

## Research Article

# Comparative Evaluation of Different Organic Media on Soil Chemical Composition, Growth, and Yield of Mushroom (*Pleurotus tubergium* L.)

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The effectiveness of organic media as sources of nutrients on soil fertility, growth, and yield of mushroom (*Pleurotus tubergium*) was studied at Akure in the rainforest zone of Nigeria. The organic media were applied at 8 t/ha with an organo-mineral fertilizer medium as a reference material and unfertilized control treatment, replicated four times and arranged in a randomized complete block design. The result showed that the use of organic media increased significantly ( $P < 0.05$ ) crown width, stalk length, stalk girth, weight of fruiting bodies of mushroom and soil K, Ca, Mg, N, P, K, Ca, and O.M compared to the control treatment. Among the organic media, loamy soil had the highest values of mushroom crown width and weight of fruiting bodies relative to the others. However, the organo-mineral medium still had higher values of mushroom growth and yield than the soil organic media, but it may increase cost of production. For soil chemical composition, loamy soil treatment had the highest values of soil O.M and % N while oil palm bunch husk had the highest values of soil K, Ca, and Mg compared to other treatments. Wood ash treatment increased most the soil pH. In these experiments, loamy soil and soybean husk media applied at 8 t/ha were the most effective organic media for improving growth, yield of mushroom, and soil fertility.

## 1. Introduction

Mushroom belongs to the plant kingdom fungi, phylum Basidiomycetes, class Homobasidiomycetes and they are noted for producing fruiting bodies.

There are millions of mushroom species in the world that grow in the wild forest and they are classified into two groups, namely, the edible mushroom and nonedible mushroom (toadstools) [1].

The edible mushrooms such as *Pleurotus* species, *Araucaria Auriculate* and *Calvata cyathiteries* commonly found in Nigeria are very rich in proteins, crude fibre, minerals, vitamins, and carbohydrates [2] while the nonedible mushrooms are poisonous which include *Amanita photodiodes*, *Amanita verna*, and *Celeriac marginal*.

Bahl [3] reported that mushrooms have been found effective against cancer, cholesterol reduction, stress, insomnia, asthma, and diabetics. Bilial et al. [4] also reported that due to high amount of proteins in mushrooms, they can be used to bridge the protein malnutrition gap. In addition, Hassan et al. [5] emphasized that mushroom production could play an important role in managing farm organic wastes when agricultural and food processing byproducts were used as growth media for edible fungi.

In spite of economic, nutritional, and natural health importance of mushroom to the people, the cultivation of mushroom on a large scale is still very low and most of the mushrooms eaten by people are collected from the wild forest. This is as a result of poor husbandry skills, sudden change in eating habit of people to foreign foods, and

lack of suitable growth media and weather vagaries which subsequently affected the production.

Therefore, there is justification to research into the use of different growth media, besides the conventional wood logs which are cheap and suitable for commercial production of mushroom. Having reviewed literature critically of some past research works except Belewu and Belewu [6] who used banana leaves to cultivate mushroom (*Volvariella volvacea*) and Aderibigbe and Kolade [7] who used organic food waste to propagate tempeh fungus (*Rhizopus oligosporus*), there is paucity of research information on the use of different organic media such as sawdust, soybean husk, rice bran, poultry manure, wood ash, and oil palm bunch ash to grow *Pleurotus tubergium*. The choice of *Pleurotus tubergium* is important because of its ability to grow in a relatively suitable environment (outdoor), short-maturity period and low cost of investment.

Presently, many agricultural wastes are generated in Nigeria which are not effectively utilized [8] and cultivation of *Pleurotus tubergium* on them for effective management and utilization is promising. In view of the growing importance of mushroom in Nigeria as a source of food, income and export potentials in future, the current study was carried out with the following objectives:

- (i) to determine the effect of different organic media (sawdust, loamy soil, oil palm bunches, wood ash etc.) on the growth and yield of *Pleurotus tubergium* mushroom,
- (ii) to determine the effect of different organic media on the soil chemical composition after harvesting mushroom *Pleurotus tubergium*.

