Asian J. of Bio Sci. (2007) Vol. 2 No. 2 : (131-136)

Effect of chemical supplementation on the yield and biological efficiency of *Pleurotus sajor caju* grown in three different lignocellulosic wastes in Chhattisgarh, India

PRASHANT KUMAR SHARMA
Biotech Lab, Training and Demonstration Centre, AMBIKAPUR (CHHATTISGARH) INDIA

(Accepted : August, 2007)

In recent years the mushroom technology has traveled far a head. The domestication of various mushroom species has been tried globally, many of which are now commercially cultivated for food as well as medicinal purposes for an amateur and professional cultivator. The production of mushroom has become important factor, which does not promote the growers. The important priority of profession is to maximize the production of mushroom by using various techniques. Different concentration of carbon sources i.e. lactose (1.0%, 2.0% and 3.0%), nitrogen sources i.e. peptone (1.0%, 2.0% and 3.0%), inorganic chemicals i.e. $Mgso_4$ (1.0%, 2.0% and 3.0%), vitamin sources i.e. vit. B-complex (100, 200 and 300 mg/l) and growth promoter i.e. EDTA (0.1%, 0.2% and 0.3%) were screened to determine the most suitable concentration for better yield of *Pleurotus sajor caju*. Three lignocellulosic agricultural waste material i.e. wheat straw, paddy straw and leman grass straw used for cultivation of *Pleurotus sajor caju* It was found that carbon source and inorganic chemical gave maximum yield and biological efficiency in 2.0% concentration in wheat straw. On that basis lactose and $Mgso_4$ were proved superior carbon source and inorganic chemical, respectively. peptone, the semisolid protein as nitrogen source gave maximum yield and biological efficiency in 3.0% concentration in lemon grass straw while in case of growth promoter it was observed maximum in 0.2% concentration in wheat straw. vitamin B-complex gave maximum yield and biological efficiency in 300-mg/l concentrations in wheat straw, among the three lignocellulosic agricultural wastes material used as substrate, best growth and high yield of *Pleurotus sajor caju* was obtained in wheat straw.

Key words : Chemical supplement, Biological efficiency, Lignocellulosic waste.

INTRODUCTION

The cultivation of edible fungi has been accepted as the easiest on farm biotechnology for profitable removal of various lignocellulosic agricultural, industrial and forestry by-products, specially in the developing countries, although about 200 species of edible fungi have been reported from India, only three viz., *Pleurotus spp*., *Agraricus bisporus* and *Volvariella spp.* are preferred for commercial cultivation and *Pleurotus spp*. alone constitutes about 65% of the total mushrooms production in the country (Munjal, 1982). These species of mushrooms belong to the class basidiomycotina and exhibit two distinct phases in their life cycle, a vegetative phase called hyphae which branch and extend into mycelium and a reproductive phase characterized by the development of a fleshy sporophore referred to as mushroom fruit body. It is this structure, which is prized for its high nutritive value and culinary properties (Mehta, 1990).

Mushrooms are a class of heterotrophic fungi and due to the absence of chlorophyll in their cells they completely depend on the substrate for all their nutritional requirement of carbon, water, nitrogen and minerals. In any cultivation programme on mushroom the primary requiste is preparing a suitable substrate. *Pleurotus sajor caju* can grow on a variety of fresh lignocellulosic residues requiring very little pretreatment (Bano *et al.*, 1982).

Mushrooms are used as delicious flavored food and having nutritional value between meat and vegetables, mushrooms are rich in protein, vitamin and minerals. It is low caloric food with very high potassium, sodium ratio and without starch as well as cholesterol. Vast quantities of renewable lignocelluloses wastes are generated every year in developing countries like India with economics, which are basically agricultural. However mushroom spp. have been reported to grow and yield successfully on many plant wastes. In special reference of chhattisgarh 36.4 lakh ton of agricultural waste material left after animal consumptions can be used as substrates for mushroom production.

Present communication, different concentrations of carbon source (lactose), nitrogen source (peptone), inorganic chemicals ($Mgso_4$), growth promoters (EDTA) and vitamin source (B- Complex) were screened to determine the most suitable concentration for better yield, biological efficiency and suitable substrates of *Pleurotus sajor caju*. The aim of various different chemical supplementations is to get maximum production of fruiting bodies but it is an intricate problem. Moreover, the knowledge, shell help to plan and prepare for the crop and equip one with a physiological tool to control the quality, quantity, timing and other characters of the mushroom cultivation.

