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Screening and Quantitative Determination of Phytochemical Constituents of *Pleurotus ostreatus* and *Pleurotus pulmonarius* commonly grown in South-western NigeriaEkute, B.O.^{1*}*Department of Pure and Applied Science, National Open University of Nigeria, Plot 91, Cadastral Zone, Nnamdi Azikiwe Expressway, Jabi, Abuja¹**Author for Correspondence*: bekute@noun.edu.ng***Abstract**

Two *Pleurotus spp* (*Pleurotus ostreatus* and *Pleurotus pulmonarius*) were screened in this study to ascertain the presence of phytochemicals in them and the detected ones were subsequently quantitatively assessed. Phlobatannin and tannin were not detected. Amongst the detected phytoconstituents analyzed; alkaloids, saponin and phytates had the highest mean values of $0.64\pm 0.03\%$, $0.36\pm 0.05\%$ and $0.29\pm 0.01\%$ respectively for *Pleurotus ostreatus* and $0.85\pm 0.04\%$, $0.26\pm 0.04\%$ and $0.13\pm 0.006\%$ respectively for *Pleurotus pulmonarius*. Overall, the mushrooms are good sources of useful phytochemicals such as flavonoids, phytates and alkaloids which are positively used in the prevention of renal stone formation, anticancer activities and analgesics.

Keywords: Phytochemicals, *Pleurotus pulmonarius*, *Pleurotus ostreatus*, flavonoids, alkaloids

Introduction

Phytochemicals are chemical compounds produced by plants. They are commonly found in fruits, vegetables, nuts, legumes and grains. Phytochemicals are bioactive compounds that could be beneficial and also detrimental to human health. However, most phytochemicals in the diet benefit us by helping to prevent diseases (Du et al., 2016).

Plants are not the only ones endowed with these excellent components. Edible mushrooms (macro fungi) have been found to be great sources of bioactive metabolites for the

development of drugs and nutraceuticals (Orhan and Üstün, 2011; Terpin and Abramovic, 2010). Studies by Vaz et al. (2011) and Garcia-Lafuente et al., (2011) showed that edible mushrooms are a good source of secondary metabolites such as phenolic compounds, flavonoids, terpenoids, sterols, ascorbic acid, ergothionine and carotenoids. Of these edible mushrooms known to possess antioxidant properties, are the *Pleurotus* species with *Pleurotus ostreatus* being the most important edible mushroom worldwide (Chang and Buswell, 1996). Gunde-Cimerman and Cimerman (1995) reported that *Pleurotus ostreatus* and other closely related species naturally produce Lovastatin® (3-hydroxy-3-methylglutaryl-coenzyme A reductase), a drug which is used for the treatment of excessive blood cholesterol.

Several researches (Ekute, 2018; Edet et al., 2016; Obodai et al., 2014) have been done on the nutritional and mineral content of the mushrooms under investigation. It is also noteworthy that although a food source may be nutritional, there are possibilities of it containing phytonutrients (phytochemicals which are beneficial in reasonable amounts) and phytochemicals which could be detrimental to human life. Therefore, it is pertinent to screen the phytochemical constituents of the mushrooms of interest to ascertain the presence of the common phytochemicals like flavonoids (which are the largest group of phytochemicals (Koosha et al., 2016), saponins, alkaloids, etc and then quantify those present.

Materials and Methods

Fresh mushroom samples were purchased from the Federal Institute for Industrial Research, Oshodi (FIIRO). The samples were washed and then dried in the oven at 40°C to constant weight and ground to powder. The mushroom powders were each kept in pre-cleaned polyethylene bottles prior to analysis.

Ethanolic extractions were done following the method described by Tsai et al. (2009) and Obodai *et al.* (2014). Ten grams of mushroom powder were extracted by stirring in 100ml ethanol at 25°C at 20xg for 24 hours and filtration through Whatman No. 1 filter paper. Extraction was done twice more with the residue and the supernatants pooled together and concentrated under reduced pressure below 40°C to obtain the dried crude extract. The crude extracts were re-dissolved in ethanol at concentration of 20mg/ml and stored at 4°C for further analysis.

The ethanolic extracts were screened for the presence of bioactive compounds following previously described standard procedures (Adebayo and Ishola, 2009; Harborne, 2005; Trease and Evans, 1989; Culei, (1982). Quantitative analysis of the detected phytochemicals was done based on methods described by Harborne (2005) and AOAC (1995).

Results

Table 1 shows the phytochemicals detected in the mushrooms screened. The screening revealed that *Pleurotus ostreatus* and *Pleurotus pulmonarius* contains flavonoids, saponin, terpenoid, phenol, alkaloid, oxalate, cardiac glycoside and hydrogen cyanide whereas phlobatannin and tannin were not detected.

Table 1: Presence of phytochemicals in *Pleurotus ostreatus* and *Pleurotus pulmonarius*

<i>Specie</i>	Flavonoid	Saponin	Terpernoid	Phenol	Reducing sugar	Phloba tanin	Tannin	Alkaloid	Cardiac glycoside
PO	+	+	+	+	+	-	-	+	+
PP	+	+	+	+	+	-	-	+	+

Key

- Means not detected

+ Means detected

The results of the quantitative determination of the detected phytochemicals are presented in Table 2. The analysis revealed that alkaloid was highest in both mushrooms investigated. The mean value for alkaloid in *Pleurotus ostreatus* (PO) was 0.64±0.035% while for *Pleurotus pulmonarius* (PP), it was 0.85±0.04%. Saponin content for PO was 0.36±0.05% and 0.26±0.04% in PP. The amounts of the detected phytochemicals are in the order: alkaloid > saponin > phytate > oxalate > terpenoid > flavonoid > cardiac glycoside > phenol > hydrogen cyanide in both mushrooms though there is an exception in which phenol and cardiac glycoside in PP had a value of 14.13±0.28mg/100g and 13.43±0.20mg/100g respectively.

