Nutritional and phytochemical evaluation of cultivated *Psathyrella atroumbonata* Pegler, a Nigerian edible mushroom

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A nutritional and phytochemical evaluation of cultivated *Psathyrella atroumbonata* Pegler was carried out at the immature and mature stages of the mushroom. The cultivated mushroom is very rich in protein and fibres compared with the wild species, and has a low lipid and sugar content. The nutrient composition is dependent upon the stage of its development and nutrient content was at a maximum at immature stage and decreased during further development. Alkaloids were detected in the mature fruit body, but not in the immature stage. However, saponins and tannins were present in both immature and mature stages. Flavonoids and anthraquinones were absent in the mushroom. The importance of these findings is discussed.

Key words: nutritional, phytochemical, evaluation, *Psathyrella atroumbonata*

Introduction

The use of mushrooms as food is probably as old as civilisation and mushrooms currently have greater importance in the diet of mankind. Cultivation and production of edible mushrooms are on the increase, particularly in Europe, America and Asia. Their increased nutritional importance is due to the nutritive value of high-grade mushrooms, which almost equals that of milk.[1] Mushrooms have been evaluated for their nutritional status on the basis of their chemical composition. Cultivated and wild mushrooms contain reasonable amounts of proteins, carbohydrates, minerals, fibres and vitamins.[2–5] Furthermore, mushrooms are low in calories, sodium, fats and cholesterol.[6] Edible mushrooms have long been considered to have medicinal value and to be devoid of undesirable effects.[7] The United States National Cancer Institute has chosen mushrooms as a source of new drugs for the treatment of cancer[8] and the ethno-medicinal value of many edible mushrooms has been reported by many researchers.[2,3,9–11]

Psathyrella atroumbonata Pegler is one of the most valuable edible mushrooms in Nigeria. The mushroom is a lignicolous fungus commonly found in small clumps on or around rotten wood or on dead roots of trees in the last phases of decomposition. In Nigeria, the mushroom appears around May and persists until the end of the rainy season. The mushroom is similar to *Coprinus* in appearance but does not undergo autodigestion, as in the case of *Coprinus.* According to Wuyep *et al.*,[12] *Psathyrella atroumbonata* has enzymes with high cellulose digestibility. The mushroom is usually collected in the wild and it grows across different parts of Nigeria. Many researchers have collected wild species of the mushroom and analysed its proximate nutrient contents.[2,3,13] In many areas of Nigeria, the mushroom yields substantial income and enhances the nutritional value of meals. Efforts have been made to domesticate the mushroom. The aim of this study was to evaluate the nutritional and phytochemical components of the cultivated strain of *Psathyrella atroumbonata,* a Nigerian edible mushroom.

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Materials and methods

Psathyrella atroumbonata was harvested from the sawdust of *Khaya ivorensis* used for cultivation of the mushroom. The harvested fruit bodies were divided into young (button stage) and mature (fully opened pileus) stage according to the methods of Hammond and Nichols,[14] Gruen and Wong[15] and Kadiri and Fasidi.[10] The fruit bodies were dried at 80°C for 48 h and powdered in a laboratory mortar with a pestle.

The ash content was determined by incinerating 3 g of powdered sample in a furnace at 550°C for 6 h.[16] The ethanol-soluble sugar content was estimated with phenol-sulphuric acid after extracting 1 g of the powdered sample with 80% ethanol for 6 h in a soxhlet extractor.[17] The total lipid content was determined by extracting 2 g of powdered sample with 30 ml petroleum ether in a soxhlet extractor for 4 h.[18] Gross energy was assayed by using the anthrone method of Carroll *et al.*[19] The moisture content was recorded as the loss in weight after oven-drying fresh mushrooms at 80°C for 48 h. The protein and crude fibre content was determined according to the method of the Association of Official Analytical Chemists.[20] The mineral content was determined after wet digestion with a mixture of nitric, sulphuric and perchloric acids using an atomic absorption spectrophotometer (AAS model PV 9100X).

For the phytochemical screening (testing for alkaloids, flavonoids, saponins, tannins and anthraquinones), the following methods were used: Alkaloid determination was done using Mayer's and Dragendoff's reagents following the method of Kapoor *et al.*[21] and Odebiyi and Sofowora[22]. The methods described by Kapoor *et al.*[21] were used for determining the flavonoids. The persistent frothing test for saponins as described by Kapoor *et al.*[21] and Odebiyi and Sofowora[22] was used. Five hundred millilitres of dissolved powdered sample was mixed with 10 ml of distilled water, and the resulting mixture vigorously shaken and filtered. Seven drops of 10% $FeCl_3$ were added to the filtrate. A colour change to blue, black, green or blue-green was taken as evidence of the presence of tannins.[22] One gram of powdered sample was shaken with benzene (10 ml) and the mixture filtered. 10% NH_4OH (10 ml) was added to the filtrate and the mixture transferred into a separating funnel. The development of pink, red or violet colour in the ammonia (lower) layer indicated the presence of anthraquinones.[22]

Results

The proximate nutrient composition and gross energy value of cultivated *Psathyrella atroumbonata* are shown in Table 1. The cultivated mushroom's nutrient composition is comparable to that of wild strains and those of other locally-consumed mushrooms (Table 2). It is very rich in protein, crude fibre and ash. However, it has a low sugar and lipid content. The crude protein represented about 30 g 100 g^{-1} of the dry matter, energy value 3 g 100 g^{-1}, ash content 67 g 100 g^{-1}, crude fibre 3 g 100 g^{-1}, while the lipid and sugar contents were 0.6 g 100 g^{-1} and 1 g 100 g^{-1}, respectively. The results also revealed that the nutrient composition was affected by the stage of development (Table 1). The protein content, crude fibres, ethanol-soluble sugar, lipid and gross energy were at a maximum at the immature stage and decreased

Table 1. The moisture content (%) and nutrient composition (mg 100 g^{-1}) of cultivated *Psathyrella atroumbonata* at different stages of growth.