MATERIAL AND METHODS

This work was carried out in Biotech lab training and demonstration center, Ambikapur, chhattisgarh during april 2006 to december 2006, parental strains of *Pleurotus sajor caju* were provided by mushroom biotechnology lab, india gandhi agriculture university, raipur, Chhattisgarh. The cultures were maintained on malt extract agar medium with regular sub-cultures at monthly intervals, spawn was prepared on wheat grain following standard procedure (Upadhyay *et al.,* 1997). 15 days old spawn was used for experimentation.

Different concentration of carbon sources i.e. lactose (1.0%, 2.0% and 3.0%), nitrogen sources i.e. peptone (1.0%, 2.0% and 3.0%), inorganic chemicals i.e. $Mgso_4$ (1.0%, 2.0% and 3.0%), vitamin sources i.e. vitamin B-complex (100, 200 and 300 mg/l) and growth promoter i.e. ethylene diamine tetracetic acid (0.1%, 0.2% and 0.3%) were selected for the research purpose.

In any mushroom cultivation programme the primary requisite in preparing a suitable substrate. *Pleurotus sajor caju* can grow on a variety of fresh lignocellulosic residues requiring very little pretreatment (Yadav *et al*., 1998), Three lignocellulosic agricultural waste i.e. wheat straw, paddy straw and lemongrass straw used for cultivation of *Pleurotus sajor caju*.

Wheat straw, paddy straw and lemon grass straw was water socked over night in 1% bavistin and 2% formaldehyde solution, at the following day, the substrate was spread clean floor to drain off excess of water. Polythene begs was prepared by layering methods. All the carbon sources i.e. lactose (1.0%, 2.0% and 3.0%), nitrogen sources i.e. peptone (1.0%, 2.0% and 3.0%), inorganic chemicals i.e. $Feso_4$ and $Mgso_4$ (1.0%, 2.0% and 3.0%) were supplemented into the substrate just before the spawning in the case of growth promoters i.e. ethylene diamine tetracetic acid (0.1%, 0.2% and 0.3%) & vitamin source i.e. vitamin B-complex (100, 200 and 300 mg/l) 20 ml solution of different concentrations were sprayed, respectively on the surface of begs and at the time of pinhead initiation and after the harvesting fruiting bodies, the bags were incubated in cultivation room at 25^0C-30^0C for spawn run after completion of spawn run, time of pinhead initiation, yield and biological efficiency were separately recorded for each treatment at the time of each flush.

After cultivation of *Pleurotus sajor caju* the effect of chemical supplementation the fruiting bodies is dried in sunlight and than prepared powder form and biochemical analysis was done and found that bio-chemical content of *Plurotus sajor caju*.

RESULTS AND DISCUSSION

Pleurotus sajor caju has been recognized as a highly potential converter of cheap cellulosic material in to valuble protein at a very nominal cost. The results obtained during the present investigation are presented in the Table 1 to 6 and photographs.

All the sets supplemented with carbon source (Lactose) took shorter time for spawn run and primordial initiation than control (16 days), the yield and biological efficiency was observed maximum in carbon source (lactose – 2%) 940 grams, 94.0% in wheat straw, compared with control 650 gram and 65.0% biological efficiency. Minimum yield was recorded in carbon source i.e. 580 gram in lactose 3% concentration in lemon grass straw. These are evidences that increase in carbohydrate beyond an optimum point results in an Absolute as well as relative decrease in growth of fungus, (H.S.Sohi 1992), In comparison to lactose for different straw lactose 3% of lemon grass straw (580 gram) was proved to be less effective to others. The similar findings were also reported by Singh (2005).

The sets treated with peptone took different time for spawn run, wheat straw (13 days), paddy straw (12 days) and lemon grass (16 days) compared with control (17 days), they showed variation in day of harvest (table-2), it was observed maximum in peptone 3% concentration of lemon grass straw (29 days). The increasing concentrations caused positive effect on yield and biological efficiency with in a certain limits. It was observed the maximum in peptone 3% concentration in lemon grass straw (900 gram and 90.0 %). This was due to peptone that serves additional available nitrogen to fungus and thus stimulates fungal growth.It also helped in maintaining high cellulase activity and cell mass synthesis, various workers have

Table 1 : Effect of different concentration of carbon source (Lactose) on yield and Biological efficiency of *Pleurotus sajor caju* in different substrates.

