally, or, in some cases, organisms that are intentionally introduced become pathogenic (Guégan *et al.*, 2023). Global trade has resulted in increased numbers of invasive non-native pest species being introduced to new areas. Controlling these invasive species presents an unparalleled challenge worldwide (Venette and Hutchison, 2021).

Various types of direct and indirect losses caused by plant diseases include, reduced quality and quantity of crop produce, increased cost of production, threat to animal health and environment, loss of natural resources and less remunerative alternatives adopted (Jauhari, 2025). Fungi are the most important cause of plant disease (Degani, 2025), since they are the most widespread and destructive parasites of plants (Rhouma, 2025).

Zhou *et al* (2024) reported chemical means of plant protection as occupying the leading place regarding their total volume of application in integrated pest management and diseases of plants. Barathi *et al.*, (2024) reported several efforts that have been made to control insects responsible for the transmission of diseases and causing damages to agricultural products. Pesticides cause toxicity to humans and warm-blooded animals. Okwute and Egharevba (2024) reported that instead of the much expected results, the use of synthetic agents has led to the disruption of natural biological control systems and development of resistance. Saberi and Vazvani (2024) reported that, due to public awareness about residual effects and development of resistance in many pathogenic microorganisms, there is an urgent need and even challenge for plant pathologists to search and promote development of novel, eco-friendly and economical, antifungal drugs as a replacement for the existing chemical/synthetic fertilizers in one of many steps toward the goal of sustainable agriculture.

Extracts isolated from several plants have reported to possess biological activity such as antimicrobial, antifungal and anti-inflammatory abilities due to the presence of bioactive compounds like alkaloids, glycosides, resins, volatile oils, gums and tannins, etc. (Riaz *et al.*, 2023). Previous studies revealed antifungal, antiviral, nematicidal, antifungal, and insecticidal and antioxidant activities of essential oils from spices and herbs, *Lavandula* sp., *Salvia* sp., *Thymus* sp., *Citrus* sp., and *Cymbopogon* sp etc., against application in skin fungal infections (Rashed, *et al*., 2021).

2. MATERIALS AND METHODS

Samples collection

Samples of cabbage heads were purchased from Ado-Ekiti market and transported to the laboratory at Federal Polytechnic, Ado-Ekiti in sterile polythene bags for fungal isolation and analysis.

Samples processing

The surface sterilized cabbage heads showing symptoms of diseases were then sliced into 2mm² pieces and plated on to sterile PDA in Petri dishes supplemented with 250mg chloramphenicol to prevent bacterial contamination (Pramod *et al.,* 2022). The plates were incubated at room temperature for 2-3 days and observed for fungal growth and later sub cultured into fresh PDA medium.

Obtained pure isolates of fungi were identified on the basis of macro and micro morphological characteristics. Morphological identification of fungi was harped on the morphology of the fungal hyphae and colony of the culture, the characteristics of the spores and reproductive structures were examined (Olumuyiwa, *et al*., 2025). The rotten tissues were stained using cotton blue and lactophenol (Yang, *et al*., 2023) and observed under microscope. The colonies that developed were counted and sub-cultured repeatedly on PDA plates to obtain pure cultures. They were later stored on PDA slants for identification and characterization.

Plant materials

Preparation of plant crude extracts

Crude plant extracts were obtained from root, back and leaf of test plants viz: *Azadirachta indica, Gmelina arborea and Cinnamomum cassia*. The extraction process followed the procedure described by Chibuye *et al.* (2023). The leaves were washed under tap water, rinsed in three changes of sterile distilled water and dried using sterile blotting paper. The test plants were then dried at a temperature of 40°C for three weeks. The root and bark were also washed under tap water and rinsed in three changes of sterile distilled water. These were blotted dry using sterile blotting papers, peeled, cut into smaller pieces and placed in the oven at the same temperature for three days. All the plant materials were then pulverized using sterile mortar and pestle so as to rapture leaf tissues and cell structures to release the active cell contents. The extracts were placed in sterile specimen bottles. This was done to maximize the surface area which in turn enabled the mass transfer of active ingredients from the plant material to the solvent.

