American Journal of Food Science and Nutrition
2020; 7(1): 1-7
http://www.aascit.org/journal/ajfsn
ISSN: 2375-3935

AASCIT American Association for Science and Technology

Effects of Different Mixing Ratios of Substrates Composed from Wheat Straw, Waste Paper and Cotton Seed Waste on Some Nutritional Contents of Oyster Mushroom (Pleurotus ostreatus)

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Citation

Abera Getachew, Asefa Keneni, Mosisa Chewaka. Effects of Different Mixing Ratios of Substrates Composed from Wheat Straw, Waste Paper and Cotton Seed Waste on Some Nutritional Contents of Oyster Mushroom (Pleurotus ostreatus). *American Journal of Food Science and Nutrition.* Vol. 7, No. 1, 2020, pp. 1-7.

Received: July 9, 2019; **Accepted:** August 29, 2019; **Published:** August 5, 2020

Abstract: Oyster mushroom is the widely cultivated mushrooms in the world, due to its functional foods is serving as nutritionally balanced and medicinally use full in today's communities where a number of old age related and degenerative diseases are recurrent. The aim of this paper is to evaluate some nutritional contents of oyster mushroom which was grown on different mixing levels of wheat straws with cotton seed wastes and wheat straw, waste paper and cotton seed waste. The quality data's such as moisture, protein, ash, fate, fiber and carbohydrate contents were determined. The means of moisture, ash, fiber, protein, and carbohydrate contents of oyster mushrooms produced under different mixing levels of wheat straws and cotton seed wastes were significant within the treatments whereas, the lipid content was non-significant. The highest moisture (85%) content was from T4, for ash content (8.98%) form T10, for crude fiber (14.64%) content from T10, for protein content (35.44 and 35.64%) from T1 and T9 respectively, for carbohydrate content (48.65 and 48.82%) from T1 and T2 respectively. For wheat straws, waste paper and cotton seed waste, the means of ash, crude fiber, lipid and carbohydrate contents were significantly within the treatments; while, the means of protein contents had highly significant differences within the treatments. Form these substrates, the highest ash content 9.17% from T5, for crude fiber content 9.59% from T5, for protein content (30.68 and 30.24%) from T3 and T4 treatments respectively while, for lipid content (3.03%) from T5 and for carbohydrate content (57.18%) from T1.

Keywords: Cotton Seed Waste, Nutrient Content, Oyster Mushroom, Waste Paper, Wheat Straw

1. Introduction

Mushrooms have been a part of the human diet since time immemorial, involving a large number of edible species. In most countries mushrooms are an important delicacy because of the unique flavor and texture [1, 2]. Mushrooms are rich in nine essential amino acids that cannot be synthesized by our body as well as the most commonly occurring non-essential amino acids. In mushrooms, starch is absent. Moreover, cholesterol and the sterol known to be dreaded for heart patients, remain absent in mushrooms [3]. Oyster mushrooms' species (Pleurotusspp.) are famous for owning all three properties expected from the food nutrition, taste, and physiological functions being thus appreciated for both their sensory characteristics and outstanding nutritional profile. Concerning the amount of crude protein, mushrooms are ranked below animal meats, but well above most other foods, including milk, which is an animal product and its proteins contain all nine essential amino acids required by humans, as a substitute for meat diet [4]. Fresh fruiting bodies of Oyster mushrooms' species contain 85-90% moisture [5], and the moisture percentage depends on the mushroom species besides other parameters related to harvest, growth, culinary and storage conditions [6]. Arti et al investigated that, the