Substrates	Supplement Concentration (%)	Mode of Application	Spawn run (Days)	Pin initiation (Days)	First harvesting (Days)	Number of Flushes	Total yield (Gram)	BE (%)
Wheat Straw	Lactose-1%	Supplement	14	18	23	4	890	89.0
	Lactose-2%	Supplement	14	18	23	4	940	94.0
	Lactose-3%	Supplement	14	20	25	4	770	77.0
Paddy Straw	Lactose-1%	Supplement	13	20	26	4	772	77.2
	Lactose-2%	Supplement	13	20	26	4	770	77.0
	Lactose-3%	Supplement	13	19	25	4	695	69.5
Lemon Grass Straw	Lactose-1%	Supplement	18	24	30	4	661	66.1
	Lactose-2%	Supplement	17	24	30	4	670	67.0
	Lactose-3%	Supplement	18	24	29	4	580	58.0
	Control		16	20	26	4	650	65.0

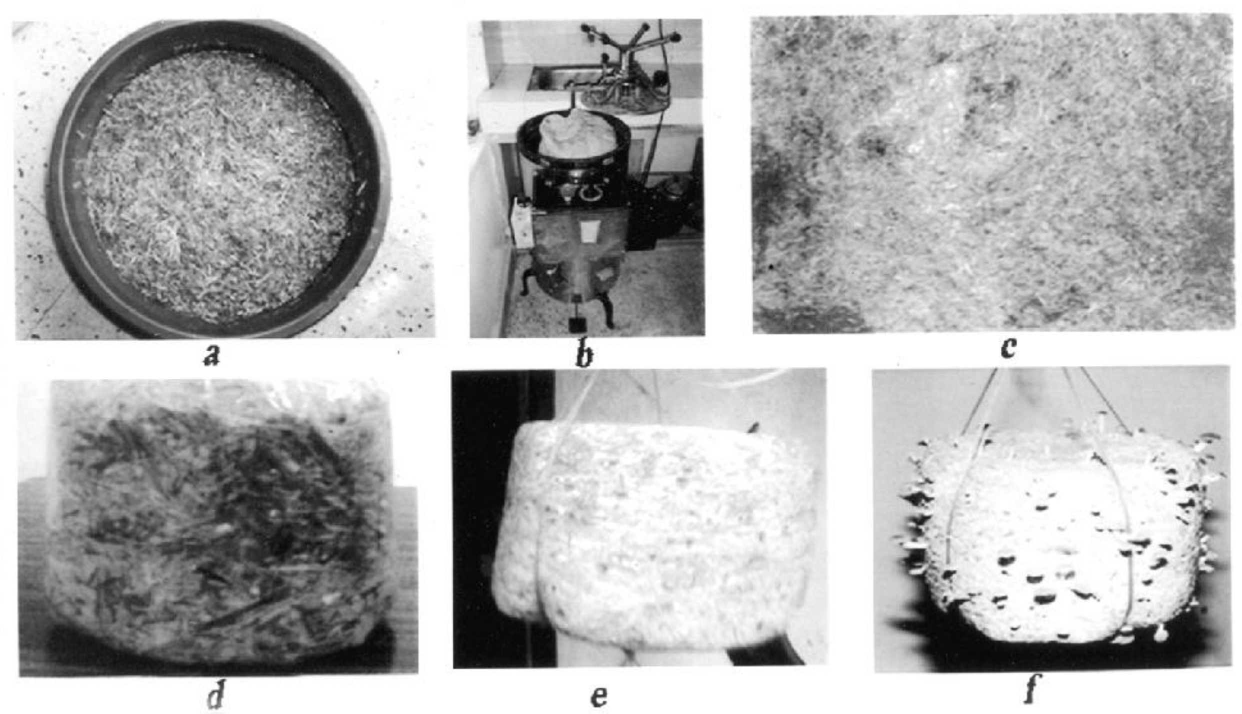

Fig. 1 : Steps involve cultivation of *Pleurotus sajor caju.*

also reported that addition of organic source of nitrogen enhances the yield of *Pleurotus sajor caju* (R. Naraian, 2002).

In our investigation, it was found that beyond certain concentration, yield and biological efficiency was decreased and recorded to the minimum peptone 1 % in wheat straw (600 gram) Sivaprakasam (1980), however, stated that the increasing nitrogen level increased biomass production. This was probably due to competitors, appeared after first flush that exhausted nutrient material from the substrates.

