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Short Communication

Cultivation of mushroom (*Volvariella volvacea*) on banana leaves

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Following the solid state fermentation of banana leaves (*Musa sapientum lina*) by lignin degrading mushroom (*Volvariella volvacea*), yield of fruiting bodies and compositional changes of the substrate were evaluated using a student parametric "T" test model. The biological efficiency was 5.21 while the total weight of fruit yield was 2.5 kg. The percentage biomass loss was 18.20%. The banana leaves treated with *V. volvacea* exhibited losses primarily in the polysaccharide components and with a greater percentage of the fibre components being degraded. The crude protein content was enhanced by the incubation of the mushroom due probably to the addition of microbial protein. The acid detergent lignin (ADL) was significantly reduced in the fungus treated sample. The acid detergent fibre (ADF) and neutral detergent fibre (NDF) followed similar trend but, the cellulose and hemicellulose increased. The development of this simple technology is expected to improve the yield of mushroom as well as provide sustainable feed (spent substrate) for ruminant animals.

Key words: Banana leaves, *Volvariella volvacea*, chemical composition, ruminant animals.

INTRODUCTION

Mushroom which is a fleshy saprophyte fungus are found growing on damp rotten log of wood trunk of trees, decaying organic matter and in damp soil rich in organic substances. Edible mushroom are highly nutritious and can be compared with eggs, milk and meat (Oei, 2003). The content of essential amino acids in mushroom is high and close to the need of the human body. Mushroom is easily digestible and it has no cholesterol content. However, the cultivation of mushroom is still very limited and the industry is still at its infancy in Nigeria (Isikhuemhen and Okhuoye, 1996; Belewu, 2002, 2003).

The major problem associated with the transfer of technology for mushroom cultivation is the lack of technical know- how for its cultivation. During an investigation of the cultivation of mushroom on agricultural residues, it was found that rice husk sorghum stover, saw dust, cotton waste, cocoa bean shell, and sawdust – Gliricidia mixture are suitable substrates for the cultivation of edible mushroom (Belewu, 2001; Belewu and Ademilola 2002; Belewu, 2002; Belewu , 2003; Belewu and Lawal, 2003). While, rice straw, water lilly and banana leaves are equally implicated (Oei, 2003). The chemical composition of banana leaves is well documented in literature (Sompson et al., 2004). The thrust of the study herein reported was to evolve a method for the cultivation of the muchroom, *Volvariella volvacea*, using banana leaves and determine their effect on the chemical composition of the spent substrate (banana leaves).

MATERIALS AND METHODS

Collection of banana leaves and inoculation

Banana leaves still hanging on the trees used for the experiment were collected around the University of Ilorin permanent site campus. The leaves were cut into uniform length preferably as wide

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as the wooden foundation and made bundles with a diameter of 10 cm (Oei, 2003).

The substrate bundles were soaked for 4 h in water and the banana leaves become more transparent after soaking. The content was later drained. A wooden foundation was created with 50 cm width, 2 m in length and 30 cm high. The foundation was cover with one layer of the banana leaves while the surface of the soil was moistened. All the butt-ends of the banana leaves of the same layer were on the same side.

Production of spawn

Spawn of *V. volvacea* was produced using cotton waste, calcium carbonate and water in the ratio of 32:2:66, respectively. The mixture was kept in a well cleaned and drained Jam bottles. The bottles were covered with aluminium foil paper and later autoclaved at 121°C for 20 min after which the bottles were cooled at room temperature. The cooled spawn of *Volvariella* mushroom was distributed evenly over the surface. Thumb sized pieces was used at every 10 cm. The second layer was also piled but the butt-ends were on the other side. It was spawn again and the whole procedure was repeated until four to six layers are piled and the temperature (35°C) was recorded. During rain season or hot period a plastic or tent-like construction or bamboo frame stretched with plastic film should be used to prevent damages to the mycelium.

