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Evaluation of Biomass of Some Invasive Weed Species as Substrate for Oyster Mushroom (*Pleurotus* spp.) Cultivation

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Abstract: This study assessed the bioconversion of Agriculture wastes like invasive weeds species (*Lantana camara, Prosopis juliflora, Parthenium hysterophorus*) as a substrate for oyster mushroom (*Pleurotus* species) cultivation together with wheat straw as a control. The experiment was laid out in factorial combination of substrates and three edible oyster mushroom species in a Completely Randomized Design (CRD) with three replications. *Pleurotus ostreatus* gave significantly ($p<0.01$) total yield of 840 g kg^{-1} on *P. hysterophorus*, Significantly ($p<0.01$) biological efficiency (83.87%) and production rate of 3.13 was recorded for *P. ostreatus* grown on *P. hysterophorus*. The highest total ash content (13.90%) was recorded for *P. florida* grown on *L. camara*. while the lowest (6.92%) was for *P. sajor-caju* grown on the *P. juliflora*. Crude protein ranged from 40.51-41.48% for *P. florida* grown on *P. hysterophorus* and *L. camara*. Lowest crude protein content (30.11%) was recorded for *P. ostreatus* grown on wheat straw. The crude fiber content (12.73%) of *P. sajor-caju* grown on wheat straw was the highest. The lowest crude fiber (5.19%) was recorded for *P. ostreatus* on *P. juliflora*. Total yield had a positive and significant correlation with biological efficiency and production. Utilization of the plant biomass for mushroom cultivation could contribute to alleviating ecological impact of invasive weed species while offering practical option to mitigating hunger and malnutrition in areas where the invasive weeds became dominant.

Key words: Biological efficiency, invasive weed species, mushroom cultivation, *Pleurotus* spp., total yield

INTRODUCTION

Mushrooms are fungi that belong to the Basidiomycotina or Ascomycotina and they produce lignocellulosic enzymes, which degrade complex organic matter and absorb the soluble substances (Chang and Miles, 1989). The cultivation of mushrooms has a great potential for the production of protein rich quality food and for recycling of cellulosic agro-residues and other wastes (Singh *et al*., 1999).

Even though mushrooms could supplement nutritional needs of people for centuries during the rainy season, which is a period of grain scarcity, the mushroom eating habit among the majority of Ethiopian population is very poor (Dawit, 1998). Globally, *Pleurotus* spp. production line in third, after remarkable boosts during the last few years as of high consumption by different nations (Royse, 2002). The cultivation of *Pleurotus* spp. offers one of the most practical and economic methods for the bioconversion of lignin wastes produced by Agriculture (Cohen *et al*., 2002).

Biomass of invasive weeds can be considered as lignocellulosic material which has become problematic for disposal. *Parthenium hysterophorus* is an invasive weed that was first introduced accidentally into Ethiopia in the 1970s (Seifu, 1990) and subsequently spread throughout the country dominating in disturbed soils. *Prosopis juliflora*, which was introduced in the late 1970s and early 1980s has become a noxious invader weed in Ethiopia (Duke, 1983). Moreover, *Lantana camara* was implicated in widespread loss of native plant species diversity via limitation of native species and changed ecosystem structure and function (Gooden *et al*., 2009). Suitable utilization of weeds is a subject of interest as most weeds are not used even as fodder due to the presence of lignin and anti-metabolites like phenolics, glycosides, flavonoids and other compounds (Fianu *et al*., 1981). Such plant materials can be used as substrate for primary decomposers such as white-rot fungi, notably *Pleurotus* spp., which have lignocellulosic-degrading enzymes (e.g., polyphenol oxidases and peroxidases) causing significant phenolic removal (Aggelis *et al*., 2003; Olivieri *et al*., 2006).

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Despite the massive research efforts that are underway to manage invasive weeds with emphasis on biological control using pathogens and insects (Tessema *et al*., 2009), immediate and complete control of the weeds could not be expected. Therefore, an attempt to convert the weed biomass into protein rich food through mushroom cultivation is prudent. This study reports on growth, mushroom yield and quality of three *Pleurotus* spp. produced on biomass of invasive weeds.

MATERIALS AND METHODS

Three oyster mushroom species were evaluated in 2011-2012 for growth, yield and related parameters on four substrates, namely biomass of three invasive weed species as test substrates and wheat straw as control. The experiment was laid out in completely randomized design with 3×4 factorial arrangements of mushroom species and substrates. The experiment was undertaken in three replications and was repeated.