Fifty (50g) each in two places of the powder were put into separate sterile conical flasks and 200mL of solvent (methanol and aqueous) added to each of the plant powder ensuring that the powder was completely immersed into the solvent, then shaken vigorously and allowed to stand on the bench at room temperature but shaken at different intervals for two days. A sterile funnel was placed into a 500ml conical flask and then a Whitman's (No.1) filter paper was folded and placed into the funnel. The extract was poured gradually into the filter paper and allowed to trickle into the conical flask. The filtrate was then poured into sterile universal bottles.

The crude extracts in the universal bottles were placed in a rotary evaporator for 60 minutes at 50°C to concentrate the extracts by evaporating the solvent. The concentrated crude extracts were dried in an oven at 40°C for two days until a powder like substance remained at the bottom of the universal bottles. The labeled universal bottles containing the powder were stored in the refrigerator at 4°C.

Preparation of inoculum

The fungal inoculum was prepared from five-day old culture grown on potato dextrose agar medium. The Petri dishes were flooded with 8 to 10mL of distilled water and the conidia were scraped using sterile spatula. The spore density of each fungus was adjusted with spectrophotometer (A595 nm) to obtain a final concentration of approximately 105 spores/mL according to Cheesbrough (2019).

Evaluation of effects of the crude extracts on the fungi isolate

The method of Ijato *et al* (2023) was used to determine the effects of the crude extracts on the fungi. Crude extracts were prepared by separately weighing root, back and leaf of *Azadirachta indica*, *Gmelina arborea* and *C. cassia* and pulverized. Each powder was dissolved in 1mL of sterile distilled methanol and water to form solutions of different concentrations. The Muller Hinton agar medium was prepared according to manufacturer's instruction and autoclaved at the 121℃ for 15 min. The media was poured into each Petri dish and set aside to solidify in bio-safety chamber. After solidifying the media, the sterile glass spreader was used to spread the inoculums throughout the medium uniformly. Then, 100µL of each extract adjusted to the same concentration (50mg/mL) and perforated filter paper (disc) were soaked for two hours before placing them on the agar plate. The agar plate was allowed to rest for 1 hour under the incubated later at 37℃ for one daytime.

The sensitivity of the test microorganisms was found by assessing the diameter of the zone of inhibition in which significant susceptibility was taken as ≥ 7 mm in diameter.

Pathogenicity test

Pathogenicity test was carried out using the techniques described by Ijato *et al.* (2023). Cabbage head samples were obtained from the market with zip lock bag and transported to laboratory. The cabbage head was then washed under running tap to eliminate dirt from their surfaces. They were surface sterilized in 1% NaOCl for three minutes. Thereafter, they were rinsed in three changes of sterile distilled water and wiped dry using a sterile blotting paper. A sterile inoculating needle containing fungal spore was used to punch the. The isolated fungal pathogens and the inoculating needle were used to inoculate the healthy wounded cabbage head (Kabiru and Yusuf (2024). The wound on the inoculated cabbage was labeled with paper tape. The negative control was also set in the same manner. Disease development was checked after exactly 24 hours. The point of inoculation of each type of fungus was examined and recorded. The diameter of the rotten portion of the fruits was measured and the fungi were later re-isolated from the inoculated samples and compared with the initial isolates.

3. RESULTS AND DISCUSSION

Pathogenicity test in cabbage revealed that the entire selected organism caused rot. The nature or rot varies between the inoculated cabbage heads with various fungi. All the isolated fungi caused softness and rot. Among the isolated fungi, A. flavus and A. niger were most pathogenic, while

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Mucor sp. is the least pathogenic as evident growth diameter. Result also revealed that isolated fungi caused softness of cabbage head from day 3.

Physiological and morphological characteristics of the isolated and identified fungi viz: *Aspergillus flavus*, *Rhizopus stolonifer*, *Aspergllus niger*, *Mucor* sp. and Penicillium sp from the cabbage are presented in Table 1.

Table 1: Physiological and morphological characteristics of isolates from cabbage

