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A STUDY ON THE PRODUCTION OF *AGARICUS BISPORUS* MUSHROOMS USING *EICHHORNIA CRASSIPES* (MART. SOLMS) – A TROUBLESOME EXOTIC AQUATIC WEED OF KOLLERU LAKE

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ABSTRACT
The production of white button mushrooms (*Agaricus bisporus* (Lange -Sing.) using *Eichhornia crassipes* (Mart- Solms) as a substrate in various seasons summer, rainy, post monsoon and winter from June 2009 to Nov 2011 was followed. The time taken for pinhead appearance was in the range of 36-44 days for all the seasons. The production of mushrooms was found to be 0.48-0.55kg and 0.26-0.33kg for first flush and second flush respectively. The highest and the lowest yields were observed in rainy and post-monsoon respectively. The standard deviation for all the seasons was 0.02 and 0.04 for first and second flush respectively. From this study it was found that water hyacinth can be used as a viable substrate for the production of white button mushrooms. The mushroom production cost can be reduced considerably by using freely and abundantly available water hyacinth instead of the priced paddy straw. Further, it helps to avoid fodder crisis to the cattle.

KEYWORDS: Mushrooms production, *Agaricus bisporus*, *Eichhornia crassipes*, Kolleru Lake.

INTRODUCTION

According to the United Nations estimation world population is going to cross nine billion by 2050 (United Nations, 2011). As a result, food security to the ever-growing world population is going to be a major challenge of the 21st century. To meet this challenge, food production should be augmented. Therefore, agricultural scientists world over are now exploring ways and means to augment food production with the help of microbiology, biotechnology and genetic engineering disciplines. Nowadays, the white button mushroom (*Agaricus bisporus* (Lange) Sing.) is becoming the most popular among the economically vulnerable sectors of the society. Thus, the demand for white button mushrooms is on the rise, (Chang, 1996). Generally paddy straw, already a scarce fodder, is used as a substrate for mushroom cultivation (Zadrazil, 1977, Surender et al., 1987). Its diversion naturally aggravates the fodder crisis further.

Water hyacinth (*Eichhornia crassipes)* causes serious harm and has an adverse effect on water resources, fisheries, irrigation, drainage canals and public health. (Sculthrope, 1967, Obeid, 1984; Batanouny and EL- Fiky, 1984 and Hussein, 1992). Its growth and biomass production is very high because of which the very existence of Kolleru Lake and the sustainable livelihoods of the locals are threatened (Naresh Reddy et. al., 2012). Showing some resource value to the biomass of prolifically growing obnoxious weed will serve dual functions. One is the lake protection (ecological) and the other one is resource generation (economical). Through this study, the biomass of water hyacinth - an exotic, nuisance aquatic weed of Kolleru Lake, was tested as a substitute of paddy straw for the cultivation of *Agaricus bisporus* mushrooms in different seasons (summer, rainy, and winter) from June 2009 to Nov 2011. Earlier Murugesan et. al., (1994); Nageswaran et. al., (2003); Keto Mshigeni, (2008) studied on the production of oyster mushrooms using water hyacinth substrate but none has studied on the production of *A. bisporus* mushrooms utilizing water hyacinth. Hence, an attempt was made to utilize water hyacinth weed of Kolleru Lake as an input resource for cultivation of white button mushrooms.

MATERIALS AND METHOD

Water hyacinth (Fig.1) was collected from Kolleru Lake and washed with fresh water to clean dirt and fauna. After removing the roots, the plant bodies including the bulbous part were sundried for one week and chopped to half to one inch with motorized chaff cutter with single blade (Fig.2). After cleaning the chippings with distilled water they were kept in already prepared 0.75ml of formaldehyde and 0.2 gms of bavistan an antifungal agent in a plastic drum for each 1 litre of water respectively and stored for 14-16 hours. These chippings were dried under cool shade under fan. These were cleaned with 0.01% phenol added water and covered with polythene cover to stop contamination. The beds were prepared when it contains 70-80% of moisture.

Spawn preparation

Sorghum grains were cleaned with raw salt water. To remove the salt residue these were soaked in the boiled water for twenty minutes. These were again half boiled for thirty minutes and the water was removed, the grains were dried under fan for one to two hours for getting 16-20% wet. Twenty grams of calcium carbonate was added for

1kg of sorghum grains. These grains were filled in polypropylene bags (300 gauge covers (3X7 cm) of 330gms for each packet. The mouth of the each cover was fixed with the plastic ring (1 inch) and plugged with non absorbent cotton and covered with thick paper to prevent contamination.

FIGURE 1. Water hyacinth substrate

FIGURE 2. Motorized chaff cutter with single blade

FIGURE 3, Water hyacinth beds

FIGURE 4. Mushrooms Produced

These grains in polypropylene bags were autoclaved at 16 pounds pressure for 2-3 hours. The autoclaved packets were kept in an inverted position to prevent the moisture formation and then incubated at 37^0C for one day and these were kept in U.V laminar air flow chamber for 17-20 minutes. Ten grams of mother spawn was added to each packet and incubated at 37^0C for thirteen days in a ventilated room. The small tissue below the head of the healthy mushroom was separated and added to Potato Dextrose Agar (PDA) and incubated below 35^0C for thirteen days.

Beds spawn

Three spoons of spawn were added into the half boiled sorghum seeds and incubated for 13 days. The mother spawn was ready after the incubation.