Experimental materials and site: Isolates of oyster mushrooms used in this study, *Pleurotus florida*, *P. sajor-caju* and *P. ostreatus*, were obtained from the Mushroom Research, Production and Training Laboratory (MRPTL) of Haramaya University. They were maintained at 4-5°C on potato dextrose agar (PDA). Cultivation of mushrooms was undertaken at the MRPTL located in the main campus of Haramaya University, Ethiopia, at 42°3'E and 9°26'N at altitude of 1980 m.a.s.l.

The three test substrates were collected as follows. Whole above ground parts of *Parthenium hysterophorus* prior to flowering and branches of *Lantana camara* were collected from Haramaya University campus whereas branches of *Prosopis juliflora* were collected from Dire Dawa town in Eastern Ethiopia.

Spawn production: Mother spawn was prepared according to the procedure described by Singh and Chaubey (1995). Nine kilogram of the maize seeds were boiled in 15 L of water for 15 min and then allowed to remain soaked in the hot water for another 25 min. The water was drained off and the grain was put in a sieve to dry over night. Next day, 120 g calcium sulfate and 30 g calcium carbonate were mixed with each 9 kg of the boiled grains. The calcium sulfate and calcium carbonate were used to maintain the pH close to neutrality (5.5-6.5) and reduce grain adhesion (Smith and Love, 1995). The supplemented grains were filled in half or one liter sterilizable bottles (225 or 450 g/bottle). Bottles were plugged with non-absorbent cotton and sterilized in an autoclave at 121°C for half hour. After cooling, the bottles were aseptically and separately inoculated by transferring agar block with mycelium of the three tests isolates. The culture bottles were then shaken thoroughly to uniformly distribute the mycelium and were incubated at 25°C. After the grains were fully covered with mycelium (in about 15 days), the bottles were used as mother spawn to produce sufficient quantity of spawn for the experiment.

Substrate preparation and spawning: Specimens of collected plant parts were chopped to 2-4 cm pieces and filled in gunny bags and then soaked in 2% aqueous formalin solution for about 18 h. The bags, after treatment with formalin solution, were taken out and allowed to drain the excess solution for 4-6 h. The soaked pieces of plant materials were then checked for excess water by pressing between the palms. If water is not dripping, the chopped plant material was considered as ready for spawning. The wet plant materials were then spread on polyethylene sheet (which is earlier wiped with swab dipped in 70% ethyl alcohol) and inoculated with spawn prepared at the rate of 3% on wet basis. The spawn was thoroughly mixed with the substrate and then filled into plastic bags (2 kg per bag).

Following spawning, the bags were kept about 15 cm apart in a crop room at about 25-30°C and 70-90% relative humidity. The humidity and temperature range were kept by a heater and by spraying water to the walls and floors of the cropping room. Data logger (DVTH, SUPCO, Allenwood, NJ) was used to record temperature and relative humidity of every 30 min throughout the experimental period. During the cropping period the bags were sprinkled with water twice a day. Mushrooms of each species were harvested when matured (after 25-30 days of cultivation) and then flushes were collected three times at 3-days interval. The temperature and relative humidity inside the cropping room were 12.9-25.7°C and 57.7-91.9%, respectively.

Data collection and statistical analysis: Data were collected on time required (days) for completion of mycelium running, appearance of pin heads formation and maturation of fruiting bodies, total yield and biological efficiency, production rate, moisture content, crude protein, crude fiber and ash content. The data were subjected to analysis of variance ANOVA (Gomez and Gomez, 1984) using Statistical Analysis System (SAS Institute, Cary, NC, USA) Version 9.1. Least significance difference (LSD) was used for mean separation.

RESULTS AND DISCUSSION

Effect of organic substrates and mushroom species on growth and fruiting: There were significant ($p<0.01$)

Table 1: Effects of growing substrates and mushroom species on yield and yield related components of oyster mushrooms (g kg^{-1})

