



## Nutrient distribution in wild and cultivated edible mushroom, *Pleurotus sajor-caju*

F.L. Oyetayo<sup>1\*</sup> and A.A. Akindahunsi<sup>2</sup>

<sup>1</sup>Department of Biochemistry, University of Ado-Ekiti, Nigeria. <sup>2</sup> Department of Biochemistry, Federal University of Technology, Akure, Nigeria. \*e-mail: ovounad@yahoo.com

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### Abstract

Two varieties of mushroom *Pleurotus sajor-caju*, obtained from the wild and cultivated (on shredded corncobs), were analysed (whole mushrooms and caps and stalks separately) on dry weight basis for their proximate, mineral and some antinutrient compositions. The caps of cultivated mushroom (Cc) accumulated higher concentrations of crude protein (26.34%) and ash (10.37%) than caps of the wild one (Wc), which had higher crude fat (3.90%) and crude fibre (16.32%) concentrations. The stalk of wild mushrooms (Ws) contained the highest concentration of crude fibre (26.14%). Of the nutritive elements analysed, potassium was the most dominant with concentration as high as 11.9 mg g<sup>-1</sup> in the stalk of cultivated mushrooms (Cs). The caps of both varieties were found to contain zinc, phosphorus and magnesium in higher concentrations than their corresponding stalks. Iron and zinc in the cultivated mushroom (Cw) were more preponderant than in the wild one (Ww). Tannin concentrations (%TA) in cap and stalk of the wild variety were at an equal level (0.57) and lower than those in the cultivated one (0.76-0.99). The total cyanide concentration (mg/100g) in both varieties (0.00-0.02) was generally low. The calculated phytate/Zn and [Ca]:[phytate]/[Zn] molar ratios were below the critical levels.

**Key words:** *Pleurotus sajor-caju*, proximate composition, total cyanide, phytate, tannin.

### Introduction

Edible mushrooms are sources of food and delicacies all over the world. They have a high nutritional value almost twice that of any vegetable or fruit. They are rich in vitamins B, C and D and mineral elements<sup>1,2</sup> but the bioavailability of some elements depend on the level of interactions with various antinutrients. Apart from their use as food, sufficient evidences suggest that many species contain substances that may prevent or alleviate cancer, heart diseases, diabetes and viral infections<sup>3,4</sup>. *Pleurotus* spp. (Oyster mushroom) which are primary wood rot fungi are well known edible mushrooms in different parts of the world<sup>5</sup>. *Pleurotus sajor-caju*, a common edible mushroom in Nigeria, which is highly appreciated for its meaty taste and biting texture, is usually obtained from the wild (as a forest product). However, with rapid urbanisation, these habitats with suitable agroclimatic conditions are being destroyed alongside the germplasm of this fungus. Hence, efforts towards their domestication are necessary. Corncobs are agricultural wastes available in Nigeria in large quantities. After the removal of the grains, they are sometimes fed to livestock or simply burnt off since they could constitute a nuisance to the environment. However, this waste could be effectively exploited to yield useful food that can improve human nutrition and the remaining material after harvesting can be composted and applied directly to the soil as organic fertilizer. A comparative evaluation of the nutritional potentials of *Pleurotus sajor-caju* cultivated on corncobs and obtained from the wild is reported in this paper.

### Materials and Methods

Experimental material included fruitbodies of mushroom *Pleurotus sajor-caju* cultivated on shredded corncobs and obtained from the wild. For production of cultivated mushrooms, corncobs of maize (*Zea* spp.) obtained from some farmers in Ibadan, Nigeria, were screened and cleaned to remove extraneous substances,

shredded into pieces of between 1-3 cm long and soaked in water to achieve moisture content of about 60-65%. Polypropylene bags were then filled with moist corncobs substrate, sterilized at 121°C for 15 min and after cooling inoculated with the mushroom spawn, watered regularly and incubated for 30 days and the emerging fruitbodies were harvested. Fresh fruitbodies of wild mushrooms were collected by local farmers and purchased from three local markets in Ado-Ekiti, Nigeria. Each lot of fruitbodies was cleaned and divided into two parts of which one part was separated into caps and stalks and the other was left as whole. The three samples per each lot were cut into smaller bits, oven-dried at 60°C and powdered in a Philips blender.