Samples	Physiological characteristics	Morphological characteristics	Isolates
1	Brown colony of fungi, the conidiosphores are rough and colourless	Hyphal growth is tread-like branching and produce mycelia, hyphae are septate and hyaline	*Aspergillus flavus*
2	Whitish colonies, growing rapidly and filling the petri dish with dense cottony mycelium and becoming brownish-black with age.	Non-septate mycelia. Sporangiophores are smooth walled. Sporangia and columella are subglobose. Sporangiospores are ovoid in shape. The conidiospore are large with septate hyphae	*Rhizopus stolonifer*
3	Produce colonies that are composed of white of white or yellow felt that is covered by dark asexually produced fungal spores	Colonies consist of a compact white or yellow basal felt covered by a dense layer of dark-brown to black conidial heads. Conidial heads are large (up to 3 mm x 15-20 um in diameter), globose, dark brown, becoming radiate and tending to split into several loose columns with age. Conidial heads are biseriate with the phialides borne on brown, often septate metulae.	*Aspergillus niger*
4	White to grey and fast growing with some black sporongiospore	The sporongiosphores have terminal sporogaia containin ground sporongiospores and columella was well developed with non septate hyphae	*Mucor sp*
5	Green fluffy myecilia with some white sporongiospore	Septate hyphae with filamentous structure	*Penicillium sp.*

Table 2 shows the frequency occurrence of the fungi isolated from cabbage head. The result showed that Mucor sp was most prevalent 7 (41.8%) while R. stolonifer and Penicillium sp. had number of occurrences. The occurrence of the fungi isolated are *Mucor* sp 7(41.8%), *Aspergillus niger* 5(29.4%), *Aspergillus flavus* 3(17.65%), R. *stolonifer* and *Penicillium* sp. had 1 (5.88%) each.

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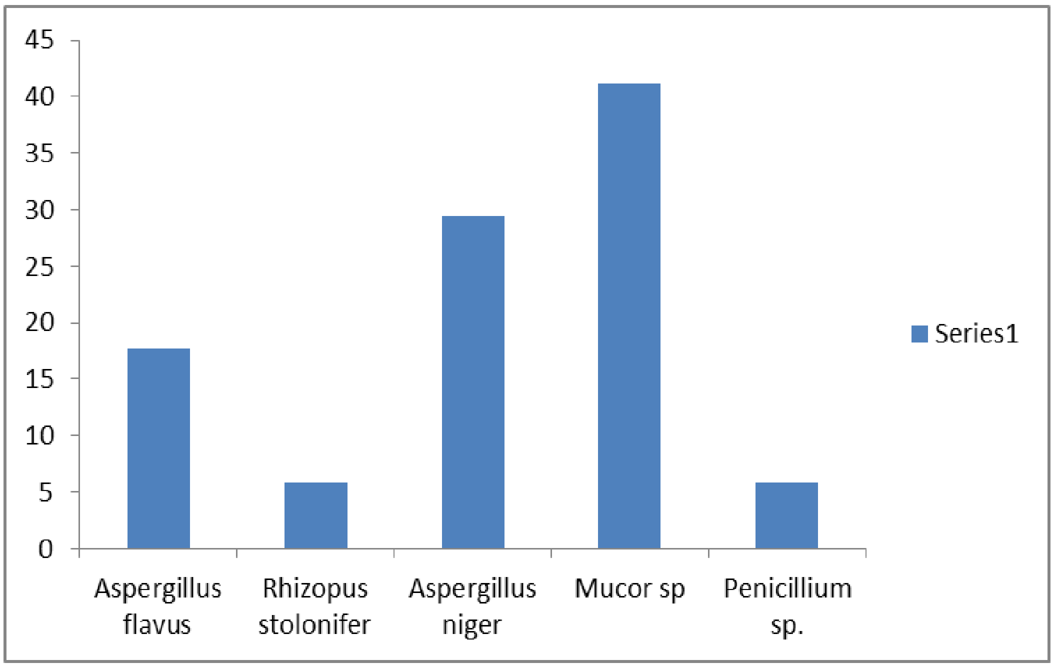
Table 2: Prevalence of fungal isolates from cabbage head

Pathogens	Frequency	Percent %
Aspergillus flavus	3	17.65
Rhizopus stolonifer	1	5.88
Aspergillus niger	5	29.41
Mucor sp	7	41.18
Penicillium sp.	1	5.88
Total	17	100.0



Bar chart showing frequency of occurrence

Antifungal activities of *Azadirachta indica* aqueous extract on isolated fungi were presented in Table 3. The result shows that aqueous extract of root, bark and leaf of *A. indica* inhibited the growth of all the isolated fungi. Aqueous root extract of *A. indica* was most effective compared to bark and leaf aqueous extracts. Antifungal activities of *A. indica* aqueous root extract ranged from 16.20 mm (*A. niger*) to 18.50 mm (*R. stolonifer*), bark aqueous extract ranged from 14.20 mm (*A. flavus*) to 17.50 mm (*Rhizopus stolonifer*), leaf aqueous extract ranged from 10.20 mm (*Penicillium* sp) to 15.50 (*Rhizopus stolonifer* and *Mucor* sp.).

