STUDIES ON THE PRODUCTIVITY OF TWO KINDS OF MUSHROOM GROWN ON SOME AGRICULTURAL WASTES

By

MAGDA WAHEED MOSTAFA
B.Sc. Agric. Sci. (Agronomy), Fac. Agric., Ain Shams Univ., 2001

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APPROVAL SHEET

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Approval Committee

Dr. MAMDOUH M. FAWZY ABDALLAH…..……………………
Professor of Vegetable Crops, Fac. Agric., Ain Shams University

Dr. RAAFAT SADEK BEKHEET …..………………… …..…… …
Assitant professor of Vegetable Crops, Fac. Agric., Cairo University

Dr. AHMED HASSAN KHEREBA……..…………………………
Professor of Vegetable Crops, Fac. Agric., Cairo University.

Dr. AMAL MOHAMED AHMED FARRAG……..…………..…
Professor of Vegatable Crops, Fac. Agric., Cairo University

Date: 23 / 3 / 2011

SUPERVISION SHEET

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SUPERVISION COMMITTEE

Dr. AHMED HASSAN KHEREBA
Professor of Vegetable Crops, Fac. Agric., Cairo University

Dr. AMAL MOHAMED AHMED FARRAG
Professor of Vegetable Crops, Fac. Agric., Cairo University

Dr. FATHI RAGAB HUSSEIN
Senior Researcher of Food Technology, ARC, Giza

Name of Candidate: Magda Waheed Mostafa **Degree: M.Sc.**
Title of Thesis: Studies on the Productivity of Two Kinds of Mushroom Grown on Some Agricultural Wastes
Supervisors: Dr. Ahmed Hassan Khereba
Dr. Amal Mohamed Ahmed Farrag
Dr. Fathi Ragab Hussein
Department: Vegetable Crops
Branch: Vegetable Crops **Approval: Date: 23 / 3 / 2011**

ABSTRACT

Cultivation of *F. velutipes* and *P. eryngii* mushrooms on rice straw, wheat straw, maize cubs, faba bean stalks and sawdust under the local environmental conditions and suitability of some local wastes as a cultivation media were studied. Effects of media of cultivation on yield of the two mushrooms were also studied. The highest yield of *F. velutipes* (٢12٦٠. g/kg wet medium) and *P. eryngii* (320.400g/kg wet medium) were obtained by maize cubs.

Chemical composition of *F. velutipes* and *P. eryngii eryngii* fruit bodies differed according to cultivation media and the range of fruit bodies moisture, crude protein, crude fiber, ash content, fats and total carbohydrates for *F. velutipes* were 89.20 - 84.50%, 24.30 - 19.10%, 12.70 - 7.00%, 8.00 - 6.50%, 3.12 - 1.71 % and 64.39 - 52.84% respectively, while *P. eryngii* contained 89.30 - 86.20%, 23.40 - 20.00%, 12.00 - 9.30%, 7.80 - 5.10%, 2.25 - 1.29% and 63.70 - 56.20%, respectivly.

It was observed that there was change in media chemical component after cultivation compared with that before cultivation.

It was found that fibers %, fat % and total carbohydrates % decreased after cultivation. Meanwhile, protein % and ash % increased after cultivation for *F. velutipes* and *P. eryngii*.

Key words: Cultivation, *F. velutipes*, *P. eryngii*, yield**,** chemical component

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CONTENTS

INTRODUCTION

Mushrooms have been treated as a special kind of food, since earliest time. They also have been considered as the oldest microbial food (Kurtzman, 1974). Ancient Egyptian, Chinese and Japanese were probably the first people who professionally cultivated mushrooms (Vangriensven, 1988). Wasser *et al*. (2000) reported that higher basidomyetes mushrooms are historically and economically highly praised for their nutritional value and acceptability, as well as their pharmacological properties. Also, Poppe (2000) reported that even in the case that the world population would not increase any more, there is an enormous amount of waste from fields, agro-industry and wood industry. The yearly available world waste in agriculture is 500 million tons and 100 million tons from forestry. The immense available waste can be used every year for mushroom cultivation. The use of waste for mushroom production can provide more food, more jobs, better family income, global warming and CO_2 level, and can clear up the crop residues and organic materials for gardens and floristry. Jie (2002) recorded that the mushroom world production in 2001 was 6280 thousand tons. The characters of the two species greatly differed. *F. velutipes* fruit bodies are small but delicious. It grows all over the world such as China, Siberia, Asia Minor, Europe, Africa, North America, Australia and Japan. It grows on trunks or stumps of broad-leaved trees from the autumn to early spring. In Japan; it was grown for many centuries and cultivated artificially (Tonomura, 1978 and Bahl, 1994). Zadrazil (1999) stated that *F. velutipes* grows as a parasite and later as saprophyte on various deciduous tree species. *F. velutipes* is long, thin and white mushrooms. It is also, called golden needle mushroom. Wild forms differing in color, texture, and sliminess are called winter mushrooms, velvet foot, or velvet stem. It looks with firm, white, shiny cabs; avoid those that have slimy or brownish stalks. The mushroom is cultivated in a plastic bottle or a vinyl bag for 30 days at 15°C and 70% humidity, on a substrate of sawdust or corn cubs, and a number of additional ingredients. Afterwards, the mushroom is grown for another 30 days in a slightly cooler but more humid environment.