Moisture content was determined by the direct oven drying method. The weight loss after oven drying of each sample (1g) at 105°C to constant weight was expressed as % moisture content<sup>6</sup>. Nitrogen was determined by the Kjeldahl method. Because of the significant content of non-protein nitrogen in mushrooms, the protein was determined by using the adjusted conversion factor 4.38 for mushroom protein<sup>4,7</sup>. Crude fat was determined by using the Soxhlet extraction method using petroleum ether as the solvent<sup>8</sup>. Ash content of 1 g powdered sample was determined as the residue of incineration at 550°C in a muffle furnace<sup>8</sup>. Total carbohydrate was determined by extracting 2 g of each sample in 50 ml distilled water of which 0.2 ml was diluted ten-fold. To 1 ml of the resulting solution and serial dilutions of glucose stock (10 mg/100 g) solution, 4 ml of anthrone reagent was added and absorbances of solutions were measured by a spectrophotometer at 620 nm against a reagent blank<sup>9</sup>. General metabolisable energy was estimated by multiplying the crude protein, fat and carbohydrate by 16.75, 37.6 and 16.75 (kJ g<sup>-1</sup>) respectively<sup>10</sup>. The solution of ash dissolved in a drop of trioxonitrate (V) acid made up to 50 ml with deionised water was analysed for Ca, Mg, Cu and Zn using the atomic absorption spectrophotometer, for Na and K

using a flame photometer, and for P using UV-Visible spectrophotometer at 436 nm after making ammonium vanadate molybdate complex according to established procedures of Perkin-Elmer<sup>11</sup>. Tannin content was determined as follows: 200 mg of three replicates of each sample were extracted with 70% acetone. Standard tannic acid solution (50 mg/100ml) was prepared and serial dilutions made. Absorbances of solutions were measured at 725 nm after the addition of 0.5 ml folin and 2.5 ml 20% Na<sub>2</sub>CO<sub>3</sub><sup>12</sup>. Cyanide concentration was determined by the standard method of AOAC<sup>6</sup>. 4 g of three replicates per sample were soaked in a mixture of 2 ml orthophosphoric acid and 40 ml distilled water overnight to free bound cyanide. The resulting solution was distilled and distillate titrated against 0.01 M AgNO<sub>3</sub>. Cyanide concentration was obtained in mg kg<sup>-1</sup>. All samples were analysed in triplicates and results were recorded as mean ± S.D. All glasswares used were washed in glass-distilled water and the chemicals used were analytical grade.

### Results and Discussion

Table 1 presents the proximate compositions (g/100 g) (on dry weight basis) of cultivated and wildy obtained *Pleurotus sajor-caju* fruitbodies. Moisture content distribution was uniform in both varieties ranging from 10.09±0.01% in the cultivated cap to 12.60±0.01% in the wild one (whole). The cultivated variety had higher concentration of protein (17.49±0.01-26.34±1.00) than the wild one (14.55±0.02-20.56±0.20) showing the cultivated variety as a better source of protein than the wild one. Protein concentration varied among the mushroom parts, the caps of both cultivated (26.34±1.00) and wild (20.67±0.20) mushrooms were higher in protein concentration than their corresponding stalks (22.51±0.20, 14.55±0.02). This type of distribution is in agreement with the reports of Fasidi and Kadiri<sup>13</sup> for *Volvariella esculenta* and Ola and Oboh<sup>14</sup> for *Termitomyces robustus* and *Lentinus subnudus*, which showed higher protein concentration in the cap.

Our results were in agreement with earlier studies<sup>15, 4</sup> which showed that mushrooms are generally low in crude fat concentration. E.g. Ragnathan and Swaminathan<sup>16</sup> obtained low fat concentration in three species of *Pleurotus* grown on various agro-wastes. In our study, the fat concentration in the cultivated variety (2.6±0.01-3.67±0.20) was lower than that in the wild one

(3.90±0.10-4.77±0.10). Hence the cultivated variety will be more useful in the formulation of weight restriction diets than the wild one.

The wild variety was found to contain higher crude fibre content (16.32-26.14) than the cultivated one (7.8-16.2). This is expected considering the fact that the wild variety grows on prostrate decaying logs from which they directly obtain nutrients and this could be their source of high fibre content. Generally, the stalks were higher in crude fibre concentration than their corresponding caps. This is in agreement with the results of Fasidi and Kadiri<sup>1</sup> and Ola and Oboh<sup>14</sup> who found in the stalks of various edible mushrooms higher crude fibre concentration than in caps. This distribution may be to strengthen the stalk for mechanical support of the cap, which is usually about thrice the stalk's size. Fibres are an essential part of a healthy diet<sup>4</sup> and have an important preventive action for colorectal carcinoma<sup>17</sup>.

