PROMOTION OF MUSHROOM PRODUCTION AND CONSUMPTION IN NORTHERN NAMIBIA

LYDIA N. HORN
Directorate of Agricultural Research and Training (Plant production Research),
P/Bag 13184 Windhoek, Tel 061- 2087020
Email:HornnL@mawf.gov.na/nhorn@yahoo.com

ABSTRACT

Mushroom experiments on *Pleurotus sajor caju* and *Pleurotus ostreatus* was conducted during the 2003/2004 cropping season at Omahenene Research Station and Ogongo Agricultural College respectively. These experiments focused on the potential utilisation of different crop residues and some plant materials for mushroom production. In these experiments the following materials were used; pearl millet straw and chaff, cowpea crop residues, maize cobs and straw, mopane cones and some selected woody materials mostly from acacia and mopane trees (bark, small dried branches, and dried leaves). Three different substrates were used namely: Crop residues from the field and grasses and woody materials from the wild in order to determine quality of the oysters and their required fruiting conditions. This experiment was also used for training purposes for UNAM Students from the Ogongo campus, the WAD women's group from Omusati and individual farmers who participated in the mushroom cultivation training courses. Promising results were obtained from the combination of woody materials, straw and cobs composted for sometime. This combination yielded 2kgs of high quality mushrooms as compared to 0.5-1.8 kgs from non-composted substrate. Results showed that the best time for fruiting is during rainy and cloudy days when the humidity is very high and the temperature is less than 30^{o}C. Considering the arid nature of Namibia, mushrooms can be considered as a future crop for Namibia in terms of achieving self-reliance for food production and agricultural development, as the crop can be grown with a minimum amount of water.

INTRODUCTION

Mshigeni and Chang, (2000) reported that mushrooms play a very important dietary role in human nutrition and health world wide when used as a dietary supplement. On a dry weight basis, about protein makes up about 30% of mushrooms and this protein is endowed with all the essential amino acids. According to the APEC 2003. Training manual for edible mushroom. pp (2-20). Mushrooms are low in calories and are almost cholesterol free and are high in carbohydrates, vitamins and in organic minerals, all which serve as important essential requirement for human health. Their medicinal value such as for healing wounds and their ability to promote body immune enhancing and tumour-retarding effects is another significant benefit.

Mushrooms are highly nutritious and contain 20-40% protein (on dry weight bases), which consists of all the essential amino acids required in human diet. Their taste and delightful aroma make them one of the delicious preferred foods in restaurants throughout the world (Mshigeni and Chang, 2000). Mushrooms are macro fungi belonging to the kingdom fungi. They do not posses green pigments and therefore cannot produce their own food; however they derive energy from complex organic materials found in dead or living tissues of plants and animals. Mushrooms are therefore called saprophytic fungi due to their mode of feeding (Campel, 1996). Cultivation of mushroom like any other agricultural undertaking requires hard work and dedication. Modern mushroom cultivation equipment is very costly; however simple and locally available materials can be used to produce mushrooms. Once enough mushroom cultivation experience is gained then this modern equipment can be sourced. Mushrooms can be grown for own consumption and for income generating purposes. The whole process takes about 42 days. This is less than local crops. Production can continue throughout the year as long as the temperature and humidity is kept close to optimum levels (Chang et al., 1993). Experience from these experiments suggests that mushroom production does not require a lot of water but does require a humid environment. This means that the house should be kept moist at all times but not damp. This will require less water compared to ordinary field crops and vegetables. Considering the arid nature of Namibia, mushrooms can be considered as a future crop for Namibia in terms of achieving self-reliance for food production and agricultural development, as the crop can be grown with a minimum amount of water. Although Mushroom is well known among Namibian farmers and is widely consumed in the northern regions during the rainy seasons, no formal attempt to cultivate mushrooms has been undertaken in most of rural Namibia. Scientific research has a major role to play in poverty reduction and hunger alleviation through active promotion and encouragement of crop diversification hence mushrooms can be introduced to Namibian farmers as an alternative source of income and nutrition. These experiments therefore focused on mushroom cultivation and promotion among the farming communities in the Northern Communal Areas of Namibia using locally available materials. Ogongo Agricultural College laboratory was used for the development of spawn while Omahenene Research station was used as the cultivation and demonstration Centre

