CSIR-FRI/MP/OM/2000/002

COUNCIL FOR SCIENTIFIC AND INDUSTRIAL RESEARCH

FOOD RESEARCH INSTITUTE

Mass Media Popularization

MUSHROOM CULTIVATION IN GHANA

By

M. OBODAI

FAO Global Network on Mushrooms Newsletter Number 3

2000

MUSHROOM CULTIVATION IN GHANA

INTRODUCTION

Ghana, primarily an agricultural based country, offers a vast potential for the cultivation of mushrooms due to the prescence of abundant raw materials and a conducive climate for its growth. Mushrooms, a good source of proteins, vitamins and minerals but low in fat, are a popular food item in Ghana. These are used largely when available ie. during the raining season (March and September) in the preparation of soups, stews and as condiments. The collection of edible mushrooms in the rural areas and subsequent sale at the urban centres is an old tradition and is a well established activity some traders.

The cultivation of mushrooms in Ghana began several centuries ago with the use of the traditional pit method , this method however gave very low and inconsistent yields.

In June 1990, cultivation of mushrooms took a different turn when the National Mushroom Development Project (NMDP) was set up by a joint collaborative effort of the Food Research Institute of the Council for Scientific and Industrial Research , Ghana Export Promotion Council and the Ministry of Food and Agriculture.

The main objective of this project is to systematically develop and promote the intensive cultivation, utilisation and export of mushrooms.

The Mushroom project has so far been very successful in reaching the Ghanaian farmer with the mushroom technology through training and continuous on- farm trials.

THE NATIONAL MUSHROOM DEVELOPMENT PROJECT

The NMDP initially had two separate units: The Research and The Commercial units.

The commercial unit was set up to:

*Produce oyster mushroom spawned compost bags in commercial quantities for sale

* Produce fresh oyster and straw mushrooms for sale to the general public.

In March 1998, however the commercial unit was closed down, and its activities have been taken up by private entrepreneurs.

The NMDP has only the Research unit functioning at the moment.

It has the following functions:

*Researches into all areas of mushroom growing technology, mushroom biotechnology,and environmental applications .

*Collects and maintains pure cultures of indigenous and exotic mushrooms in the National Mycelium Bank. There are over 76 cultures received from 10 countries of the world kept on agar slants under refrigeration.

*Investigates into efficient methods for processing and preserving mushrooms of both local and exotic strains.

* Produces and supplies improved mushroom spawn to growers for commercial cultivation.

*Carries out training programmes and extension services for farmers.

1) INDIGENOUS MUSHROOMS OF GHANA

Indigenous and edible mushroom species, which are common during the wet season from March to September, form an important part of the diet and a source of income for many rural and urban Ghanaians. This is evidenced by the presence of stalls selling mushrooms in both rural and urban markets and along major roads. The mushrooms are mainly collected by women who through field experience can accurately distinguish edible mushrooms ('Mbre' in Akan) from the poisonous ones ('Saman mbre'). The exact quantities of mushrooms collected each year throughout the country have not been established.

The major edible mushroom genera found in Ghana are:

a) - *Termitomyces* -the Termite mushroom locally called '*Twenwodro*', '*Onu*' and '*Sibre*'

b) - *Volvariella* - straw or oil-palm mushrooms locally known as '*domo* '.

c) '*Pinpran* ' -local name. The scientific name is not yet known. It is a common delicacy for the rural folks.

Other mushroom genera available in Ghana include:

i) *Auricularia* -wood ear mushrooms

ii) *Ganoderma lucidum* - monkey seat mushrooms

iii) *Boletus*- the boletes

iv) *Coprinus* -shaggy mane

v) *Pleurotus tuber -regium* - A sclerotium forming oyster mushroom (locally known as 'fuo'), used in the treatment of underweight and convulsion in babies, and also for hypertension and heart pains in adults (Sawyerr ,1993).

Although there is a large mushroom germplasm in Ghana they have not been collected and identified yet.

2) CULTIVATED MUSHROOM SPECIES

With the introduction of the Plastic bag method a technology adapted from South-East Asia (Taiwan) and modified to suit Ghanaian conditions, four (4) out of the 76 different species of mushrooms in the National Mycelium Bank have been introduced and accepted by the Ghanaian populace. The introduced species are:

i) *Pleurotus eous* strain EM-1 originally from Mauritius
P. ostreatus strain OT-3 from Thailand
P. ostreatus strain OT-6 "

ii) *Auricularia polytricha* strain APT-6 from Thailand
A. polytricha strain APG-1 from Ivory Coast

iii) *Ganoderma lucidum* strain GLA-1 from United States of America (This is still under experimentation)

iv) *Volvariella volvacea* strain VVO-1 from Ghana

About 90% of the *Pleurotus species* produced are sold fresh .The surplus of about 10% are dried usually by solar drying or oven dried at 45 C .The mushrooms are sold locally to restaurants, supermarkets and individual consumers. Some are also exported to neighbouring countries such as Nigeria in the dried form.