## 2. Materials and Methods

**2.1. Description of the Study Area.** The experiment was carried out at Akure in the rainforest zone of Nigeria in 2009 elevation 10 m, 7°N, 5° 10'E in 2009 and was repeated in 2010 to validate the results.

The soil is a sandy loamy soil (skeletal, kaolinitic, isohyperthermic oxic paleustalf (Alfisol) or Ferric Luvisol (FAO). The rainfall amount is between 1100 and 1500 mm per annum while the temperature is 24°C.

**2.2. Soil Sampling and Analysis.** Thirty (30) core soil samples were collected from 0–15 cm depth on the site before application of organic media and cultivation of *Pleurotus tubergium* mushroom. They were bulked together and mixed thoroughly, air-dried, and sieved with 2 mm sieve for routine analysis in the laboratory.

The soil pH was determined in a 1 : 1 soil water suspension and 2 : 1 CaCl<sub>2</sub> soil suspension using a glass/calomel electrode system [9]. Organic matter was determined by Walkley and Black [10] method through chromic acid digestion. Soil N was extracted through addition of 5 mL concentrated H<sub>2</sub>SO<sub>4</sub> and selenium catalyst, then distilled with NaOH, and titrated against 0.1 M HCl [11].

Available soil P was extracted using Bray pi extractant and the amount in the extract was measured with Murphy

and Riley [12] blue colouration method on a spectronic 20 at 882 μm.

The soil exchangeable bases (K, Ca, Mg, and Na) were extracted with 1 M NH<sub>4</sub>OAc pH7 and the amount in the extracts (K, Ca, and Na) were determined using flame photometer while Mg content was determined on the atomic absorption spectrophotometer.

The exchangeable acidity (H<sup>+</sup> and Al<sup>3+</sup>) was measured from 0.1 M HCl extracts by titrating with 0.1 M NaOH [13]. Micronutrients (Mn, Cu, Zn and Fe) were extracted with 0.1 M HCL [14] and measured with atomic absorption spectrophotometer.

The soil bulk density (mg m<sup>-3</sup>) was determined by a core method [15] and porosity was calculated from the values of bulk density. The mechanical analysis of the soil was done by the hydrometer method [16] and percentage sand, silt, and clay were read on a textural triangle to determine the soil texture.

**2.3. The Sources and Processing of the Organic Residues Used for Growing Mushroom (*Pleurotus tubergium*).** The organic residues used for growing the mushroom such as poultry manure, saw dust, rice bran, oil palm bunch ash, soybean, oil palm bunch husk, and loamy soil were obtained from the livestock, arable crop processing units of the Teaching and Research Farm of the Federal College of Agriculture, Akure.

The wood ash was sieved with 2 mm sieve to remove pebbles, wood, and charcoal remains. The soybean, oil palm bunch ash, rice bran, and saw dust were partially composted for 6 weeks to allow decomposition for quick release of nutrients. The poultry manure was stacked under a shade to allow quick mineralization and reduction of C/N ratio.

The loamy soil was also sieved with 2 mm sieve to remove pebbles and air-dried under a shade for few days. All the growth media were sterilized before they were used to grow *Pleurotus tubergium* mushroom. The spawns for *Pleurotus tubergium* were obtained from Ekpoma in Edo State of Nigeria, air-dried, and sterilized before planting. NPK fertilizer was obtained from Ondo State Agricultural Input Supply Agency, Akure.

**2.4. Analysis of the Organic Residues Used as Growth Media for *Pleurotus tubergium*.** Two grammes each of the processed organic residues were analysed. The percentage (%) nitrogen was determined by kedahl method [11], while the determination of other nutrients such as P, K, Ca, Mg, Fe, Zn, Cu, and Mn was done using the wet digestion method based on 25-5-5 mL of HNO<sub>3</sub>-H<sub>2</sub>SO<sub>4</sub>-HClO<sub>4</sub> acids [17]. The organic carbon was determined by chromic acid digestion [10].

**2.5. Experimental Procedure.** The site was cleared, packed of the debris, and tilled to maintain optimal tilth for mushroom. The size of the experimental site was 11 m × 19 m (209 m<sup>2</sup>), and each plot size was 2 m × 2 m with a discard of 1 m between each plot.