	Pleurotus ostreatus				*Pleurotus florida*				*Pleurotus sajor-caju*					
	LC	PH	PJ	WS	LC	PH	PJ	WS	LC	PH	PJ	WS	LSD (%)	CV (%)
DMI	19.83^{c}	19.83^{c}	23.17^{a}	16.50^{d}	20.83^{bc}	20.37^{bc}	23.83^{a}	16.83^{d}	22.17^{ab}	21.17^{bc}	23.50^{a}	17.33^{d}	1.96**	5.67
DPF	24.83^{cde}	23.83^{e}	26.0^{bc}	20.37^{g}	24.83^{cde}	24.70^{de}	27.0^{b}	21.17^{fg}	26.0^{bc}	25.17^{cd}	28.83^{a}	22.37^{f}	1.22**	2.94
DFF	29.33^{b}	26.87^{c}	29.70^{b}	24.83^{c}	29.67^{b}	29.03^{b}	31.0^{ab}	25.33^{c}	30.53^{ab}	29.37^{b}	32.37^{a}	26.37^{c}	2.09**	4.31
TY (g kg^{-1})	610.00^{d}	840.00^{a}	405.50^{h}	770.00^{b}	510.00^{g}	590.00^{de}	377.00^{h}	665.00^{c}	545.00^{f}	555.00^{ef}	280.00^{i}	615.00^{d}	73.77**	3.88
BE (%)	61.11^{d}	83.87^{a}	40.68^{h}	76.94^{b}	51.19^{g}	58.92^{de}	37.68^{h}	66.30^{c}	54.94^{f}	55.34^{ef}	27.77^{i}	61.74^{d}	3.69**	3.88
PR	2.08^{d}	3.13^{a}	1.37^{g}	3.11^{a}	1.73^{f}	2.03^{de}	1.22^{g}	2.62^{b}	1.80^{ef}	1.89^{def}	0.86^{h}	2.35^{c}	0.24**	7.20

**Significant at 1% probability level. LC: *Lantana camara*, PH: *Parthenium hysterophorus*, PJ: *Prosopis juliflora* and WS: Wheat straw substrates (control), DMI: Days to mycelium invasion, DPF: Days to pin-head formation, DFF: Days to fruit body formation, TY: Total yield, BE: Biological efficiency and PR: Production rate. Means followed by the same letter (s) in a row are not significantly different

differences among substrates in terms of the time taken from spawning to mycelium invasion as well as pin head and fruit body formation (Table 1). In general, the oyster mushrooms were faster in mycelial invasion and in fruiting on wheat straw.

The fastest mycelium invasion was recorded for wheat straw with 16.5 days required after spawning was followed by *Lantana camara* and *Parthenium hysterophorus* (19.83 days). While invasion of *Prosopis juliflora* substrate by mycelia was the slowest (23.83 days). Bhatti *et al.* (1987) reported that the variation in the duration to complete mycelium running of oyster mushroom in different substrates might be due to differences in their chemical composition and C: N ratio. There was no significant difference among the three *Pleurotus* spp. in terms of time taken for mycelium invasion. The interaction between effects of substrates and mushroom species on days to mycelium invasion was non-significant (Table 1).

The earliest pin-head formation was recorded on wheat straw with 20.37 days after spawning was followed by *Lantana camara and Parthenium hysterophorus* (23.83 days). Statistically the slowest pin-heading was observed with dried *Prosopis juliflora* (28.83 days). This might be the chemical nature (phenolic contents) of the substrate and also plant type like being herbs. Cherney *et al.* (1989) also reported the inhibitory effect of phenolic compound on mycelium growth. There was no significant difference between *L. camara* and *P. hysterophorus* in terms of pin heading. Wheat straw, *Parthenium hysterophorus* and *Lantana camara* were recorded earlier pin head formation by *Pleurotus* species compared to *Prosopis juliflora* substrate (Table 1). The difference observed between the species with regard to the time taken from spawning to pin head formation was statistically significant (Table 1). The interaction between the effect of substrates and mushroom species of the mushroom on days Pin head formation was non-significant.

The fastest fruiting body formation was observed on wheat straw (24.83 days) followed by *Parthenium hysterophorus* (26.87 days) this might be the nature of the plant. The slowest fruiting body formation was recorded on *Prosopis juliflora* (32.37 days). This could be the high antifungal characteristics. This result is in agreement with the work of Tagele (2011) that the *Prosopis juliflora* has highest antifungal effect. Although significant difference was not observed between *Prosopis juliflora* and dried *Lantana camara* in terms of fruiting body formation that could be due to the chemical nature of the two substrates (Table 1). The results of this study are in harmony with Robert (1996) who reported that long period of fruiting body formation is related to high nitrogen content of a different lignocellulosic substrate (enzymatic activity). *Pleurotus ostreatus* had significantly faster ($p<0.01$) fruiting body formation than *Pleurotus florida* and *Pleurotus sajor-caju* (Table 1). However the interaction between substrates and mushroom species was non-significant in terms of time taken to fruit body formation.