The sets supplemented with inorganic chemicals $Mgso_4$ was found that gave maximum yield and biological efficiency in 1.0% concentration in wheat

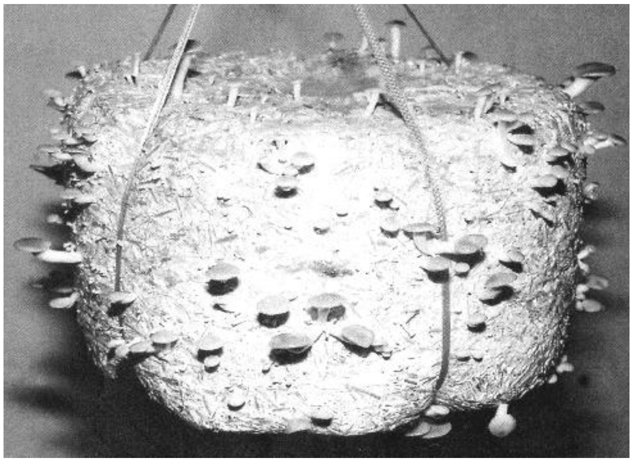

Fig. 2 : Lactose 2% concentration in Wheat straw.

straw (880 grams and 88.0%). These results are similar to findings of Verma (2005) who observed higher yield and biological efficiency in 0.5% concentration while working with Volvariella volvacea as a test fungus. He also stated that the use of inorganic chemicals capable of interacting with phenolics could protect the side chains of extra cellular enzymes, important during the fruiting process as well as substrate utilization. The use of micronutrient at low concentrations may intervene the importance of in enzymatic reaction. Several workers also used inorganic sources in the supplementation of various substrates, increasing *Pleurotus spp*. productivity.

The sets treated with vitamin B- complex shows

Table 2 : Effect of different concentration of Nitrogen source (Peptone) on yield and Biological efficiency of *Pleurotus sajor caju* in different substrates.

Substrates	Supplement Concentration (%)	Mode of Application	Spawn run (Days)	Pin initiation (Days)	First harvesting (Days)	Number of Flushes	Total yield (Gram)	BE (%)
Wheat Straw	Peptone-1%	Supplement	13	16	21	4	600	60.0
	Peptone-2%	Supplement	13	16	21	4	630	63.0
	Peptone-3%	Supplement	13	16	21	4	605	60.5
Paddy Straw	Peptone-1%	Supplement	12	17	23	4	705	70.5
	Peptone-2%	Supplement	12	17	23	4	720	72.0
	Peptone-3%	Supplement	12	18	22	4	695	69.5
Lemon Grass Straw	Peptone-1%	Supplement	16	21	27	4	710	71.0
	Peptone-2%	Supplement	16	22	27	4	780	78.0
	Peptone-3%	Supplement	16	22	29	4	900	90.0
	Control		17	19	24	4	611	61.1

Table 3 : Effect of different concentration of Inorganic chemical ($MgSo_4$) on yield and Biological efficiency of *Pleurotus sajor caju* in different substrates.

Substrates	Supplement Concentration (%)	Mode of Application	Spawn run (Days)	Pin initiation (Days)	First harvesting (Days)	Number of Flushes	Total yield (Gram)	BE (%)
Wheat Straw	$MgSo_4$-1%	Supplement	13	17	24	4	880	88.0
	$MgSo_4$-2%	Supplement	13	17	24	4	795	79.5
	$MgSo_4$-3%	Supplement	13	17	23	4	760	76.0
Paddy Straw	$MgSo_4$-1%	Supplement	14	19	26	4	770	77.0
	$MgSo_4$-2%	Supplement	13	19	26	4	810	81.0
	$MgSo_4$-3%	Supplement	14	19	25	4	695	69.5
Lemon Grass Straw	$MgSo_4$-1%	Supplement	16	24	30	4	530	53.0
	$MgSo_4$-2%	Supplement	16	24	31	4	685	68.5
	$MgSo_4$-3%	Supplement	16	23	30	4	730	73.0
	Control		15	20	27	4	688	68.8

Table 4 : Effect of different concentration of Vitamin source (B-Complex) on yield and Biological efficiency of *Pleurotus sajor caju* in different substrates.

Substrates	Supplement Concentration (%)	Mode of Application	Spawn run (Days)	Pin initiation (Days)	First harvesting (Days)	Number of Flushes	Total yield (Gram)	BE (%)
Wheat Straw	Vit.B-100 mg/l	Spray	12	14	19	4	765	76.5
	Vit.B-200 mg/l	Spray	12	14	19	4	780	78.0
	Vit.B-300 mg/l	Spray	12	15	19	4	860	86.0
Paddy Straw	Vit.B-100 mg/l	Spray	13	16	22	4	692	69.2
	Vit.B-200 mg/l	Spray	13	17	21	4	696	69.6
	Vit.B-300 mg/l	Spray	14	18	22	4	705	70.5
Lemon Grass Straw	Vit.B-100 mg/l	Spray	16	20	26	4	760	76.0
	Vit.B-200 mg/l	Spray	16	19	26	4	765	76.5
	Vit.B-300 mg/l	Spray	16	19	25	4	715	71.5
	Control		15	17	23	4	690	69.0

Table 5 : Effect of different concentration of Growth promoter (EDTA) on yield and Biological efficiency of *Pleurotus sajor caju* in different substrates.