A shed was constructed over the site with wire nets to prevent rodents and other animals from tampering with

the mushroom as well as moderating the immediate weather conditions suitable for the growth of the mushroom.

Eight organic media treatments, namely, loamy soil, sawdust, poultry manure, rice bran, oil palm bunch ash, wood ash, oil palm bunch husk, and soybean were each applied at 8t/ha, replicated four times and arranged in a randomized complete block design with an organic mineral medium as reference treatment (Loamy soil + 400 kg/ha NPK) and a control treatment which did not receive any application of residues nor NPK fertilizer.

The choice of 400 kg/ha NPK 15-15-15 fertilizer was based on recommendation of Agboola and Corey [18] while the choice of 8t/ha for the organic residue was based on the work of Moyin-Jesu [19] for growing crops in the study area.

In each plot, planting space of 30 × 30 cm was used with a depth of 1 meter, filled with the organic media treatments, watered daily for three (3) days to attain field moisture water capacity, and allowed to rest for 2 days. Each spawn of *Pleurotus tubergium* mushroom weighing 2 kg was planted and watered twice daily both in the morning, and evening. Spawning occurred after seven days and continued at different days depending on the treatment. Weeding was done manually to prevent weed growth interference while the few pest weevils observed were hand-picked before reaching economic injury level and no disease was observed.

The parameters such as crown width, stalk girth, and stalk length were taken starting from seven days after spawning and continued till harvest period. The harvested mushroom fruiting bodies were weighed for each organic medium and data recorded.

At the end of the experiment, soil samples were taken on each treatment basis and analysed for soil pH, O.M, N, P, K, Ca, and Mg as explained earlier.

**2.6. Statistical Analysis.** The data for mushroom crown width, stalk length, stalk girth, and yield of fruiting bodies and soil properties in each of the organic media for the experiment were subjected to Analysis of Variance (ANOVA F-test). Variables for which significant treatment effects were found and were characterized further using Duncan Multiple Range Test (DMRT) at 5% level of significance [20].

### 3. Results

**3.1. Initial Soil Analysis before Spawning.** Table 1 presents the soil analysis before spawning of *Pleurotus tubergium* mushroom. The soil pH value is 5.72 which is slightly acidic and the organic matter is 0.43% which is below 3% critical level recommended for crop production in South West Nigeria [18]. The soil P is 5.84 mg/kg P which is lower than 10 mg/kg P recommended by Agboola and Corey [18].

The soil K, Ca, Mg, and Na were lower than 0.2 mmol/kg soil recommended by Adeoye [21]. The soil bulk density is high 1.60 mg m<sup>-3</sup> soil and the soil texture is sandy loam which is classified as skeletal, isohyperthermic kaolinitic soil under USDA soil classification.

TABLE 1: Soil chemical composition before planting mushroom.

Soil properties	Values
Soil pH (H <sub>2</sub> O)	5.72
Soil pH 0.01 M CaCl <sub>2</sub>	5.30
Organic matter (%)	0.43
Nitrogen (%)	0.08
Available P (mg/kg)	5.84
K <sup>+</sup> (mmol/kg)	0.13
Ca <sup>2+</sup> (mmol/kg)	0.10
Mg <sup>2+</sup> (mmol/kg)	0.08
H <sup>+</sup> (mmol/kg)	4.30
Al <sup>3+</sup> (mmol/kg)	1.49
Fe (mmol/kg)	8.50
Zn (mmol/kg)	3.80
Mn (mmol/kg)	1.83
Cu (mmol/kg)	2.10
Sand (%)	79.50
Silt (%)	14.80
Clay (%)	5.70
Bulk density (mg m <sup>-3</sup> )	1.60
% Porosity	41.81

**3.2. Chemical Composition of the Different Organic Materials Used for *Pleurotus tubergium* Mushroom Production.** The chemical composition of the different organic materials used for growing *Pleurotus tubergium* mushroom is presented in Table 2.