95% of the *Volvariella volvacea* produced are sold fresh with only 5% sold in the frozen state.

3) MUSHROOM CULTIVATION

3.1) Traditional Practices

3.1.1) Oil-Palm Mushroom (*Volvariella volvacea*)

The Pit-method

The oil palm or straw mushroom occurs naturally on felled and rotten oil palm trees(*Elaeis* guineenis) which has been tapped for palm wine (toddy). They are also found on fermenting cocoa wastes in cocoa growing areas and on dead logs, and sawdust of some forest tree species, such as the silk cotton tree (*Ceiba petandra*),*Triplochiton scleroxylon* (locally known as 'wawa' or 'obeche') and *Antiaris africana.*

Traditionally, the oil palm mushroom has been cultivated in some forest areas on cassava, cocoyam and yam peelings , or oil palm and cocoa wastes. A pit of about (21cm by 5cm) is dug and lined with fresh banana leaves. Heaps of cassava, cocoyam, and yam peelings are put into the pit. A fresh fruiting body of the oil-palm mushroom is mashed and the brown suspension of spores sprinkled all over the surface of the materials. The heap is then covered with more fresh leaves to retain moisture and avoid the direct sunlight. Mushrooms begin to appear after three to four weeks, especially during the wet season,and is ready for harvesting at the button or egg stage. Fresh materials are added to the heap from time to time to prolong the period of production. . With this method the yield is low and unstable.

In areas where cocoa is cultivated, beds of cocoa husk are moistened with palm wine and covered with fresh banana leaves to produce the oil palm mushroom.

3.1.2.) The Termite Mushroom (*Termitomyces* species)

Several species of *Termitomyces* regarded as the 'King of the mushrooms' by the local people can be collected twice in the year . This is at the beginning of the major rains (late March to April) and before the minor rains (August to September). They occur on termite hills or mounds constructed by specific mushroom-growing termites.

In the Eastern Region of Ghana where these mushrooms are normally picked, the farmers cultivate it artificially. They put bundles of dried banana leaves and twigs on top of the termite mound producing the mushrooms and allow termites to invade it. These 'infested' banana leaves are then transfered to other sites on the farm to allow the termites to build their mounds. It takes two years for the first production of these mushrooms. Subsequently it produces termite mushrooms every year around the same time.

These mushrooms are mostly eaten fresh and the surplus preserved by smoke drying over a fireplace, or sundried for future use.

3.2) Current Cultivation Methods

There are two current methods for cultivation of mushrooms in Ghana. These are the Plastic bag method and the low-bed method.

3.2.1) Plastic bag method

This method is used in the production of *Pleurotus* , *Auricularia* and *Ganoderma* species .

The main material used as substrate is sawdust compost prepared from either *Triplochiton scleroxylon* , or a mixture of *Chlorophora excelsa* and *Terminalia invorensis* .

Fresh sawdust from either of these woods is initially mixed with 10% ricebran and 1% calcium oxide on a weight to weight basis and brought to a moisture content of 70% by adding water (using the squeeze test). It is then heaped on a cemented platform, and allowed to decompose for 21-28 days in the case of *Triplochiton scleroxylon* sawdust (Obodai, 1992), and 60 days for the mixture of *Chlorophora excelsa* and *Terminalia invorensis*(Obodai et al.1995). During decomposition the heap is turned every 4 -5 days interval to allow for aeration and uniform composting. After composting , the substrate is bagged in heat resistent polypropylene or high density polythene bags dimensions (33x17cm) to a wet weight of about one kilogram. Each bag is fitted with a plastic neck or 2.5cm diameter 'PVC' pipe or cut bamboo and closed with a cap (Auetragul,1984). The bagged substrate are then sterilised by steaming in a 200-litre oil barrel drum with a perforated lid at 100 C for 2-3 hours to kill competitors. After sterilisation the bags are allowed to cool and then sent to the inoculating room where each bag is spawned with 3-5g good quality sorghum grain spawn. The spawned bags are sent to a semi- dark incubation room where the temperature is maintained at 26 to 30 C for complete mycelia colonisation of the substrate. The

mycelium permeates and degrades the substrates and virtually knits the substrate together. Most of the *Pleurotus* species under cultivation require between 30 to 33 days for complete colonisation, whilst *P. cystidiosus* and *Auricularia* species requires between 45 to 65 days. After the mycelium have fully colonised the substrate, they are allowed to 'thicken' (form pinheads) for about a week and then the bags are sent to the cropping house for cropping and harvesting. In the case of the *Auricularia* species , 12 diagonal slits of 4cm are made around the bag and left in the incubation room for 14 days before they are sent to the cropping house.