Substrates	Supplement Concentration (%)	Mode of Application	Spawn run (Days)	Pin initiation (Days)	First harvesting (Days)	Number of Flushes	Total yield (Gram)	BE (%)
Wheat Straw	EDTA-0.1%	Spray	13	16	19	4	775	77.5
	EDTA-0.2%	Spray	13	16	19	4	900	90.0
	EDTA-0.3%	Spray	13	16	19	4	865	86.5
Paddy Straw	EDTA-0.1%	Spray	12	17	21	4	690	69.0
	EDTA-0.2%	Spray	12	17	21	4	770	77.0
	EDTA-0.3%	Spray	12	17	21	4	685	68.5
Lemon Grass Straw	EDTA-0.1%	Spray	17	23	28	4	705	70.5
	EDTA-0.2%	Spray	17	24	28	4	716	71.6
	EDTA-0.3%	Spray	17	24	30	4	690	69.0
	Control		15	20	23	4	657	65.7

Table 6 : Comparative chemical analyses of *Pleurotus. sajor caju* in different supplement and substrates (100 gm dry wt. basis)

Contents (%)	Supplement-Lactose- 2%	Supplement-Peptone-3%	Supplement-$MgSo_4$-1%	Supplement-EDTA-0.2%	CONTROL
	Substrates-Wheat straw	Substrates-Lemon straw	Substrates-Wheat straw	Substrates-Wheat straw	
Protein	47.96	47.90	47.94	47.99	47.93
Sugar	0.288	0.281	0.280	0.271	0.285
Starch	0.110	0.122	0.123	0.110	0.120
Fibers	1.077	0.984	1.109	1.092	1.084
Ash	0.990	0.991	0.969	0.973	0.974
Moisture	90.92	90.89	90.94	90.93	90.95

maximum yield and biological efficiency in 300mg/ltr i.e. 860gram and 86.0% in wheat straw. The yield and biological efficiency increased with increasing order of concentrations. All the sets took equal time for spawn run and pin initiation (13 days wheat straw, 12 days paddy straw and 17 days lemon grass), they showed lesser time for harvesting of crop when treated with growth promoter EDTA (Table 5). Among the three lignocellulosic agricultural wasted used as substrate, best growth and high yield of P. sajor caju was obtained in wheat straw.

REFERENCES

Bano, Z. and Rajarathnam, S. (1982). In tropical mushroom (eds. S.T. Chang and T.H.Quimio). The Chinese Univ. Press, Hong Kong, pp: 363-380.

Sohi, H.S. (1992). Importance of edible mushrooms in India diet and factors responsible for low production of cultivated mushrooms, Indian phytopathology, **45(2):** 147-157 (1992).

Mehta, K.B. (1990). Mushroom Recipes, Technical Bulletin No.3 Solan, India, National Centre for Mushroom Research and Training. Pp-17-19.

Munjal, R.L. (1982). Prospects of mushroom cultivation in India. *Indian Phytopathology,* **35:** 1-13.

Singh Rochica (2005). Studies on some larger fungi of Faizabad with reference to their eco-physiological characteristics. Ph.D. Thesis, Dr. R.M.L.Avadh Univ., Faizabad, pp- 114-115.

Sivaprakasam, K. (1980). Studies on oyster mushroom (Pleurotus sajor caju (Fr.) Singer). P.h.D. Thesis, Tamil Nadu Agric. Univ. Coimbatore, pp- 115-116.

Naraian, R. (2002). Effect of nitrogen supplementation on the yield of fruitbodies and changes in enzyme profile of Pleurotus florida. Ph.D. Thesis, Dr. R M. L. Avadh University, Faizabad, pp-19-21.

Upadhyay, R.C. and Fritsche, W. (1997). In Advance in Mushroom Biology and Production (eds. R.D. Rai, B.L. Dhar and R.N. Verma) MSI, Solan (HP), pp: 281-290.

Verma, D.N. (2005). Studies on cultivation of Volvariella volvacea (Bull. Ex. Fr.) Singer with special reference to certain organic and inorganic amendments, pp-23-27.

Yadav, M.C., Dhar, B.L., Verma, R.N. and Kamal, S. (1998). International Symposium: Science and Cultivation of Mushroom, Nanjing, October-1988, pp- 12-15.