nutritional compositions of Pleurotus spp. (P. floridanusSinger, P. pulmonarius, P. sapidus, P. cystidiosus and P. sajor-caju (Fr.)) under dry weight basis, carbohydrates (85.86-88.38%), proteins (0.98-2.17%), crude fat (0.62-0.84%), crude fibers (2.76-3.12%) and ash (1.03-2.20%) [7]. However, Maftounet. al showed that mushroom nutritional supremacy in relation to the vegetarian diet is also virtue of their chitin rich cell wall that acts as a source of dietary fiber, along with their vitamin content (including thiamine, riboflavin, ascorbic acid, ergosterine and niacin), considerable contents of micro and macro-elements as phosphorus and iron, carbohydrates and very low fat tenor [8]. Atriet. al "illustrated that the fresh fruiting bodies of Pleurotus spp. contain 85-90% moisture and the moisture percentage depends on the mushroom species besides other parameters related to harvest, growth, culinary and storage conditions [9]". According to Maftounet. althe carbohydrates in Pleurotus spp. are mainly in the form of polysaccharides or glycoproteins [8]. The most abundant polysaccharides are chitins, α-and β-glucans and other hemicelluloses e.g., manna's, xylans and galactans. The glucans present various types of glycoside linkages, such as branched β-glucans and linear α-glucans. The contents of these polysaccharides in the fruiting bodies range from 36 to 60g/100g dry weight. Total dietary fiber (mainly chitin) in Pleurotus mushrooms ranges from 10 to 31g per 100gdry weight, glucans being also components of soluble or insoluble dietary fibers. Atriet. al reported that, among the fatty acids, the monounsaturated are present in a higher proportion (37.17–68.29%) than the saturated ones (26.07-47.77%) in Pleurotus spp.[9] and also Maftounet. al in their broad compilation data reported that the nutritional composition of Pleurotus mushrooms, the oleic acid (C18:1) was the major monounsaturated fatty acid while, the linoleic acid (C18:2n–6c) was the major polyunsaturated fatty acid in the P. ostreatus (oyster mushroom) [8]. Manzi et. al as reported in his studies, the trace elements which are essential for human health, have physiological effect on different organs and cellular mechanisms [10]. And also he explained as the mushrooms fruit bodies are rich in vitamins, mainly vitamin B1, vitamin B2, vitamin C and vitamin D2. The vitamins of group B are abundant particularly thiamine, riboflavin, pyridoxine, pantotene acid, nicotinic acid, nicotinamid, folic acid and cobalamin as well as other vitamins such as ergo sterol, biotin, phytochinon and tocopherols [11]. The vitamins and minerals contents also vary with composition of substrates and time of harvest.

The fructifications of mushroom are characterized by a high level of well assailable mineral constituents [12]. Minerals content of P. ostreatus mushroom [12] in mg/100g dried mushrooms Potassium 1.4, Calcium 2-36, Sodium 3, Magnesium 9-17, Zinc 3-27, Iron 55-65 Manganese 0.5-3, Copper 0.65 and Selenium 0.011. Oyster mushrooms have multilateral enzyme system that helps to grow on a wider variety of agricultural wastes [13]. Agricultural wastes which are suitable for production of oyster mushroom and other species as indicated by [14] are cereal crops straws, horticultural crops' wastes, sugarcane bagasse, forest by products and cotton seed wastes and etc. In and around the study areas substrates (wheat straws and waste paper) used for mushroom production are available but, rather than for production the paper is burned or exposed as a waste after uses while, wheat straw is also left on the land and may be used as animals feed or burn in fields of producers. Therefore, this study was addressed on recycling of different mix compositions of wheat straw, waste papers and cotton seed wastes into: nutritionally rich, high yield and environmental friendly mushroom fruit bodies in short time on small plot of land and to analysis some nutritional composition of oyster mushroom fruit bodies grown on the different mix ratio of substrates composed from those substrates

2. Materials and Methods

2.1. Description of the Study Area

The study was conducted in Oromia regional administration, West Shoa at Ambo town in Ambo University. Ambo is located 110Km to West of the capital Addis Ababa, on the road to Nekemt. The Latitude and Longitude of Ambo University is 8.9° and 37.8° respectively [15].

2.2. Experimental Design

The experiment was set up in a Completely Randomized Design (CRD) with two replications. For experiment I, 10 levels of wheat straw and cotton seed wastes were used, whereas 5 levels of waste paper and wheat straw supplemented with cotton seed wastes were used for experiment II. The control treatment was wheat straw 100% [16] for experiment one and waste paper plus wheat straw (50% and 50%) [17] was used for experiment II. The mixing levels proportions for the substrates of experiment I (wheat straws supplemented with cotton seed wastes) and II (waste paper and wheat straws supplemented with cotton seed wastes) are presented in table 1 and table 2, respectively.