Fruiting and harvesting

In about 20 days, pin heads started appearing and at this time watering was stopped and in about 2-3 days it grew into matured fruit bodies and harvesting was done 2-3 times per day for the next three days. After 5-6 days of resting, other crops are due for harvesting and total harvesting time was 2-3 months. Total weight of fruit was taken during each harvesting and weighed using weighing scale.

$$\text{Average Growth rate (mycelium)} = \frac{\text{shortest growth length} + \text{longest growth length}}{2}$$

$$\text{Biological efficiency} = \frac{\text{Total weight of fruit bodies}}{\text{Total weight of substrate (compost) of spawning}} \times \frac{100}{1}$$

All data collected were subjected to student parametric "T" test.

RESULT AND DISCUSSION

The mycelia covered the banana leaves in about 12 days while full colonization of the substrate was observed in 15 days. The total number of fruits and the total weight of the fruits was 2.5 kg. Biological value was put at 15.21%. The yield and the pileus diameter observed in this study agreed with the observation of Oei (2003) for similar mushroom.

There was a reduction in the weight of the banana leaves (16.30%) used as substrate and this shows that the mushroom has the ability to degrade lignocellulosic materials during the idiophase stage following severe nitrogen and carbon depletion (Mason et al., 1989). Banana biomass loss was 18.20%, which shows that

Table 1. Performance characteristics of *Volvariella volvacae* grown on banana leaves.

Parameters	Values
Period of mycelium colonization	15 days
Mycelium average growth rate	5.4 cm
Total weight of fruit	2.5 kg
Biological efficiency	15.21
Banana biomass loss	18.20%

Table 2. Comparison of the mushroom treated and untreated banana leaves.

Parameters	Untreated banana	Treated banana
Dry matter	85.98	67.20
Crude protein	6.81	10.25*
Crude fibre	12.81	9.23*
Ether extract	3.06	2.98*
Acid detergent lignin	6.01	2.15*
Acid detergent fibre	30.20	19.12*
Neutral detergent fibre	54.24	30.31*
Hemeicellulose	24.04	26.42
Cellulose	24.19	25.64

Values are mean of 4 determinations.
*Significantly different.

degradation and solubilization was more intensive in the banana leaves based substrate (Table 1). The crude protein, crude fibre, ether extract, acid detergent fibre (ADF), neutral detergent fibre (NDF), cellulose and hemicellulose contents of the untreated banana leaves agreed with the report of Sompson et al. (2004). However, the dry matter decomposition after inoculation with fungus spawn (% of original sample) was 18.75%. The protein content of the fungus treated banana was significantly higher than the untreated sample due probably to the addition of fungal proteins during solubilization and degradation (Table 2). This agrees with the report of Farkas (1979) and Jacqueline and Visser (1996) who reported that the extracellular enzymes secreted by the fungus contain amorphous homo and heteropolysaccharides which is often in association with protein (fungal protein). The protein content of the fungus treated sample increased from 7.08 to 10.26%. The increasing crude protein content could be compared to the protein content of most cereal crops. It was however, higher than common straw and grasses. The higher crude protein content will likely increase the importance of the leaves as ruminant diet.

The fibre fraction decreased significantly in the fungus treated leaves compared to the untreated leaves. The The acid detergent lignin (ADL) decreased from 6.01 to 2.15% this was followed closely by ADF, NDF in that order (Table 2). The decrease in the fibre fractions could

be due to the production of various enzymes during the vegetative and reproductive phases with lignocellulose degrading properties. The solubilization of the lignin occurs during the vegetative phase and enzymes like laccase, manganese peroxidases and lignin peroxidases are secreted while cellulose degrading enzymes is secreted during the reproductive phase (Tamara et al., 1995).

The higher hemicellulose content recorded for the fungus treated banana leaves indicates that it is a valuable product for the lignin degrading fungus (for it provides the organism with energy source for better functioning). Also, the higher cellulose content recorded for the fungus treated sample will provide more glucose for ruminant animals since the gut of the animal is well equipped with microbes that can convert the cellulose to glucose. Conclusively, the study revealed the potential of banana leaves as a good substrate for the cultivation of *V. volvacea* and the spent substrate as a viable ingredient in ruminant feed.

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