Poultry manure and loamy soil had the highest values of N and P while oil palm bunch ash, oil palm bunch husk and wood ash had the highest values of K, Ca, and Mg compared to others. Rice bran and sawdust had the highest C/N ratios and were very low in N, P, K, Ca, and Mg nutrients.

**3.3. Growth and Yield Parameters of *Pleurotus tubergium* Mushroom under Different Organic Media.** There were significant increases ( $P < 0.05$ ) in the crown width, stalk length, stalk girth and weight of fruiting body (kg/ha) of mushroom under different organic media compared to the control treatment (Table 3).

Among the organic media, loamy soil had the highest values of mushroom crown width and weight of fruiting bodies compared to poultry manure, rice bran, wood ash, bunch ash, saw dust, soybean husk, and oil palm bunch husk respectively. For instance, loamy soil medium increased the crown width and weight of fruiting body by 57.4% and 24%, respectively, compared to poultry manure.

In addition, soybean, rice bran, wood ash, and saw dust growth media also significantly increased ( $P < 0.05$ ) the values of crown width, yield of fruiting body, stalk length, and girth of mushroom *Pleurotus tubergium* signifying them as very good growth media.

Soybean and sawdust were second and third to loamy soil in termS of performance of mushroom fruiting bodies yield also soybean husk medium increased the mushroom fruiting body by 7.3% compared to wood ash.

TABLE 2: Chemical composition of the different growth media used for cultivation of *Pleurotus tubergium*.

Treatments	% C	% N	P mg/kg	K %	Ca %	Mg %
Poultry manure	30.00	4.33	385.00	9.72	3.20	4.10
Rice bran	14.00	0.60	56.00	7.93	0.12	1.80
Oil palm bunch ash	16.00	1.60	42.23	14.00	9.10	4.80
Oil palm bunch husk	15.00	1.90	45.00	16.00	9.20	4.90
Wood ash	18.00	1.53	86.00	23.02	9.40	8.52
Soybean	25.00	3.80	185.00	3.50	2.10	1.99
Sawdust	8.00	0.42	10.00	5.12	0.10	1.30
Loamy soil	29.00	5.20	390.00	9.85	4.20	4.80

TABLE 3: Effect of different growth media on the growth and yield parameters of *Pleurotus tubergium* mushroom.

Treatments	Crown width (cm)	Stalk length (cm)	Girth width (cm)	Weight of fruiting bodies (kg/ha)
Control	2.01 <sup>a</sup>	1.80 <sup>a</sup>	0.80 <sup>a</sup>	145.25 <sup>a</sup>
Loamy soil	5.03 <sup>g</sup>	3.32 <sup>de</sup>	3.35 <sup>e</sup>	322.88 <sup>i</sup>
Poultry manure	2.14 <sup>b</sup>	2.93 <sup>bc</sup>	3.33 <sup>ef</sup>	245.20 <sup>c</sup>
Rice bran	4.56 <sup>f</sup>	4.18 <sup>g</sup>	3.66 <sup>g</sup>	222.20 <sup>b</sup>
Oil palm bunch ash	2.18 <sup>bc</sup>	4.52 <sup>h</sup>	2.67 <sup>c</sup>	295.36 <sup>f</sup>
Wood ash	2.50 <sup>c</sup>	3.12 <sup>d</sup>	1.18 <sup>b</sup>	256.83 <sup>d</sup>
Oil palm bunch husk	2.09 <sup>b</sup>	4.76 <sup>hi</sup>	3.78 <sup>h</sup>	286.20 <sup>e</sup>
Soybean husk	3.21 <sup>de</sup>	3.88 <sup>f</sup>	3.95 <sup>j</sup>	303.33 <sup>h</sup>
NPK + loamy soil	5.37 <sup>gh</sup>	5.20 <sup>j</sup>	3.83 <sup>hi</sup>	400.00 <sup>j</sup>
Sawdust	3.09 <sup>d</sup>	2.58 <sup>b</sup>	3.07 <sup>d</sup>	301.70 <sup>g</sup>

Treatment means followed by the same letter are not significantly different from each other using Duncan Multiple Range Test at 5% level.