METHODOLOGIES

The Oyster mushrooms (*Pleurotus sajor caju* and *Pleurotus ostreatus*) fig.8 that have been tried and found to be suitable under local conditions were used in this experiment. Crop residues from the field and grasses and barks from the wild were used in substrate making. The types of materials used for substrate were pearl millet, grass, mopane cones and some barks, cowpea and maize straw. Straw was first crushed with a hammer mill using the silage sieves. After crushing the size of substrate material was about 2-3cm in length. During preparations, some crop residues were mixed (50kg straw plus 10kg cowpea straw). Substrates were soaked in a drum with water overnight. After soaking, the substrate was removed from the water to drain and an additional amount of 10kgs of dry millet chaff was added to absorb excess water to bring the water content to the required level of 60%. 0.97kgs of agricultural lime was added to bring the acidity level of the

substrate to between 8-10 (alkaline) using an indicator strip. According to Kadhila training notes 2003, Lime is calculated as 1.5% of the substrates' dry weight. Substrates were well mixed with a garden fork and spade to obtain uniformity. After mixing and checking the moisture (fig.3), substrates were placed in the vacuum plastic bags (fig.5) of 2kg for pasteurisation. A drum was used to pasteurise the substrate by means of steaming the bags (fig.6). A layer of diamond mesh wire was used as a barrier between the plastic bags and the water to prevent the substrate cooking. Substrates were heated for two hours in the drum and taken to the shade to cool. After cooling, the bags were inoculated, using a cleaned and methylated spirit sterilised bench at Omahenene. While at Ogongo an autoclave was used to sterilize the bags and inoculation was done aseptically in the laboratory (fig.2). Hands were first cleaned with soap and then sterilised with ethanol before handling of inoculation materials. A burner was kept on and every tool used was first sterilized on the flame. Each bag was spawned or inoculated with two spoons full of spawning materials. The bags were labelled with the species name, date and the inoculator's name before being placed in a dark room for the mycelia to invade the substrate fully.

Fig 1. Mushroom (oyster mushroom) growing on crop residues.

Mushrooms (oyster mushroom) (fig1) grow on crop residues; straw and other agricultural waste that are readily available in Namibia and spent substrates can be used as livestock feed or compost for fields or gardens. The above-mentioned uses were significant enough to trigger the promotion of mushroom production and consumption in Namibia. The efforts to cultivate mushrooms in Namibia have not been undertaken widely. The project was thus intended to make an important contribute to the nutritional and economic welfare of the Namibian people, through the promotion of Mushroom cultivation (fig.2).

Fig.2 WAD-Omusati practicing on how to inoculate the substrates left and UNAM-Ogongo Campus students' right.

A group of WAD women-students, UNAM students at Ogongo and some individual farmers took part in these experiments on different occasions and helped with substrate inoculation. The students at Ogongo inoculated 20 bags, which they kept for monitoring under the supervision of Dr Kosina as part of their practical work. The rest of the bags were kept at Omahenene for observation. The inoculated bags were kept in a dark room at the temperature between 22-30^{o}C. Humidity was not taken into consideration at this point. The bags were monitored daily and contaminated bags were isolated from the others. After the period of 45 days in the dark, most bags turned white, showing that the mycelium had fully invaded the substrate, after which the bags were ready to be opened. In order to allow fruiting, vertical cuts were made through some of the bags while some bags were totally uncovered leaving the substrate exposed to the air.


Fig.3 Participants checking the substrate moisture content before bag filling left and watering in the mushrooms house right.

Pleurotus grown on millet chaff and on grass residues:

In this experiment 5kg of millet chaff alone was soaked in the water overnight. It was removed from the water and excess water drained off. An additional 5kg of dry millet chaff was added to absorb the excess water. An amount of 0.15kgs agricultural lime was added to the mixture in order to bring the acidity down. The Substrate was placed in 1kg bag and pasteurised for one hour in the drum.