Effect on total yield, biological efficiency and production rate: Significant ($p<0.01$) difference between the total mushroom yield of *Pleurotus* species on the three substrates was observed (Table 1). *Pleurotus ostreatus* on *Parthenium hysterophorus* gave significantly higher total yield (840 g kg^{-1} of dry substrate) over the other substrates while the lowest yield was obtained from *Prosopis juliflora* for *Pleurotus sajor-caju* (280 g kg^{-1} of dry substrate). This result was to some extent greater than that of Vats *et al.* (1994) who grew oyster mushroom on *Lantana camara* and wheat straw and reported a yield of 36000 g and 54800 g 100 kg^{-1}, respectively. The highest yield of mushroom grown on *Parthenium hysterophorus* may be due to the high nitrogen content and narrow C:N ratio. But in the case of *Prosopis juliflora* the yield it gave was very low perhaps due to the nature of the plant (its high phenolic content). Cherney *et al.* (1989) reported the inhibitory effect of phenolic compounds on mycelium growth. Significant difference was not observed between *P. ostreatus and P. sajor-caju* grown on *Lantana camara* and wheat straw.

Significant ($p<0.01$) interaction effect between the substrates and *Pleurotus* species on the Biological Efficiency (BE) was observed (Table 1). The highest BE was recorded with 83.87% for *Pleurotus ostreatus* grown on *Parthenium hysterophorus*. This could be high cellulose content and low lignin content of the substrate (Table 1). The BE obtained for *Pleurotus ostreatus* grown on dried *Parthenium hysterophorus* was within the range (68.7-88.4) grows on paddy straw provided by Oei (2003). This result was approximate to Alam *et al*. (2007) who observed that the BE ranged from 45.21 to 125.70% in case of oyster mushroom on saw dust and rice straw. Significantly lower BE (27.77%) was recorded for the *Pleurotus sajor-caju* grown on *Prosopis juliflora* (Table 1). High value of biological efficiency could be observed for mushrooms grown on narrow C:N ratio substrates such as *Parthenium hysterophorus* and low value of BE was observed for mushrooms grown on wide C:N ratio. Significant difference was not observed among *Pleurotus ostreatus* and *Pleurotus florida* on *Prosopis juliflora* substrate. Significant difference was also not observed for *Pleurotus sajor-caju* grown on dried *Lantana camara* and *Parthenium hysterophorus* substrate. This might be nature of the plant (Table 1).

Significant ($p<0.01$) interaction effect between different substrates and *Pleurotus* species was observed in terms of Production Rates (PR) (Table 1). The highest production rates (3.13) were recorded for *Pleurotus ostreatus* grown on *Parthenium hysterophorus* followed by Wheat straw (3.11). The lowest production rate (0.86) was observed in *Pleurotus sajor-caju* on *Prosopis juliflora*. This could be possibly due to the positive relation in case of PR with nitrogen and the negative relation with carbon. This observation is in line with Sharma and Madan (1993) who reported the positive correlation of PR with nitrogen level of the substrates. However, significant difference was not observed in *Pleurotus sajor-caju* grown on *Lantana camara* and *Parthenium hysterophorus*. *Pleurotus ostreatus* and *Pleurotus florida* grown on *Prosopis juliflora* showed PR values significantly lower than those grown on *Parthenium hysterophorus* and *Lantana camara*. Wheat and *Lantana camara* substrates were significantly different from one another on PR regardless of the mushroom species used (Table 1).

Effect of substrates on quality parameters of mushroom species: In the present study, moisture content, dry matter percentage, total ash, organic matter, crude protein and crude fiber content of oyster mushrooms at harvest were measured to assess quality of mushrooms grown on different substrates.

Effect of growing substrates was significant ($p<0.01$) on moisture content of the harvested mushrooms of *Pleurotus* spp. (Table 2). The highest moisture content was recorded with 92.42% in *Pleurotus florida* grown on wheat straw. This might be the water holding capacity of the substrate, the nature of mushroom species during the cultivation time. These results are slightly greater than that of McKellar and Kohrman (1975) and Ortega and Martinez (1997) who reported a range of 70-90.9% and 89-91% moisture, respectively. The lowest moisture content was recorded with 85.92% for *Pleurotus sajor-caju* on *Prosopis juliflora* substrate. This might be the poor nature of the plant in water holding capacity as compared to the other substrate. The result was to some extent close to the value by Kidane (2006) who reported 88.6 to 93.4% moisture content of *Pleurotus sajor-caju*; similar moisture content (80.0-92.5%) was reported for *Pleurotus* sp. grown on different agro wastes (Kurtzman, 2005; Ahmed *et al*., 2009). Moisture content is influenced by mushrooms age, growing environments, mushroom strains and postharvest environments (Kurtzman, 2005). The interaction effects between other substrates and *Pleurotus* species were found variable within this range. No significant ($p<0.01$) difference on the *Pleurotus* species was observed during the study time.