Relative to the organic media, the organomineral (NPK + loamy soil) treatment increased significantly ( $P < 0.05$ ) the crown width, stalk length, stalk girth, and weight of fruiting body of mushroom *Pleurotus tubergium*. For instance, the NPK + loamy soil medium increased mushroom crown width, stalk length, stalk girth, and weight of fruiting body by 59.4%, 15%, 30.2%, and 26.3% compared to the oil palm bunch ash medium.

Rice bran and sawdust also showed better performances in crown width, and stalk length of mushroom compared to the oil palm bunch ash, wood ash, and oil palm bunch husk. The shade constructed over the site helped to moderate the immediate weather conditions which encouraged faster spawning rate of the *Pleurotus tubergium*.

**3.4. Soil Chemical Composition after Harvesting Mushroom Fruit Bodies of *Pleurotus tubergium* under Different Growth Media.** There were significant increases ( $P < 0.05$ ) in the soil chemical composition after harvesting mushroom fruiting bodies under different organic media used when compared to the control treatment (Table 4). Loamy soil treatment had the highest values of soil O M and % N compared to other treatments. For instance, loamy soil treatment increased soil O M and % N by 41% and 82% compared to the poultry manure treatment after harvesting the mushroom *Pleurotus tubergium*. However, poultry manure treatment also had the highest value of soil P.

Oil palm bunch husk had the highest values of soil K, Ca, and Mg compared to other treatments. For instance, it

increased the soil K, Ca, and Mg by 94.8%, 81%, and 78.5% compared to rice bran.

In addition, it increased the soil K, Ca, and Mg by 13%, 72%, and 14% compared to the organo-mineral medium (NPK + loamy soil). Wood ash treatment had the highest values of soil pH followed by oil palm bunch husk and oil palm bunch ash, respectively.

Sawdust and poultry manure media had lower values of soil pH compared to wood ash treatment. NPK fertilizer + loamy soil treatment also improved considerably the values of soil PH, O M, N, P, K, Ca, and Mg, respectively. The control treatment had the least values of the soil pH, N, P, K, Ca, and Mg in the experiment.

## 4. Discussion

The increase in *Pleurotus tubergium* mushroom crown width, stalk length, fruit bodies weight, soil N, P, K, Ca, and Mg under the different organic media treatments compared to the control could be attributed to the balanced nutrient contents of the organic media and their subsequent quick release of nutrients due to low C/N.

This was further enhanced because the different growth media were processed which reduced the C/N ratio. The above observation agreed with experiments of Ukioma and Ogbonnaya [22], and Hassan et al. [5] which reported that farm wastes were good sources of media for mushroom growth, improving soil structure and enhanced quick release of nutrients to the soil.

TABLE 4: Soil analysis after harvesting mushroom under different growth media.