Beds preparation

Covers of 14x26 sizes (one side closed with rubber band) were used to prepare the beds. For every four inch layer, the spawn was added around the layer (Fig-3). These filled in polypropylene covers were tagged with rubber bands. These beds were kept in a dark room at maximum of 35^0C and a minimum of 30^0C for 18-21 days. These beds were taken out when white mycelium was formed heavily. These beds were cut into two equal halves and treated black soil was added on the top of both halves up to 1 inch. These beds were kept in the cultivation shed and the temperature was maintained at 26-32^0C and humidity 50-60%. After 24 hours the water was sprayed on the surface of soil bed with water sprayer. Soil moisture was maintained through water sprayings. After eight days from bed preparation, pinhead appears, within another11-14 days 6 inch pin head formed. Each pinhead (6 inches) weighed 30-40gms. Each bed produced 15-20 pin heads and a minimum of 5 -10 in case of contamination. After 5-7 days of the first crop the second crop started. First crop yielded the maximum of 1kg pinheads for 2 kgs dry weight of the substrate (Fig- 4). For the second crop the yield was reduced to half. In the subsequent harvests the yields are not worth mentioning. One or two ink caps appeared during the first crop. These were very toxic in nature, therefore, these were removed. After the cultivation of mushrooms these were packed in polyethylene bags and stored in a freezer. The self life was very short. Hence, recommended for consumption within 3 to 4 days of harvest.

RESULTS AND DISCUSSION

The time taken for pin head appearance and yield for 1st flush and 2nd flush was shown in the Table 1. As can be seen from Table 1, the yield of mushrooms was studied in summer, rainy, post-monsoon and winter from June 2009 to November 2011. The highest time, starting from the spawn preparation, taken for pin head appearance was 44 days of all seasons. The yield ranged from 0.48 to 0.55,

and 0.26 to 0.33 kgs for first and second flushes respectively. The total yield of first and second flushes combined was between 0.76 to 0.87 kgs of all seasons.

TABLE 1. Showing the time taken for pin head appearance (starting from spawn preparation) and yield of white button mushrooms using water hyacinth substrate from June 2009 - Nov 2011

S.No	Month	Season	Time taken for pinhead appearance (days)	Production of Mushrooms (Kgs)- I Flush	Production of Mushrooms (Kgs)- II Flush	Total (Kgs) I and II flushes combined
1	Jun-09	Summer	44	0.53	0.31	0.84
2	Aug-09	Rainy	43	0.55	0.32	0.87
3	Nov-09	Post Monsoon	37	0.5	0.3	0.8
4	Jan-10	Winter	38	0.52	0.31	0.83
5	May-10	Summer	40	0.54	0.33	0.87
6	Aug-10	Rainy	38	0.53	0.32	0.85
7	Nov-10	Post Monsoon	36	0.5	0.29	0.79
8	Jan-11	Winter	42	0.54	0.27	0.81
9	May-11	summer	39	0.5	0.26	0.76
10	Aug-11	Rainy	37	0.53	0.33	0.86
11	Nov-11	Post Monsoon	38	0.48	0.28	0.76
		Minimum	36	0.48	0.26	0.76
		Maximum	44	0.55	0.33	0.87

The yield was calculated for 2kg of dry water hyacinth substrate used. Murugesan *et al*. (1994) worked on the production of oyster mushrooms using water hyacinth and paddy straw as substrates. The time taken for pinhead appearance using only water hyacinth was 17 days and in case of paddy straw it was 10 days. The maximum yield was 1.07 kgs for water hyacinth substrate and 0.75 kgs for paddy straw. Following the method of Krishnamurthy *et al.* (2003), Nageswaran *et al.* 2003) produced oyster mushrooms using 100% of water hyacinth and obtained maximum yield of 0.36 kg. The method we followed yielded good results (maximum 0.87 kgs). The maximum yield for 100% of paddy straw by Nageswaran et. al., (2003) was 0.46 kgs. The duration was 13 days until first harvest for water hyacinth and 17 for paddy straw. From the Table 1. it was evident that the lowest time taken for pin head appearance, starting from the spawn preparation, was 36 days during November 2010 which was the post-monsoon season. The highest yield for first flush was maximum 0.55kg during the rainy season. This was due to the low temperatures which are favorable for mushroom production. Of all the seasons the lowest yield 0.48kg was observed during the post-monsoon season. During the second flush the yield was reduced to half and the highest yield was only 0.33kg. The total yield was 0.87kg during the rainy season.

The water hyacinth weed is a known hyper accumulator (Ravera et. al., 2003). Therefore, a possible movement of heavy metals from water hyacinth to mushrooms was suspected. After ruling out such threat (Naresh Reddy *et al*., 2012) the freely and abundantly available water hyacinth was recommended as a right substitute to paddy for the cultivation of *A.bisporus* mushrooms. Further the mushroom yields were relatively higher in comparison to those yields obtained with paddy straw by other workers. From the results of the present work it was proved that water hyacinth was a viable substrate for white button mushroom cultivation.

CONCLUSION

From this study, it was unequivocally proved that water hyacinth is a good substrate for the production of white button mushrooms (*Agaricus bisporus*). Hence, we recommend water hyacinth biomass as an inexpensive substitute to paddy straw for white button mushrooms production because of which fodder crisis can be averted. Simultaneously the ecological risks to Kolleru Lake caused by the world's worst aquatic weed (*Eicchornia crassipes*) can be reduced and the development of sustainable livelihoods for the locals can also be achieved.

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