The interaction effects of growing substrates and type of species were significant ($p<0.01$) in relation to total ash content mushrooms (Table 2). The highest total ash content was recorded with 13.90% for *Pleurotus florida* grown on *Lantana camara* while the lowest (6.92%) was for *Pleurotus sajor-caju* and

Table 2: Interaction effects of growing substrates and mushroom species on proximate compositions of oyster mushrooms

	Pleurotus ostreatus				*Pleurotus florida*				*Pleurotus sajor-caju*					
Parameter	LC	PH	PJ	WS	LC	PH	PJ	WS	LC	PH	PJ	WS	LSD (%)	CV (%)
Moisture	88.98^{cd}	89.0^{cd}	88.06^{d}	89.38^{c}	86.61^{e}	90.24^{bc}	87.96^{d}	92.42^{a}	91.40^{ab}	88.06^{d}	85.92^{e}	91.76^{a}	1.29**	0.86
Total ash(%db)	11.19^{b}	11.08^{b}	6.92^{d}	7.69^{d}	13.90^{a}	13.02^{a}	9.03^{c}	11.06^{b}	11.26^{b}	7.69^{d}	6.92^{d}	11.19^{b}	1.06**	6.23
Crude protein(%db)	32.33^{c}	32.76^{c}	30.87^{c}	30.11^{c}	41.48^{a}	40.51^{a}	32.60^{c}	32.69^{c}	37.63^{ab}	31.60^{c}	31.77^{c}	33.84^{bc}	4.04**	7.06
Crude fiber(%db)	6.67^{cd}	8.56^{b}	5.19^{d}	8.61^{b}	5.75^{d}	6.52^{cd}	5.65^{d}	8.87^{b}	7.54^{bc}	7.93^{bc}	7.71^{bc}	12.73^{a}	1.57**	12.16

**Significant at 1% probability level. LC: *Lantana camara*, PH: *Parthenium hysterophorus*, PJ: *Prosopis juliflora*, WS: Wheat straw (control) and db: Dry basis, Means followed by the same letters in a row are not significantly different

Pleurotus ostreatus grown on the *Prosopis juliflora* substrate. This value was close to the value mentioned by Kidane (2006) reported higher ash content (12.32%) for *Pleurotus sajor-caju* grown on *chat* leaves. A number of factors usually influence the nutritional composition of mushrooms. These factors include growing site, type of substrates, mushroom type, developmental stages and part of the fungal samples analyzed (Mshandete and Cuff, 2007). This difference could be due to straw type and species type. On the other hand the lowest ash content result of this study are somewhat close to the Oei (2003) and Dawit (1998) who reported ash content of 8.80% for oyster mushroom and 7.20% for *Pleurotus sajor-caju* respectively. Significant difference was observed among substrates (Table 2).

Interaction effect of growing substrates and types of *Pleurotus* species (Table 2) was significant ($p< 0.01$) on crude protein content of edible oyster mushrooms. Crude protein content of *Pleurotus florida* grown on *Lantana camara* was recorded with 41.48% followed by (40.51%) of the same species grown on *Parthenium hysterophorus*. This values was slightly similar to the range of Kurtzman (2005) in which the Protein on dry matter basis (db) in oyster mushrooms can range 20-40%. The lowest crude protein (30.11%) was for *Pleurotus ostreatus* grown on wheat straw that was not significantly much different from other combinations (Table 2). The lowest crude protein values fall in the range of values mentioned by Chang *et al.* (1981) of 26.9-37.2, 26.6-35.5 and 26.6-35.6% crude protein content of *Pleurotus* species grown on various kinds of substrates. The differences in crude protein could be the high nitrogen content of *Lantana camara* substrate which contributed towards the higher crude protein content to growing mycelium while wheat straw supplied less nitrogen and it could be attributed to the efficiency nitrogen utilization by the species. The positive correlation of high protein content with high nitrogen content of Lantana substrate implies that nitrogen is essential for synthesis of protein in mushroom fruiting bodies. This result was in line with Sangwan and Saini (1995) and Ragunathan and Swaminathan (2002), the protein contents of mushrooms are dependent on biological, chemical differences and the C:N ratio of substrates. Mshandete and Cuff (2007) also reported that the protein content of edible mushrooms besides being species/strain specific could also vary with the growing substrate.