Treatments	pH (H <sub>2</sub> O)	% O.M	% N	P mg/kg	K mmol/kg	Ca mmol/kg	Mg mmol/kg
Control	4.20 <sup>a</sup>	0.53 <sup>a</sup>	0.09 <sup>a</sup>	4.70 <sup>a</sup>	0.09 <sup>a</sup>	0.07 <sup>a</sup>	0.05 <sup>a</sup>
Loamy soil	6.25 <sup>e</sup>	2.71 <sup>h</sup>	1.36 <sup>h</sup>	14.98 <sup>g</sup>	0.58 <sup>e</sup>	2.00 <sup>g</sup>	1.20 <sup>f</sup>
Poultry manure	5.9 <sup>c</sup>	1.60 <sup>e</sup>	0.24 <sup>g</sup>	17.13 <sup>hi</sup>	0.45 <sup>d</sup>	1.50 <sup>e</sup>	0.89 <sup>e</sup>
Rice bran	6.45 <sup>f</sup>	0.99 <sup>b</sup>	0.16 <sup>de</sup>	11.70 <sup>e</sup>	0.21 <sup>b</sup>	0.61 <sup>c</sup>	0.30 <sup>c</sup>
Oil palm bunch ash	6.68 <sup>g</sup>	1.39 <sup>d</sup>	0.13 <sup>b</sup>	10.4 <sup>d</sup>	2.30 <sup>g</sup>	2.61 <sup>h</sup>	0.75 <sup>d</sup>
Wood ash	6.80 <sup>h</sup>	1.61 <sup>e</sup>	0.14 <sup>bc</sup>	8.90 <sup>c</sup>	3.80 <sup>i</sup>	0.89 <sup>d</sup>	0.77 <sup>d</sup>
Oil palm bunch husk	6.70 <sup>g</sup>	1.87 <sup>f</sup>	0.15 <sup>d</sup>	14.10 <sup>f</sup>	4.00 <sup>j</sup>	3.20 <sup>j</sup>	1.40 <sup>g</sup>
Soybean husk	6.10 <sup>d</sup>	1.88 <sup>f</sup>	0.19 <sup>f</sup>	16.10 <sup>h</sup>	1.50 <sup>f</sup>	1.65 <sup>f</sup>	0.90 <sup>e</sup>
NPK + loamy soil	6.51 <sup>e</sup>	2.0 <sup>g</sup>	0.24 <sup>g</sup>	15.10 <sup>g</sup>	3.50 <sup>h</sup>	0.90 <sup>d</sup>	1.20 <sup>f</sup>
Sawdust	5.80 <sup>b</sup>	1.2 <sup>c</sup>	0.13 <sup>b</sup>	8.40 <sup>b</sup>	0.33 <sup>bc</sup>	0.44 <sup>b</sup>	0.27 <sup>b</sup>

Treatment means followed by the same letter are not significantly different from each other using Duncan Multiple Range Test at 5% level.

The increase in soil pH by oil palm bunch ash, oil palm bunch husk and wood ash could be due to the fact that they are liming materials. Liming has been reported by the soil physical and chemical properties and nutrients availability [23]. This observation was also supported by the fact that oil palm bunch husk had the highest values of soil K, Ca, and Mg nutrients which supported the spawning, growth and fruiting of *Pleurotus tubergium*.

The organic media or substrates used for the mushroom production were sterilized and this explained why they had higher spawning rate, weight, crown width and stalk length than those in the control treatment which was not sterilized. The observation agreed with the work of Paul [24] which reported that substrates used for mushroom should be sterilized or pasteurized in order to destroy any fungal or bacterial competitors. This was collaborated by Hassan et al. [5] who reported that the sterilization of paddy straw, maize stalks/cobs, and vegetable plant residues increased significantly stalk weight, stalk diameter, and fresh weight of fruiting bodies of Oyster mushroom (*Pleurotus ostreatus*).

The highest values of growth and yield of mushroom in the organomineral medium (NPK fertilizer + loamy soil) could be attributed to the fact that N, P, and K nutrients in the NPK fertilizer were already in available ionic forms which encouraged quick utilization by mushroom coupled with the nutrients contained in the loamy soil. This combination gave the treatment nutrients superiority in supplying balanced nutrients for the better performance of the mushroom.

Nevertheless, sole application of NPK fertilizer to grow mushroom should be discouraged because its continuous use might lead to reduced values of soil O M and increased soil acidity. This is supported by Agboola [25] who reported that arbitrary use of inorganic fertilizers resulted in signs of toxicities, poor yield response, and deterioration of soil properties.

In addition, the high cost of purchase and availability of NPK fertilizer could increase the cost of mushroom production and discourage farmers from using it as organo-mineral medium unlike the organic media (sawdust, rice bran, oil palm bunch, husk, and soyabean) which are easily available and cheap [6].

The better performance of wood ash, oil palm bunch ash in improving growth and yield value of mushroom (*Pleurotus tubergium*) soil pH, K, Ca, and Mg could be due to the fact that the ash component is more soluble than other residues. This observation agreed with the work of Moyin-Jesu [26] and Ojeniyi [15] which reported that K and Ca components of wood ash were very high and this could be responsible for the increase in the soil pH which subsequently enhanced quick absorption of nutrients such as P, K, Ca and Mg that are essential for good growth and yield parameters of mushroom. In addition, Okhunaya and Okigbo [27] also reported that oil palm bunch fibres were good substrates for *Pleurotus tubergium*.