Table 1. *The different mix ratio of wheat straws and cotton seed waste treatments.*

TRTMS	WS g	WS %	CW g	CSW%	TS g	Remark
T (1)	500	100%	_	_	500	Control
T (2)	450	90%	50	10%	500	Mixed
T (3)	400	80%	100	20%	500	Mixed
T (4)	350	70%	150	30%	500	Mixed
T (5)	300	60%	200	40%	500	Mixed
T (6)	250	50%	250	50%	500	Mixed
T (7)	50	10%	450	90%	500	Mixed
T (8)	100	20%	400	80%	500	Mixed
T (9)	150	30%	350	70%	500	Mixed
T (10)	200	40%	300	60%	500	mixed

TRTMS = treatments, WS in g = wheat straws in gram, CSW in g = cotton seed waste, TS in g = total substrates in gram.

Table 2. *The different mix ratio of wheat straws, waste paper and cotton seed waste treatments.*

TTMTS	WS g	WS %	WP g	WP %	CW g	CW%	TS	Remark
(T1)	250	50	250	50	-	-	500	Control
(T2)	200	40	200	40	100	20	500	Mixed
(T3)	150	30	150	30	200	40	500	Mixed
(T4)	125	25	125	25	250	50	500	Mixed
(T5)	100	20	100	20	300	60	500	Mixed

TRTMS = treatments, WS in g = wheat straws in gram, WP = waste paper in gram, CSW in g = cotton seed waste, TS in g = total substrates in gram.

2.3. Organism and Culture Conditions

The fungal strains of Pleurotusostreatus (Oyster mushroom) were obtained from the Department of Biology in Mycology Laboratory, Addis Ababa University, Ethiopia. The pure cultures of Pleurotusostreatus were transferred to Potato Dextrose Agar (PDA) prepared in the laboratory, Department of Biology using fresh potato 250g, glucose (Dextrose) 20g, agar 20g and chloramphenicol 0.2g in 1000ml of water. The medium was poured into the Petri-dishes and allowed to cool under aseptic condition in a laminar flow chamber. The cooled and solidified medium was inoculated with 1cm x 1cm agar block of the fungal strain and incubated at 25°C. The growth of the culture and presence of contamination were visually inspected at three day intervals [18].

2.4. Grain Spawn Productions

In this study, the spawn (mushroom seed) of Pleurotusostreatus was produced on yellow colored sorghum grain (Sorghum bicolor L), wheat bran and calcium sulfate (gypsum) in the ratio of 88:10:2 respectively [18]. The required amount of sorghum grain was weighed and soaked overnight in a sufficient amount of water. The grains were washed and drained to remove the dead and floating seeds with water. After removing the excess water from the grain, the required amount of wheat bran and gypsum ($CaSO_4{\cdot}2H_2O$) were added and transferred to 1000 ml glass bottles (75% level) leaving a head space over the grain and autoclaved at 121°C temperature for 45 minutes. After cooling, each bottle was inoculated with 20 agar blocks (1cm × 1cm) of a 15day old mushroom culture from the Petri dish and incubated for 21 days at 24-30°C until the substrate were fully colonized and the mycelia invasion and contamination were inspected at five day intervals and after 15 days the grain spawn was ready to use [19].

2.5. Substrate Collection and Preparation

Wheat straw and cotton seed wastes were collected around Ambo town rural kebeles and from Addis Ababa, respectively. Waste papers were collected from Ambo University's offices of different departments; lime stone and wheat bran were obtained from Laboratory of Biology department, Ambo University. The wheat straws were cut into small pieces approximately (3-5cm) weighed and soaked in a sufficient amount of water over night in order to imbibe sufficient amount of water.

The waste paper was also cut into small pieces by hand and weighed and soaked in a sufficient amount of water in the morning until it absorbed sufficient amount of moisture. Cotton seed wastes were weighed and soaked in sufficient amount of water over night [20]. After excess water in the substrates was drained, the substrates were mixed with 10% wheat bran, one percent calcium carbonate, and then filled in yellow colored polyethylene bags (75cm length and 65cm width) in order to sterilize the substrates. The substrate prepared were autoclaved at 15Psi pressure and at 121°C temperatures for 15-20minutes [19].