Based on the crude protein, carbohydrate and fat contents the energy values (kJ/100 g) of the mushrooms were calculated. The cultivated mushroom would be a better energy source (1133-1215) than the wildy obtained one (940-1163).

Mineral composition (mg g<sup>-1</sup>) of cultivated and wildy obtained *Pleurotus sajor-caju* fruitbodies is shown in Table 2. Potassium was the most abundant nutrient followed by phosphorus and magnesium. Fasidi and Ekuere<sup>18</sup> and Manzi et al.<sup>19</sup> also reported that potassium was the most abundant mineral element in various species of edible mushrooms. In our study potassium concentration in the cultivated stalk (11.9) was higher than in the cap (8.7). Mushrooms are generally low in sodium concentration<sup>15</sup>. The low sodium and high potassium concentration is of significance as a Na/K ratio less than 0.6<sup>20</sup> suggests that the mushrooms will be suitable for diet formulation for hypertensives. Zinc was distributed such that the cultivated variety had a higher concentration (0.17-0.34) than the wild one (0.15-0.27) and the caps contained higher concentrations than the stalks.

The antinutrient compositions are shown in Table 3. The total cyanide concentration (mg/100 g) was generally low (0.00-0.02) and interestingly it was not detected in both stalks. This shows that the stalk could be a mere passage for cyanide in these mushrooms. The tannin concentration (%TA) was higher in cultivated (0.76-0.99) than in wild mushrooms (0.47-0.57), which

**Table 1.** Proximate (g/100 g) composition\* of cultivated and wildy obtained *Pleurotus sajor-caju* fruitbodies.

|                     | Cc         | Cs         | Cw         | Wc         | Ws         | Ww         |
|---------------------|------------|------------|------------|------------|------------|------------|
| Moisture            | 10.20±0.02 | 10.09±0.01 | 12.60±0.10 | 10.20±0.02 | 10.80±0.01 | 12.60±0.01 |
| Crude protein**     | 26.34±1.00 | 22.51±0.20 | 17.49±0.01 | 20.67±0.20 | 14.55±0.02 | 14.94±0.10 |
| Crude fibre         | 8.97±0.10  | 16.24±0.30 | 7.80±0.05  | 16.32±0.10 | 26.14±0.01 | 17.13±0.10 |
| Crude fat           | 3.67±0.20  | 2.60±0.10  | 3.00±0.21  | 3.90±0.10  | 4.77±0.10  | 4.60±0.20  |
| Ash                 | 10.37±0.20 | 8.54±1.00  | 10.51±1.20 | 8.67±2.10  | 9.90±0.02  | 7.41±2.10  |
| Total carbohydrates | 38.18±0.02 | 40.02±0.10 | 48.5±0.10  | 40.20±1.00 | 31.0±0.20  | 42.36±1.00 |

\*Analysed on dry weight basis, (mean ±SD) \*\* (Nx4.38)

Cc Cultivated cap, Cs Cultivated stalk, Cw Cultivated whole, Wc Wild cap, Ws Wild stalk, Ww Wild whole.

**Table 2.** Mineral composition\* (mg g<sup>-1</sup>) of cultivated and wildy obtained *Pleurotus sajor-caju* fruitbodies.

|    | Cc         | Cs         | Cw        | Wc         | Ws         | Ww         |
|----|------------|------------|-----------|------------|------------|------------|
| Ca | 5.28±0.20  | 6.60±0.01  | 4.23±0.1  | 4.49±0.01  | 4.49±0.00  | 6.98±0.2   |
| Fe | 1.90±0.01  | 1.29±0.1   | 1.37±0.1  | 1.09±0.02  | 1.51±0.01  | 1.63±0.02  |
| K  | 8.71±0.00  | 11.88±0.02 | 7.74±0.01 | 8.73±0.01  | 8.28±0.01  | 9.81±0.01  |
| Na | 1.90±0.01  | 1.29±0.02  | 1.37±0.10 | 1.09±0.10  | 1.51±0.10  | 1.63±0.03  |
| Zn | 0.34±0.00  | 0.27±0.10  | 0.17±0.10 | 0.27±0.02  | 0.09±0.10  | 0.15±0.10  |
| Cu | 0.03±0.02  | 0.05±0.01  | 0.02±0.01 | 0.04±0.01  | 0.01±0.01  | 0.05±0.00  |
| Mg | 7.24±0.00  | 7.05±0.01  | 6.23±0.01 | 7.94±0.01  | 7.13±0.00  | 6.69±0.00  |
| P  | 10.52±0.02 | 7.26±0.01  | 9.38±0.01 | 11.80±0.01 | 11.42±0.01 | 11.73±0.01 |