Table 3: Antifungal activities of *Azadirachta indica* aqueous extract

Fungal isolates	Diameter of zones of inhibition (mm)		
	Concentrations (mg/mL)		
	Root	Back	Leaf
Aspergillus flavus	17.70[a]	14.20[b]	11.50[b]
Rhizopus stolonifer	18.50[a]	17.00[a]	15.50[a]
Aspergillus niger	16.20[a]	15.00[b]	11.00[b]
Mucor sp	17.00[a]	15.00[b]	15.50[a]
Penicillium sp.	18.00[a]	16.50[a]	10.20[b]

Values are mean ± standard error of the mean for bioassay conducted in triplicate. Means followed by the same letter(s) are not significantly different (multivariate analysis, Fisher's protected LSD at $p \leq 0.05$).

Table 4 shows that antifungal activities of *A. indica* methanol extract on isolated fungi species. Result presented in Table 4 shows that methanol extract of root, bark and leaf of *A. indica* had significant effects on the growth of all the isolated fungi. Methanol root extract of *A. indica* was most effective compared to bark and leaf aqueous extracts. The antifungal activities of *A. indica* aqueous root extract ranged from 23.10 mm (*A. niger*) to 35.10 mm (*Mucor* sp.), bark methanol extract ranged from 22.00 mm (*A. flavus*) to 30.30 mm (*Mucor* sp.), leaf methanol extract ranged from 21.00 mm (*Aspergillus* sp) to 27.20 mm (*Mucor* sp).

Table 4: Antifungal activities of *A. indica* methanol extract

Fungal isolates	Diameter of zones of inhibition (mm)		
	Concentrations (mg/mL)		
	Root	Bark	Leaf
Aspergillus flavus	28.00[c]	27.00[b]	25.10[b]
Rhizopus stolonifer	30.00[b]	26.70[b]	23.00[c]
Aspergillus niger	23.10[d]	22.00[c]	21.00[c]
Mucor sp	35.10[a]	30.30[a]	27.20[a]
Penicillium sp.	26.20[c]	23.40[c]	21.10[c]

Values are mean ± standard error of the mean for bioassay conducted in triplicate. Means followed by the same letter(s) are not significantly different (multivariate analysis, Fisher's protected LSD at $p \leq 0.05$).

Table 5 shows the antifungal activities of *G. arborea* aqueous extract on fungi isolated from cabbage. The result obtained shows that *G. arborea* aqueous extract root inhibited the growth of all the isolated fungi. Result also showed that *G. arborea* aqueous bark and leaf extract had no inhibitory effect on *Mucor* sp and *A. niger* growth. Aqueous root extract of *G. arborea* was most effective compared to bark and leaf aqueous extracts respectively. The antifungal activities of *G. arborea* aqueous root extract ranged 10.00 mm (*Mucor* sp.) to 14.50 mm (*A. flavus*), bark aqueous extract ranged from 0.00 mm (*Mucor* sp.) to 12.00 mm (*A. flavus*), leaf aqueous extract ranged from 0.00 mm (*A. niger*) to 10.00 mm (*R. stolonifer, Penicillium sp* and *A. flavus*).

Table 5: Antifungal activities of *G. arborea* aqueous extract

Fungal isolates	Diameter of zones of inhibition (mm)		
	Concentrations (mg/mL)		
	Root	Back	Leaf
Aspergillus flavus	14.00^{a}	12.00^{a}	10.00^{a}
Rhizopus stolonifer	12.00^{b}	10.00^{b}	10.00^{a}
Aspergillus niger	12.00^{b}	8.00^{c}	0.00^{c}
Mucor sp	10.00^{c}	0.00^{d}	7.00^{b}
Penicillium sp.	12.00^{b}	10.00^{b}	10.00^{b}

Values are mean ± standard error of the mean for bioassay conducted in triplicate. Means followed by the same letter(s) are not significantly different (multivariate analysis, Fisher's protected LSD at $p \leq 0.05$).