2.6. Spawning and Spawn Running

After sterilization, two different substrates proportions were prepared from wheat straw supplemented with cotton seed waste for experiment I and a different proportion of substrate levels of wheat straws and waste paper supplemented with cotton seed waste for experiment II. The prepared substrates were transferred to transparent polyethylene cultivation bags (65cm length and 45cm width) for easy supervision of the growth of the mycelia and presence of contamination. After cooling under normal temperature, each substrate (500g) with 70% moisture was mixed with 10% spawn (dry weight/wet weight basis) under laminar flow inoculated and the inoculated polythene bags were then tightly tied with string made from cotton cloth. Pin holes were made by sterilized needle through bags ($1/100cm^2$) or (10-14) per bag for drainages and aerations [19]. Then the inoculated bags were kept in a spawn running room at room temperature (23-25°C) in the dark until primordial were formed.

3. Data Collection and Analysis

3.1. Moisture Content of Harvested Mushroom

The moisture content of mushroom was expressed in percent and calculated as the formula proposed by [21, 22].

$$\text{Moisture content \%} = \frac{\text{Weight of fresh sample} - \text{weight of dry sample} \times 100}{\text{Weight of fresh sample}}$$

3.2. Determination of Crude Protein

Crude protein of the mushroom fruits was determined by following the Kjeldahl method as described in [23]. The fruits were dried and grinded using a mortar and pestle and was analyzed for crude protein content. The nitrogen content was first determined and multiplied with 6.25 to obtain the protein content of the sample. Sampled weight (1g) was

added into a Kjeldahl digestion flask. One gram of a mixture of catalysts (Na_2SO_4 mixed with $CuSO_4$ in the ratio of 10:1 was also added into sample. Then 10ml of concentrated H_2SO_4 was added into the mixture. After this, the digestion flask was placed in the digester and the temperature was brought to 350°C ultimately, the mixture was heated until a clear solution was obtained; then it was allowed to cool appropriately. After cooling, 30ml of distilled water was added into the solution and 25ml of 45% NaOH solution was added into the digestion flask.

The contents were distilled immediately by inserting the digestion tube line into the receiver flask that contains 25ml of 4% boric acid solution in which 3 drops of a mixture of indicators, i.e. methyl red indicator and bromocressolgreen, were added and about 150ml of distillate was collected. The collected distillate was titrated using a standard acid (0.1NHCL). Finally, percentage of nitrogen was calculated by using appropriate formula and the value was converted to percentage protein by multiplying with 6.25 [23].

$$\text{Nitrogen (\%)} = \text{V HCL in lit X NHCL (0.1)} \times 14(\text{mass of Nitrogen}) \div \text{Ws} \times 100$$

Where: Ws = Weight of sample in g on dry matter basis.

Therefore, % Protein (Crude protein content) = 6.25 × % of Nitrogen

3.3. Determination of Total Ash

A 2.0g of each sample was placed in a crucible and dried at 120°C for 1hour in a drying oven. The sample was removed from the oven and carbonized using the blue flame of a Bunsen burner. Ash content was determined by subjecting the carbonized sample at 550°C for 8 hours in a muffle furnace until the ash process was completed. At this temperature, all the organic matters were burned off as CO_2, oxides of Nitrogen and H_2O vapor and the remaining matter was determined as ash [23].

$$(\%)\ \text{AC} = \text{W2 (g)} - \text{W1 (g)} \div \text{W (g)} \times 100$$

Where: W1 = Weight of empty crucible,
W2 = Weight of crucible + ash, and
W = Weight of sample.

3.4. Determination of Crude Fat

For the determination of crude fat, the soxhlet solvent extraction method of James [24] was employed for determination of fat content. A 2g of each sample was separately wrapped in a porous filter paper and put in a thimble. The thimble was then placed in a soxhlet reflux flask and mounted into a weighed extraction flask containing 200ml of petroleum ether. The upper end of the reflux flask was converted to a condenser. When heating, the solvent condenses into the reflux flask and covers the sample until the flask was filled up and siphoned over carrying oil (fat) extract down to the boiling flask. The process was allowed to go on repeatedly for about 4 hours before the defatted sample was removed and kept for crude fat content analysis. The solvent was recovered and the flask with its oil extract was dried in the oven at 60°C for 30minutes, cooled in desiccators and re-weighed to obtain the weight of the oil extract (fat), which was then expressed as percentage of the sample. The % fat content was calculated using the following formula: (%) Crude Fat Content = W2-W1/Sample mass in g on dry matter basis (db.) × 100 Where: W2 = Weight or mass of flask and fat (oil) extract, W1 = the mass of dried flask [25].