\*Analysed on dry weight basis, (mean ±SD)

Cc Cultivated cap, Cs Cultivated stalk, Cw Cultivated whole, Wc Wild cap, Ws Wild stalk, Ww Wild whole.

**Table 3.** Some antinutrient components\* (mg/100g) of cultivated and wildy obtained *Pleurotus sajor-caju* fruitbodies.

|               | Cc          | Cs          | Cw          | Wc          | Ws          | Ww          |
|---------------|-------------|-------------|-------------|-------------|-------------|-------------|
| Phytate       | 451.29±0.00 | 225.64±0.00 | 338.47±0.10 | 225.64±0.10 | 394.88±0.10 | 310.26±0.10 |
| Total cyanide | 0.02±0.00   | ND          | 0.15±0.02   | 0.02±0.02   | 0.00        | 0.02±0.00   |
| Tannin**      | 0.99±0.00   | 0.85±0.02   | 0.76±0.01   | 0.57±0.02   | 0.57±0.00   | 0.47±0.02   |

\*Means of triplicates determined on dry weight basis.

ND Not detected

\*\*Tannin expressed as %TA

Cc Cultivated cap, Cs Cultivated stalk, Cw Cultivated whole, Wc Wild cap, Ws Wild stalk, Ww Wild whole.

**Table 4.** Calculated values of phytate/Zn, Ca/phytate and [Ca]:[phytate]/{Zn}\*molar ratios of cultivated and wildy obtained *Pleurotus sajor-caju* fruitbodies.

|                     | Cc    | Cs    | Cw    | Wc    | Ws    | Ww    |
|---------------------|-------|-------|-------|-------|-------|-------|
| Phytate: Zn         | 1.33  | 0.85  | 1.93  | 0.83  | 4.36  | 2.09  |
| Ca: phytate         | 18.84 | 46.77 | 20.33 | 32.06 | 18.39 | 36.46 |
| [Ca]:[phytate]/{Zn} | 0.18  | 0.14  | 0.20  | 0.09  | 0.49  | 0.37  |

\*(mol/kg)

Cc Cultivated cap, Cs Cultivated stalk, Cw Cultivated whole, Wc Wild cap, Ws Wild stalk, Ww Wild whole.

presented equal concentrations in the cap and stalk. These levels however might not affect the nutritional potential of the mushroom since they are less than 10% of the total dry weight of the sample<sup>21</sup>. Phytate concentration (mg/100 g) in the cultivated mushroom was higher than in the wild one, and in the cultivated one the cap had higher concentration (451) than the stalk (226) while in the wild one the concentration in stalk was highest. However these concentrations are below those considered unsafe for human consumption.

Table 4 shows the calculated values of phytate/Zn, Ca/phytate and [Ca]:[phytate]/{Zn} molar ratios of cultivated and wildy obtained fruitbodies. Phytic acid forms stable complexes with mineral ions rendering them unavailable for intestinal uptake<sup>22</sup>. The inhibitory effect of phytate on zinc absorption has been quantified by molar ratio of 15: 1 for phytate/Zn<sup>23</sup>. The calculated phytate/Zn molar ratios were all lower than the critical value. The value in the cultivated whole mushroom was lower than in the wild one. The calculated Ca/phytate molar ratios were higher than the critical value (6: 1)<sup>24</sup> for all mushrooms. This result contradicts the findings of Ola and Oboh,<sup>25</sup> who got Ca/phytate values lower than the critical value for *T. striatus* and *T. robustus*. However, the trend was made clearer by the calculated [Ca]:[phytate]/{Zn} molar ratio since it is considered to be a better predictor of increased relative risk to reduced zinc bioavailability<sup>26</sup>. Except for the wild stalk (0.49), the ratio was below the critical value 0.5 mol kg<sup>-1</sup>.

The results of the present study indicate that mushrooms are rich in nutrients and minerals and low in fat, and contents of antinutrients are not in sufficient quantities to result in toxicity or poor mineral bioavailability.

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