Table 2: Phytochemical contents of *Pleurotus ostreatus* and *Pleurotus pulmonarius*

Parameter	<i>Pleurotus ostreatus</i>	<i>Pleurotus pulmonarius</i>
Oxalate (mg/100g)	39.60±0.88	65.12±0.88
Flavonoid (mg/100g)	22.49±0.28	18.35±0.42
HCN (mg/100g)	0.266±0.006	0.25±0.00
Cardiac glycoside (mg/100g)	21.87±0.33	13.43±0.20
Terpernoid (mg/100g)	23.55±0.46	24.32±0.13
Phenol (mg/100g)	14.88±0.32	14.13±0.28
Phytate (%)	0.29±0.01	0.13±0.006
Saponin (%)	0.36±0.05	0.26±0.04
Alkaloid (%)	0.64±0.035	0.85±0.04

NB: Values are expressed as mean ± std deviation

Discussion

The results of this study showed that PO and PP are good sources of phytochemicals and phytonutrients. Alkaloids, saponins, phytates are higher in these edible mushrooms with the least phytochemical being HCN. Alkaloids are produced by a large variety of organisms including bacteria, fungi (mushrooms), plants and animals. Alkaloids are pharmaceutically significant as revealed in their use in analgesics, anti-tumor, anti-malarial and anti-hypertensive drugs. The alkaloid content of these mushrooms is indicative of their possible use in drug formulations (Tadeuz Aniszewski, 2007). The result of this study is in line with that obtained by Edet *et al.* (2016) who reported a value of $0.60 \pm 0.10\%$. However, this value varied from that reported by Mariappan *et al.* (2015) which had a mean value of 0.32% for *Pleurotus ostreatus* (Jacq.fr) Kumm. It was also observed that the alkaloid concentration obtained in this study is lower than that for *Psalliota campestris* (2.0%) and *Tricholoma nudum* ($1.0 \pm 0.04\%$) as reported by Udu-Ibiam *et al.* (2014).

The saponin content of the assayed mushrooms is higher than that ($1.21\text{mg}/100\text{g}$) reported for *Cantharellus species* by Okigbo *et al.* (2018). The result is also lower than those documented by Edet *et al.* (2016). Also, the oxalate concentration of PO was lower than $90\text{mg}/100\text{g}$ and $60\text{mg}/100\text{g}$ reported by Afiukwa *et al.* (2013a) for Coral mushroom and *Agaricus bisporus* respectively. However, the oxalate concentration in PP is very similar to that reported for *Agaricus bisporus* by Afiukwa *et al.* (2013a) and lower than $412\text{mg}/100\text{g}$ reported by Harden (2007). It was also observed that the flavonoid content of the mushrooms studied was lower than $270\text{mg}/100\text{g}$, $130\text{mg}/100\text{g}$ and $850\text{mg}/100\text{g}$ reported by Afiukwa *et al.* (2013a) for the three mushrooms they analyzed and $42.63 \pm 0.63\text{mg}/\text{g}$ in *Pleurotus ostreatus* documented by Mariappan *et al.* (2015). However, the flavonoid concentration recorded in this study is higher than $7.23\text{mg}/100\text{g}$ reported by Okigbo *et al.* (2018) for *Cantharellus species*. Similarly, the phenol concentration in both mushrooms investigated was higher than that documented by Okigbo *et al.* (2018) and Udu-Ibiam *et al.* (2014) for *Tricholoma nudum*, *Psalliota compestris* and *Flammulina spp.* The

values were however lower than that obtained by Afiukwa *et al.* (2013b) for *Pleurotus ostreatus* and *Auricularia polytrichia* in Ohaukwu Local Government, Mariappan *et al.* (2015) for *Pleurotus ostreatus* in India and Edet *et al.* (2016).

The mean values of terpenoid in both mushrooms studied were significantly lower than $14.83\text{mg}/\text{g}$, $23.9\text{mg}/\text{g}$ and $33.1\text{mg}/\text{g}$ reported by Ogidi and Oyetayo (2016) for ethanol extracts of *Rigidoporus ulmarius*, *Ganoderma lucidum* and *Lenzites quercina*. Same was observed for Cardiac glycosides. The HCN content of the *Pleurotus spp* studied were lower than those reported by Afiukwa *et al.* (2013a and 2013b). Generally, there were some variations in the results of this study in comparison with what some researchers reported. It is pertinent to note that such variations are expected because as has been previously established by several researchers (Siwulski *et al.*, 2019, Khan and Chandra, 2017 and Belletini *et al.*, 2016; Udu-Ibiam *et al.*, 2014). Environmental conditions such as light, temperature, media components, etc, the type and composition of substrates on which the mushroom is grown and the mushroom specie has effect on both the nutritional and phytochemical composition of the mushroom.

Conclusion

Phytochemicals are essential for the sustenance of life especially as they are applicable in pharmaceuticals used in curing life threatening illnesses. The mushrooms studied contained phytonutrients like flavonoids and other useful phytochemicals such as alkaloids and saponin amongst others. They are all present in reasonable but not excess amounts. Therefore, this does not make consumption of these mushrooms detrimental to human health rather if consumed in right amount; good health is actually promoted especially for cancer and hypertensive patients.

Recommendation

The author recommends that more research be done on these edible mushrooms with relation to the maximum amount of phytochemicals tolerable for humans to prevent toxicity.

Conflict of Interest

The author declares no conflict of interest.

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