Ohga and Denial (2004) mentioned that *P. eryngii* (also known as king trumpet mushroom, French horn mushroom, king oyster mushroom) is an edible mushroom native to Mediterranean regions of Europe, the Middle East, and North Africa. In Chinese, it is called *xìng bào gū* lit "Almond abalone mushroom stab celery mushroom". In Japanese, it is called eringi (katakana). It is the largest species in the oyster mushroom genus; *Pleurotus eryngii* species complex comprises at least five varieties: *eryngii*, *ferulae*, *elaeoselini*, *nebroensis*, and *tingitanus*. In nature it's found in association with specific members of the umbelliferae and compositae families, which also contains the oyster mushroom *Pleurotus ostreatus*. It has a thick, meaty white stem and a small tan cap (in young specimens). It has little flavor or aroma when raw. The fact that it grows in association with the roots of *Eryngium campestre* or other it can be easily cultivated on sawdust. Its production is concentrated in Japan, Korea Republic and Taiwan. Royse *et al.* (2008) found that yields for each successive break decrease mainly as a consequence of nutrient depletion in the production medium.

Edible mushroom including *F. velutipes* and *P. eryngii* are used in Japan and China to develop not only food materials, but also medicines. Three kinds of carcinostatic polysaccharides drugs such as immunpotentiators (BRM, biological respanse modifiers) have been developed in Japan. Beta-D-glucans, heteropolysaccharides, glycoproteins, steroids, terpenoides and nucleotidies were isolated from fruiting bodies or mycelium of many mushrooms (Poppe, 2000).

F. velutipes and *P. eryngii* mushrooms have been newly obtained by from China for their cultivation on local cheap organic wastes. So, the present study aimed to achieve the following goals:

1. Using some agricultural wastes; i.e. rice straw, wheat straw, faba bean stalks and maize cubs as well as soft sawdust as industrial waste for cultivation of mushroom.
2. Determination the effect of agricultural wastes on the growth parameters and yield of the tested mushrooms.
3. Evaluation the produced mushrooms for its nutritional values.

REVIEW OF LITERATURE

1. *Flammulina velutipes*

Mushrooms have been increased at an accelerated rate because of their delicious, nutritious, and health stimulating properties (Yamanak, 1997). Nanagulyan (2000) reported that proposed waste-free technology of growing *F. velutipes* allows getting a valuable food product as well as some additional feeding materials for livestock.

a. Substrates used for *F. velutipes* mushroom cultivation

Tonomura (1978) stated that *F. velutipes* is usually cultivated on sawdust with rice bran. The mycelium growth rate ranged from 3.0-4.4 mm/ day according to the type of sawdust tree. Also, the time required for primordia formation differed from 12-30 days or even no primordia formation at all, according to the type of sawdust tree. Moreover, Stamets and Chilton (1983) as well as Royse (1995) stated that sawdust mixed with rice bran could be used as a favorable substrate for *F. velutipes* cultivation. Bahl (1994) mentioned that in Japan mostly sawdust of *Cryptomeria japonica*, *Cryptomeria obtusa* or *Pinuss* spp. is used for commercial cultivation of *F. velutipes.* Furthermore, Venkatroman *et al*. (1989) reported that rice straw was found to be a better substrate for the bioconversion by *F. velutipes* than other straw. Poppe (2000) stated that wood shavings, containing 0.3% N, was useful for cultivation of *Pleurotus* spp., *Flammulina spp*. On the other hand, Zhanxi and Zhanhua (2001) mentioned that *F. velutipes* can utilize various kinds of materials such as sawdust, agricultural by products (cereal straw, cotton seed residue). They also, recommended a substrate formula for cultivation *F. velutipes* being sawdust 73%, wheat bran or rice bran 25%, calcium carbonate 1% and sugar 1%. Another medium based on cereal straw, consists of straw powder 75%, wheat bran or rice bran 23%, calcium carbonate 1%. This addition increased yield and quality. Moreover, Hong *et al*. (2001) cultivated some of *F. velutipes* on four media consisting of (I) 70% maize straw (MS), 10% cotton seed hulls, 15% wheat bran (WB) and 5% maize flour (MF) ; (II) 88% MS, 5% WB, 5% MF, 1% sucrose and 1% lime; (III) 90% MS, 5% WB and 5% MF; and (VI) 79% MS, 5% WB, 5% MF, 10% sawdust and 1% lime. They declared that the highest formula for hyphal of *F. velutipes* were II and IV, repectively. Wang (1989) investigated the effect of different carbon and nitrogen sources on the growth of two of *F. velutipes*. The mycelium growth rate differed on the same medium according to the strain. Also, among the carbon sources, lactose recorded the lowest growth. *F. velutipes* grow well in medium with soybean powder, peptone, beef cream or yeast powder as a nitrogen source but could not grow well with nitrate or amine nitrogen. Several studies have been devoted to the supplementation of the cultivation media of mushroom with some additives to increase the obtained by yield. In this connection Chen *et al*. (1995) found that the high productivity and good quality were obtained by using a substrate of cotton hull (50%), rice bran (20%), wheat bran (15%), corn powder (10%) and bean cake (5%). This substrate furnishes vitamins and minerals for the growth of *F. velutipes.* Beside, Xiong and Jiang (1999) reported that growth of *F. velutipes* was run quickly on medium containing 88% cotton seed hulls, 1% gypsum and 1% refined sugar with 10% quail droppings. Tang-Xiang *et al*.(2001) used four formulae,