	Moisture	Dry matter	Ash	Protein	Lipid	Fibre	Soluble sugar	Gross energy
Young fruit body	89.30 ± 0.03	91.0 ± 1.01	60.90 ± 0.22	30.40 ± 0.05	0.6 ± 0.10	3.10 ± 0.06	1.10 ± 1.03	3.80 ± 0.02
Mature fruit body	78.62 ± 0.04	94.0 ± 0.61	67.40 ± 1.00	27.60 ± 0.31	0.3 ± 0.02	2.70 ± 0.13	0.93 ± 0.23	2.34 ± 0.33

Each value is a mean of three replicates ± s.d.

Table 2. Comparison of nutrient composition of cultivated *Psathyrella atroumbonata* with other wild locally-consumed mushrooms.

	Moisture (%)	Dry matter (g 100 g^{-1})	Protein (g 100 g^{-1})	Fibre (g 100 g^{-1})	Ether extract (g 100 g^{-1})	Ash (g 100 g^{-1})
Termitomyces robustus	83	91.7	33.80	3.7	0.1	61.3
Lentinus subnudus	68	97.7	16.40	6.5	0.2	52.1
Auricularia auricular	64.0	96.0	8.90	3.5	0.1	53.2
Volvariella volvacea	88	96.8	19.95	1.38	0.74	49.46
Pleurotus tuberregium	63.6	89.4	14.97	1.22	0.02	54.86
Pleurotus pulmonarius	69	86.2	29.40	1.66	0.13	53.10
Psathyrella atroumbonata	89	94.0	30.40	3.10	0.6	67.40

Garcha *et al.*[27]; Crisan and Sands[29]; Kurtzman[30].

Table 3. Mineral content (ppm) in cultivated *Psathyrella atroumbonata* at different stages of growth.

	Cu	Fe	Mn	Zn	Ca	Na	K	Mg	P
Young fruit body	0.10 ± 0.01	1.00 ± 0.05	0.06 ± 0.02	0.09 ± 0.11	0.91 ± 0.3	1.17 ± 0.12	4.45 ± 1.11	3.38 ± 0.02	0.61 ± 0.03
Mature fruit body	0.09 ± 0.021	0.90 ± 0.32	0.05 ± 0.06	0.05 ± 0.01	1.15 ± 0.034	1.09 ± 0.021	4.05 ± 0.11	5.16 ± 1.32	0.58 ± 0.l4

Each value is a mean of three replicates ± s.d.

during further development of the mushroom. However, the ash content showed an opposite trend. The dry matter of both mature and immature stages did not show significant differences. The mineral content of the sporophore also decreased with maturity (Table 3).

The results of phytochemical screening of the mushroom are shown in Table 4. Alkaloids were detected in the mature fruit body stage but not in the young fruit body stage. Saponins and tannins were also present in both young and mature stages. Flavonoids and anthraquinones were absent in the mushrooms.

Table 4. Phytochemical screening of cultivated *Psathyrella atroumbonata* for alkaloids, saponins, flavonoids, tannins and anthraquinones.

	Alkaloids	Saponins	Flavonoids	Tannins	Anthraquinones
Young fruit body	–	+++	–	+++	–
Mature fruit body	+	++	–	++	–

– indicates absence.
+ indicates presence.
+, ++, +++ indicate increasing concentration.

Discussion

The result of the nutritional evaluation of cultivated *Psathyrella atroumbonata* is similar to the wild strains and other common species of edible mushroom studied in Nigeria.[2,13,23,24] This mushroom is a richer source of protein than most commonly-consumed vegetables in Nigeria.[25] While the protein content is lower than that found in eggs, meat and fish, it is adequate to be used as a substitute in the diet of the general public. These findings are similar to the previous findings of Aletor.[3] The mineral content in this mushroom is higher than in several cowpea varieties,[26] but lower than in fish, snails and broiler meat. On the basis of the observed nutritional value of cultivated *P. atroumbonata,* its nutritional quality falls between most legumes and meat.[3] The protein content was at a maximum at the immature stage and slightly decreased during further development. However, the protein content continued to be high up to the harvest stage. These findings are in line with the work of Garcha *et al.*[27] who evaluated the nutritional importance of *Agaricus bisporus, Pleurotus florida* and *Pleurotus ostreatus* and found that their protein contents were at a maximum at immature primordial stage and decreased as the mushrooms aged.

From the information gathered so far about the nutritional potential of edible mushrooms, it is conceivable that a number of wild and cultivated edible species of mushrooms such as *P. atroumbonata* hold great promise of reducing the protein and mineral deficiencies prevalent in the diets of humans in several developing countries.

The phytochemical screening shows the presence of alkaloids, saponins and tannins. Alkaloids were detected only in the mature stage of the fruit bodies. Flavonoids and anthraquinones could not be detected. In comparison, Kadiri and Fasidi[10] detected alkaloids, tannins and anthraquinones, but not flavonoids, in some edible Nigerian mushrooms. These findings are in line with those of Hammond.[28] The medicinal uses of many Nigerian mushrooms have been reported.[9] The medicinal value may be due to the presence of the secondary metabolites in these mushrooms, such as *Psathyrella atroumbonata*.[10] However, further studies on its polysaccharide contents, toxicity and medicinal value are highly recommended.

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