Table 6 shows that antifungal activities of *G. arborea* methanol extract on the fungi species isolated from cabbage head. The root and bark methanol extracts of *G. arborea* had significant effect on the growth of all the isolated fungi while of *G. arborea* was able to inhibit the isolated fungi except *Mucor* sp. Methanol root extract of *G. arborea* was most effective compared to bark and leaf aqueous extracts. Antifungal activities of *G. arborea* methanol root extract ranged 10.00 mm (*Mucor* sp.) to 23.00 mm (*Penicillium* sp.), bark methanol extract ranged from 10.00 mm (*A. niger* and *Mucor* sp.) to 18.00 mm (*A. flavus* and *Penicillium* sp.), leaf methanol extract ranged from 0.00 mm (*Mucor* sp) to 16.00 mm (*A. niger* and *Mucor* sp).

Table 6: Antifungal activities of *G. arborea* methanol extract

Fungal isolates	Diameter of zones of inhibition (mm)		
	Concentrations (mg/mL)		
	Root	Back	Leaf
Aspergillus flavus	22.00^{a}	18.00^{a}	16.00^{a}
Rhizopus stolonifer	16.00^{b}	12.00^{b}	10.00^{b}
Aspergillus niger	12.00^{c}	10.00^{b}	8.00^{c}

Mucor sp	10.00[c]	10.00[b]	0.00[d]
Penicillium sp	23.00[a]	18.00[a]	16.00[a]

Values are mean ± standard error of the mean for bioassay conducted in triplicate. Means followed by the same letter(s) are not significantly different (multivariate analysis, Fisher's protected LSD at $p \leq 0.05$).

Table 7 shows the antifungal activities of *C. cassia* aqueous extract on fungi isolated from cabbage head. The result obtained shows that root, bark and leaf aqueous extract of *C. cassia* inhibited the growth of all the isolated fungi. Aqueous root extract of *C. cassia* was most effective compared to bark and leaf aqueous extracts respectively. Antifungal activities of *G. arborea* aqueous root extract ranged from 12.00mm (*Penicillium* sp) to 15.00 mm (*Mucor* sp.), bark aqueous extract ranged from 10.70mm (*A. flavus*) to 13.10 mm (*Mucor* sp.), leaf aqueous extract ranged from 7.00mm (*R. stolonifer*) to 10.80 mm (*A. niger*).

Table 7: Antifungal activities of *C. cassia* aqueous extract

Fungal isolates	Diameter of zones of inhibition (mm)		
	Concentrations (mg/mL)		
	Root	Back	Leaf
Aspergillus flavus	12.10[b]	10.70[b]	8.50[b]
Rhizopus stolonifer	13.20[b]	12.00[a]	7.00[b]
Aspergillus niger	14.00[a]	11.60[b]	10.80[a]
Mucor sp	15.00[a]	13.10[a]	10.70[a]
Penicillium sp.	12.00[b]	11.40[b]	8.00[b]

Values are mean ± standard error of the mean for bioassay conducted in triplicate. Means followed by the same letter(s) are not significantly different (multivariate analysis, Fisher's protected LSD at $p \leq 0.05$).

Table 8 shows that antifungal activities of *C. cassia* methanol extract on the fungi species isolated from cabbage head. The result shows that all the methanol extracts of *C. cassia* had significant effect on the growth of all the isolated fungi. Methanol root extract of *C. cassia* was most effective compared to bark and leaf aqueous extracts. Antifungal activities of *C. cassia* methanol root extract ranged 22.00 mm (*R. stolonifer*) to 26.00 mm (*A. niger*), bark methanol extract ranged from 21.00 mm (*R. stolonifer*) to 23.10 mm (*A. niger*), leaf methanol extract ranged from 20.00 mm (*Penicillium* sp. and *R. stolonifer*) to 22.00 mm (*A. niger*).

Table 8: Antifungal activities of *C. cassia* methanol extract

Fungal isolates	Diameter of zones of inhibition (mm)		
	Concentrations (mg/mL)		
	Root	Back	Leaf
Aspergillus flavus	22.20[b]	21.50[a]	20.20[a]
Rhizopus stolonifer	22.00[b]	21.00[a]	20.00[a]

Aspergillus niger	26.00[a]	23.10[a]	22.00[a]
Mucor sp	22.10[b]	22.00[a]	21.00[a]
Penicillium sp.	25.10[b]	21.20[a]	20.00[a]

Values are mean ± standard error of the mean for bioassay conducted in triplicate. Means followed by the same letter(s) are not significantly different (multivariate analysis, Fisher's protected LSD at $p \leq 0.05$).