(A) 80% rice straw, 10% rice bran, 7% corn flour, 2% plaster, 1% sucrose; (B) 80% *P. notatum*, 20% cotton seed hulls; (C) 92% cotton seed hulls, 5% rice bran, 1% calcium superphosphate, 1% plaster and 1% urea, and (D) 90% *P. notatum*, 6% rice bran, 2% calcium superphosphate, 1% plaster and 1% sucrose, to prepare media. Afterwards, these media were sterilized for 1.5 h at 126 ºC and 147.1 kPa and inoculated with *F. velutipes*. The hyphal growth rate on the 4 media was ranked D<B<A<C. Fan-Leifa *et al*.(2001) used coffee husk and spent-ground as substrates for the production of edible mushroom *F. velutipes* under different conditions of moisture (45, 50, 55, 60, 65 and 70%) and spawn rate (2.5, 5, 10, 20 and 25%). The highest results were obtained by with 25% spawn rate, although there was no much difference when lower spawn rates (10-20%) were used. Medany (2004) used rice straw, wheat straw, sawdust, oak sawdust, pea peels, faba beans, sawdust + wheat straw, sawdust + rice straw, rice straw + wheat straw, faba bean peels + sawdust, faba bean peels + rice straw, faba bean peels + wheat straw, pea peels + sawdust, pea peels+ rice straw, pea peels + wheat straw and pea peels + faba bean peels, (composted and non-composted) as substrates for cultivation of *F. velutipes*. Masahiro *et al*. (2005) reported that an edible mushroom (Enokitake in Japanese) could use sawdust-based medium and corn cub-based medium. The yield of fruit bodies increased by using the corn cub - based medium than, sawdust-based medium. Sharma *et al*. (2006) showed that the wheat bran at 10% resulted in the fastest linear growth (110 mm), followed by wheat bran at 5% (99.8 mm). Other supplements (soyabean meal, cotton seed cake and deoiled soyabean) reduced linear

growth. They also, mentioned that the incorporation of 10% wheat bran into sawdust resulted in the most rapid spawn run and the highest biological efficiency (37.5%). Fruiting body formation did not occur when the substrate was supplemented with either cotton seed cake, soyabean meal or deoiled soybean. Sharma *et al*. (2008) declared that the addition of wheat bran and deoiled soybean, at the proportion of 10%, were the highest supplements for mycelial growth of *F. velutipes* and also, wheat bran to the medium caused increased biological efficiency and quicker spawn running, whereas poor spawn running and no fruiting - body formation were recorded in the medium enriched with cotton seed cake, soybean meal, or deoiled soybean.

b. Chemical composition of some wastes used for growing of *F. velutipes*

Agricultural and industrial wastes are available in large quantities all over the world, and have a different chemical composition. These wastes are usually suitable for mushroom cultivation as a single or could be adjusted to be suitable by mixing more than one or even by addition of some supplements (Hassan, 2002). Chemical composition of rice straw was studied by many authors. In this connection, Kaul *et al*. (1981) found that rice straw contained 0.55% total nitrogen and C/ N ratio was 70. Also, Tsang *et al*. (1987) and Silanikove *et al*. (1988) reported that total carbohydrate was lower in the substrates after harvesting than that before spawning. Mehta *et al*. (1990) declared that cellulose, lignin, ash and total nitrogen content of rice straw were 32, 25, 15 and 0.4%, in succession. Stamets (1993) found that rice straw contained 7.5% moisture content besides 0.62% nitrogen, 1.4% fat,