The performance of soybean husk on the growth and yield of *Pleurotus tubergium* could be due to its high nitrogen and phosphorus contents. N is reported to increase growth and yield of crops [28].

The rice bran and sawdust effectiveness as substrates for the mushroom could be attributed to the fact that they were allowed to decompose through partial composting before use which led to lowering their C/N ratio and this explained why they were able to release nutrients to mushroom faster than when they were not decomposed. This result differed from that of Adebayo and Adebayo and Olayinka [29] who used unprocessed sawdust to grow maize and found out that its high C/N 1:135 made it difficult for quick release of nutrients.

The shade constructed over site has helped to moderate the immediate weather conditions which encouraged faster spawning rate of *Pleurotus tubergium*. This observation agreed with van Peer et al. [30] who reported that various mushrooms are known to be sensitive to the climatic conditions particularly temperate and relative humidity.

The poor soil nutrients such as N, P, K, Ca, Mg, growth and yield parameters of *Pleurotus tubergium* in the control treatment might be due to its low fertility status arising from low nutrients and nonapplication of both organic residues and NPK fertilizer. Hence, this experiment demonstrated the importance of organic media to the enhancement of mushroom productivity in poor nutrient-deficient tropical soils.

*Pleurotus* mushroom nutritional status was reported by Fakoya and Akinyele [31], Masamba and Kazombo-Mwale [32] to contain crude fibre, low carbohydrate, minerals, vitamins, and proteins which are useful for human nutrition. Also, Wasser and Weis [33] reported that high composition of lovastatin in *Pleurotus ostreatus* mushrooms has ability to reduce serum and cholesterol concentration in human beings.

Furthermore, Gao et al. [34] reported that the triterpenes of reishi mushroom have also been found to inhibit cholesterol synthesis, reduce hypertension, protect the liver and have antioxidant properties.

The implication is that consumers of *Pleurotus tubergium* mushroom will monetarily spend less on vitamins, mineral supplements, and crude fibre in the drugs chemical form, thereby, improving their healthy living and increasing their productivity to the advancement of national economy and millennium goals development (MDGs).

The significance of the increase in mushroom nutrition by the application of the organic media to soil is that profitable and sustainable production of *Pleurotus tubergium* will be achieved by farmers through reduction in purchasing high-cost inorganic fertilizers as well as preference for organically produced foods in the Western countries.

## 5. Conclusion and Recommendation

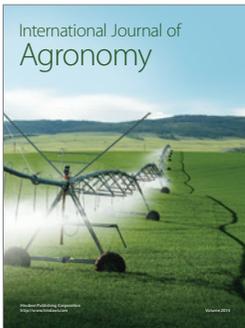
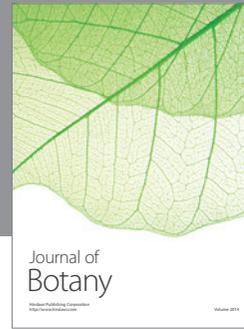
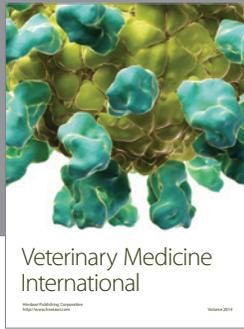
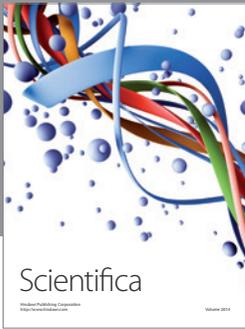
It is recommended that organic media, loamy soil, and soybeans husk compost applied at 8 t/ha were good media for improving nutrient availability and ensuring sustainable cultivation of *Pleurotus tubergium* mushroom on infertile soils in humid tropics as well as improving its nutritional quality for human consumption.

This recommendation is significant because inorganic-based growth media are scarce and expensive for resource-poor farmers who are producers of mushroom in most developing countries. In addition, the increasing interest in organic farming in developed countries further justified the recommendation to utilize these organic media for mushroom production.

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