The crude fiber content of edible oyster mushrooms was significant ($p<0.01$) due to the interaction effects of growing substrates and type of mushroom species (Table 2). Crude fiber content (12.73%) of *Pleurotus sajor-caju* grown on wheat straw was the highest followed by (8.87%) of *Pleurotus florida* grown on wheat straw. These values are close to the value mentioned by Crisan and Sands (1978) who reported 13.3% crude fiber for cultivated edible mushrooms and Kidane (2006) who reported 10.6% crude fiber content for *Pleurotus sajor-caju*. *Pleurotus ostreatus* grown on *Prosopis juliflora* recorded the lowest Crude fiber with 5.19%. This result was close to the range of the Obodai (1992) reported fiber values of 6.5-16.3% for *Pleurotus* species. Over all the crude fiber content in different kinds of oyster mushroom might be dependent on the harvesting time of the particular mushroom species. The difference in crude fiber content could be attributed to the variation in the nutritional compositions of substrates and the type of *Pleurotus* species grown. In general, results of the present study showed that organic residues having wide C:N ratio reduced the yield and quality of mushrooms.

Correlation between mushroom yield parameters: Results of the simple linear correlation analysis (Table 3) showed that TY had a high positive and significant correlation with BE ($r = 1.0^{***}$) and PR ($r = 0.98^{***}$). This indicated that high TY was essential for biological efficiency and production rate to increase but low yield had negative effect on the yield parameters. This result was slightly close to the value of Kidane (2006).

Correlation between mushroom quality parameters: Results of the simple linear correlation analysis (Table 4)

Table 3: Correlation coefficient for different yield parameters of mushroom

	DMI	DPF	DFF	BE	PR	TY
DMI	1.00					
DPF	0.87***	1.00				
DFF	0.79***	0.92***	1.00			
BE	-0.73***	-0.79***	-0.77***	1.00		
PR	-0.78***	-0.86***	-0.87 ***	0.98***	1.00	
TY	-0.73***	-0.79***	-0.77***	1.00***	0.98***	1

***Indicate significant difference at 0.001 probability level. DMI: Days to mycelium invasion, DPF: Days to pin-head formation FBF: Days to fruiting body formation, BE: Biological efficiency, PR: Production rate and TY: Total yield

Table 4: Correlation coefficient for different quality parameters of mushrooms

	MOS	DM	TA	OM	CP	CF
MOS	1.0					
DM	-1.0***	1.0				
TA	0.31ns	-0.31ns	1.0			
OM	-0.31ns	0.31ns	-1.0***	1.00		
CP	0.11ns	-0.11ns	0.69***	-0.69***	1.00	
CF	0.49 **	-0.49**	0.04ns	-0.04ns	-0.18ns	1

***and** Indicate significant at 0.01 and 0.05, respectively while ns indicates non significant. %MOS: Percentage moisture content, %DM: Percentage dry matter, %TA: Percentage total ash, %OM: Percentage organic matter, %CP: Percentage crude protein, %CF: Percentage crude fiber

showed a negative and significant correlation of MOC with DM (r = -1.0***) and non significant with TA (r = 0.31ns), OM (r = -0.31ns) and CP (r = 0.11ns) but on the case of CF (r = 0.49**) it was significant. DM with TA (r = - 0.31ns), OM (r = 0.31ns) and CP (r = -0.11ns) was significant but in the case of CF (r = -0.49**) it was negatively correlated. This result was approximate to the value of Kidane (2006).

CONCLUSION

Selective weeds can be used successfully as substrates for oyster mushroom cultivation. Weeds are not only proved asthe alternative substrate for oyster mushroom cultivation, they also can significantly increase the protein content and reduce the production time. In the present investigation *Lantana camara* and *Parthenium hysterophorus* are weeds that has been identified as the best substrate for oyster mushroom cultivation with respect to the total yield, biological efficiency and fruiting time. Therefore, oyster mushroom cultivation proves to be a highly efficient method for disposing of weed plants as well as producing protein-rich food.

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