Table 9 presents the nutritional effect of fungi infected cabbages. The result obtained indicated that moisture content ranged between 94.65 and 97.09% with *A. niger* having the highest value while *R. stolonifer* having the least value. The value of dry matter of ranged between 7.49 and 7.98% with *R. stolonifer* having the highest value while *A. niger* has the least value. Ash content of the cabbages ranged between 0.89 and 1.06% with *A. niger* having highest value while *A. flavus* has the least. Results of crude fibre content revealed that it ranged between 2.50 and 3.00% with *A. niger* having the highest value while *Mucor* sp. has the least value for crude fibre. Fat content ranged between 0.01 and 0.02% with *R. stolonifer* having the least value of fat content. Crude protein ranged between 1.82 and 1.90% with *R. stolonifer* having the highest value while *Mucor* sp. having the least value. Carbohydrate content of the cabbages ranged between 7.01 and 7.61% with *R. stolonifer* having the highest value while *A. flavus* has the least value.

Table 9: Result of proximate analysis of cabbage infected with rot pathogens

Parameter (%)	Control	Samples				
		A. flavus	*R. stolonifer*	*A. niger*	*Mucor* sp	*Penicillium* sp.
Moisture content	93.02	95.11	94.65	97.09	96.13	95.90
Dry matter	6.94	7.49	7.98	7.85	7.53	7.70
Ash content	0.67	0.89	0.93	1.06	1.00	0.92
Crude fibre	3.24	3.00	2.89	2.92	2.50	2.68
Fat content	0.1	0.01	0.02	0.01	0.01	0.01
Crude protein	1.80	1.89	1.90	1.89	1.82	1.98
Carbohydrate	6.64	7.01	7.61	7.43	7.55	7.35

Lots of spring-like fungi live tangled with plants roots and helped to pass on nutrient (Priyashantha *et al.*, 2023). Wounds are also known to be the major pre-disposing factor of fruits and vegetables to microbial attack both in transit and in storage (Alegbeleye *et al.*, 2022). The present study investigated the antifungal effect of the root, bark and leaf aqueous and methanol extract on isolated fungi from cabbage.

Some of these fungi isolated in these studies have been reported by several researchers to be commonly implicated in post-harvest deterioration of many fruits and vegetables in the tropics (Alegbeleye *et al*., 2022). Several reports showed the implication of *A. niger* in spoilage of many vegetables (Ramesh *et al*., (2021). Alajlani (2023) suggested that the presence of some antifungal substances such as terpenoid in the tissue of plants are responsible for their antifungal potential on different fungi species.

This result of this study revealed that antifungal activities of methanol extracts are more effective than aqueous extract. Avinash and Nandan (2022) attributed to the presence of active principles that are extracted by several factors such as age of plant, method of extraction and type of extracting solvent.

The percentage ash content values obtained are lower than what was reported by Owolabi *et al.*, (2022) for water leaf and bitter leaf 1.6% and 2.5% respectively. The values obtained for the affected cabbage are lower compared with the value range of 5.50 - 16.10 % as reported by Udousoro and Ekanem (2013) for twelve edible vegetables in Nigeria.

Crude fibre content revealed that it ranged between 2.50 to 3.00 with *Aspergillus niger* having the highest value while *Mucor* sp. The values obtained from these findings are in close range with values reported by Nisha *et al*. (2012) and Gotruvalli *et al.* (2016) for the leaves of *Amaranthus viridis* and *Alternanthera sessilis* with values of 1.93% and 3.40% respectively.

The crude fat contents in the studied cabbages are similar to the report of Onwordi *et al*. (2009) who reported the range of 0.21 – 0.45 % for three leafy vegetables consumed in Lagos Nigeria.

The crude protein contents is low compared with the ranged of 8.44 - 24.32 % reported in some selected Nigerian leafy vegetables by Ajayi *et al*. (2018). The values obtained in this study are lower when compared with the crude protein range of 25.06 - 30.02 % reported for some medicinal leaves (Aborisade *et al*., 2017).

The inhibitory potentials of the plant extracts tested on the growth of isolated fungi from cabbage indicated that *Azadiracthta indica*, *Gmelina arborea* and *C. cassia* are capable of inhibiting the growth of isolated fungi. All the test plants can serve as sources of potent biocides that have immense fungi toxic effect on isolated fungi

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