The cropping house is a wooden framed structure , covered on the outside with local sedge or woven mats, and roofed with thatch to allow for aeration and water retention. Inside the cropping house are wooden or bamboo racks on which the bags are arranged horizontally on top of each other. The surface of the bags are exposed by cutting off the neck. To obtain good flushes a high relative humidity of 85-95 %, and temperature between 24 and 28 C is kept in the cropping house. This is maintained by watering regularly with at least 4 buckets of water twice a day in the wet season, and three to four times in the dry season. When these bags are opened it takes 5 to 7 days for the pinheads to appear and 36 to 48 hours for the mushrooms to be ready for harvesting.

The fruitbody yield per compost bag is between 200 to 300 grams every cycle of two months , depending on environmental conditions.

A cropping house of size 4x6x2.4m can contain 2,000-2,500 bags, and a size of 6x8x2.4 contains 5,000- 6,000 bags.

3.2.2.) Low bed method

This method is used in the cultivation of the oil-palm mushroom (*Volvariella* spp.).

The substrates used in this method are rice straw, maize stover, sorghum stover, cotton waste, banana leaves and pseudostem, oil palm pericarp fibre and empty bunches, peelings from root tubers such as cassava, cocoyam and yam.

The method is as follows:

A bed is made with the help of a wooden trapezoid mould frame with both ends opened. The dimensions are base 35mm, top 30cm, the height 35cm and the length 91cm or more.

Dry bedding materials such as rice straw, maize stover, etc. are soaked overnight. Some materials such as cotton waste are soaked , shredded and used immediately.

The wooden mould is placed on the ground (cemented floor or soil which has being initially treated against termites if there are any) with the base downwards. The soaked materials are put into the mould, up to one-third the height and compacted.

The mushroom spawn (with the chlamydospores formed) is dispersed into pieces by shaking the bottle.This is then sprinkled on top of the materials, along the periphery inside of the mould. This is the first layer.

Two more layers are made in the same manner. With the top-most layer the entire surface is inoculated with the spawn.

The wooden mould is then removed and used to make more beds. The beds are spaced about 10-15 cm apart . In between the beds a layer of composted sawdust of *Triplochiton scleroxylon* is placed. At least 5 beds are made in a row parallel to each other. The beds are then covered with transparent plastic sheets and woven mats placed on top of them to prevent the beds from drying up by sunlight or wind. The beds are left for one week, after which the polythene and woven mats which had been used to cover them are raised off the beds to a height of 15cm. This is to allow for aeration, and also to allow enough space for the growing mushrooms. Mushroom pinheads appear 3-5 days later on the beds as well as the ground, and button to egg- stage mushrooms are picked 48 hours later. The average yield per bed varies between 1.2 to 2 kilograms.

3.2.3.) Production

With the plastic bag method used in the production of the Oysters, Woodear, and Monkey-seat mushrooms, there is an all year round production of these mushrooms. Over 75 to 200 kilograms of the oyster mushrooms are produced daily depending on the season. There is however a potential to produce between 500 to 1000 kilogram fresh mushrooms each day. Presently, there are 15 commercial bag producers in the country, with production levels of between 3,000 to 10,000 bags a month. There are, however, over 30 farmers in fresh mushroom production with cropping capacities of between 50-5,000 bags.

With the low bed method of production of the oil palm mushroom several kilograms of these mushrooms can be produced daily.

4) MAJOR CONSTRAINTS

*An inadequately equiped Research Laboratory with little or no facilities for Germplasm collection, identification and strain development.

* Lack of trained personnel in genetics, breeding of mushrooms and also in the indoor cultivation of *Volvariella volvacea.*

* Lack of equipment to meet the growing demand of spawn.

REFERENCES

Autregual,A. 1984. The highest aspects for cultivating oak mushroom (*Lentinus edodes*) in plastic bags. Mushroom Newsletter for the Tropics 5(2): 11-15

Obodai, M. 1992. Comparative studies on the utilisation of agricultural waste by some mushrooms (*Pleurotus* and *Volvariella* spp.) M.Phil. thesis, University of Ghana.

Obodai, M. Sawyerr L.C. 1995. Effect of composting of mixed redwood sawdust on fruitboby yield of two *Pleurotus eous* varieties: Technical report

Sawyerr, L.C. 1993: Sclerotium formation on sawdust compost by *Pleurotus tuber regium*, a medicinal Ghanaian mushroom. Presented at the first International mushroom Biology and Mushroom Products , Hongkong.