Fig.4 Millet chaff and grass residues left, and harvested Pleurotus right.

Pleurotus on; composted mopane cones and leaves, grass, millet chaff and straw and maize cobs and cattle manure:

5kgs mopane cones and leaves, 5kgs wood, barks, 5kgs cattle manure, 5kgs dried grass, 5kgs millet straw, 5kgs millet chaff, 5kgs maize cobs and 0.6kgs lime. These residues were layered up in a form of sandwich to form a big heap on the cemented floor (outdoors).


Fig.5 Trainees turning and bagging the Composted substrate.

The layering of materials was repeated until all the materials were piled up. Lime was spread on top of the heap and water was applied until thoroughly moistened. The heap was then covered with a black polythene sheet and left covered for one week. After a week the compost was turned and watered again and covered for another two weeks.


Fig.6 packing bags for pasteurisation left and pasteurisation drums at work during training right.

After two weeks the compost was opened and did smell good however it did not turn into finer compost. The materials were found to be soft and easy to fill the bags with (Fig 5). A small amount of water was added to bring the water content to at least 60% before filling the bags.


Fig.7 Two different types of mushroom houses in China.

The bags were pasteurised in the pasteurising drums for two hours and inoculated after cooling. Inoculated bags were then transferred to a dark room until fully invaded by the mycelia. Fully invaded bags that appeared white were moved to a fruiting house. In the fruiting house, conditions of dim light, good ventilation, and controlled humidity were maintained and water was applied three times a day. The floors were kept moist at all times to maintain the humidity. The walls were lined with a polythene sheet while a fine sprayer nozzle was used to water the substrate. Care was taken to make sure that no excess water was coming into close contact with the mushroom fruiting bodies.

Fig.8 simple mushroom house constructed from local materials (left) while old bomb shelters (right) are excellent for mushroom spawn running.

RESULTS

The fruiting, pinheads appeared 3-5 days after the bags were cut open and the substrate watered, however during the first day, pinheads were so small they were invisible to the naked eye. It took 3-4 days for the pinhead to develop into a mature mushroom, ready for consumption. A total weight of 2kgs was harvested from the composted substrate during the first flush and 1.5kgs on the second flush. This experiment showed that a combination of an increase in temperature above 30^{o}C and low humidity causes substrates to dry out and fruiting is delayed for each bag. The best time for fruiting was found to be during rainy and cloudy days especially when humidity is high. Results from other substrates are presented in the table below.

Table 1; Fruit weights from two flushes on different substrates

Treatment/Substrate used	1st flush (kgs per bag)	2nd flush (kgs per bag)
Composted substrate	2	1.5
Straw and cobs mixture	1.8	1.49
Millet seed hull/chaff	0.7	0.65
Grass	0.5	0.60

CONCLUSION AND DISCUSSION

Mushroom cultivation being a new farming activity for most rural farmers, this experiment was used for training purposes for UNAM Students Ogongo campus, WAD women group Omusati and individual farmers who participated in the mushroom cultivation training courses. Promising results were obtained from the combination of woody materials, straws and cobs composted for some time. This combination yielded 2kgs of high quality mushroom as compared to 0.5-1.8kgs from non-composted substrate. Results showed that the best time for fruiting is during rainy and cloudy days when the humidity is very high and the temperature is less than 30^{o}C. Considering the arid nature of Namibia, mushrooms can be considered as a future crop for Namibia in terms of achieving self-reliance for food production and agricultural development, as the crop can be grown with a minimum amount of water.

This experiment demonstrated that Mushrooms (oyster mushroom) could be successfully grown on crop residues, straws and other agricultural wastes that are readily available in Namibia. It has also confirmed that spent substrates can be used as livestock feeds and compost for fields or gardens. It was demonstrated that *pleurotus* could be successfully produced with little or no modern technology. Results indicate that grass and millet chaff produced low quantity of mushrooms probably due to insufficient cellulose and lignin in these substrates.

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