3.5. Determination of Crude Fiber

Fiber content was determined through digestion of 3g of each dried, ground (using mortar and pestle) and fat free sample by boiling in a weak solution of 1.25% H_2SO_4 for 30 minutes. The sample was boiled again in a weak solution of 1.25% NaOH for 30 minutes. Then the residue was washed with two 25ml near boiling water and filtered onto a filter paper containing no ash after each washing and drying had taken place. The dried residue was then transferred to the ash dish and ignited at 550°C in a muffle furnace [26]. The fiber content in percentage was calculated using the formula shown below:

$$(\%)\ \text{Fiber Content} = \text{W3} - \text{W2} \div \text{W1} \times 100$$

Where, W3 = Weight of crucible with dry residue before ash,
W2 = Weight of crucible with ash after ignition
W1 = Weight of sample used in g

3.6. Determination of Total Carbohydrate

The available carbohydrate content was determined using the following equation [23].

$$\%\ \text{Carbohydrate} = 100 - (\text{moisture} + \text{crude fat} + \text{crude protein} + \text{total ash} + \text{crude fiber}) \div 100$$

3.7. Data Analysis

The collected data on proximal compositions were subjected to Analysis of Variance (ANOVA) Gomez [27] with two replications using Statistical Analysis System (SAS Institute and Cary NC) Version 9.0. Means were compared for significant difference using Fisher's LSD (FLSD) at $P < 0.05$.

4. Results and Discussion

4.1. Effects of Different Substrate Composition on Moisture, Ash and Crude Fiber Contents of Oyster Mushroom

The means of moisture, ash and crude fiber contents of oyster mushrooms produced under different mixing amounts

of wheat straws supplemented with cotton seed waste had significant ($p < 0.05$) differences within the treatments (Table 3). The highest values of moisture, ash and crude fiber contents of oyster mushrooms were 85%, 8.98% and 14.64%which were grown on T4 and T10 for both ash and crude fibers respectively. But, the minimum value of moisture contents was 76.50%, 76% and 74.5% which were grown on T1, T2 and T3 respectively, whereas, the minimum ash contents were 5.52% and 5.79% respectively, which were grown on T1 and T2, but for the crude fiber the minimum value was 8.13%which was grown on T1. The means of oyster mushroom's moisture contents grown on wheat straws, waste paper and cotton seed waste was non-significant at ($p > 0.05$). But the ash contents and crude fiber contents of oyster mushroom grown on wheat straws, waste paper and cotton seed waste had significant ($p < 0.05$) differences with the treatments (Table 4). For this trails the maximum moisture and crude fiber contents of oyster mushroom were 83.01% and 9.59% which were collected from T1 and T5 respectively, and also the minimum moisture and crude fiber contents were 81.04% and 6.85% which were collected from treatments of T4 and T3 respectively. The maximum ash content was 9.17% which was recorded from T5 and the minimum was 6.16% and 6.42% which were observed from mushrooms collected from T3 and T1 respectively. The remaining treatments for moisture contents were intermediate between the maximum and minimum. The results of this study was related to the results reported by [28, 29] for both crude fiber and ash contents ranging 7.5%-16.5% and 8.80%-11.96% and 8.05% to 6.51% respectively. The results of this study for moisture contents were closely related to the finding of [29] in which oyster mushroom moisture contents 77.5%-85.5% ranges on substrates of sugar cane bagasse, waste paper and leaves of Prosopis and also closely related to the finding of [30] in which oyster mushroom moisture contents of 70-90% reported on some Agricultural wastes and also for ash contents the results were related to 8.05% to 6.51% as reported by [29].

4.2. Effects of Different Substrate Mixing Ratio on Protein, Lipid and Carbohydrate Contents of Oyster Mushrooms

The means of crude protein, lipid and carbohydrate content of oyster mushroom grown on different mix ratio of wheat straws supplemented with cotton seed wastes were indicated in Table 5. The means of crude protein and carbohydrate contents of oyster mushroom grown on wheat straws supplemented with cotton seed waste showed significant ($p < 0.05$) differences within the treatments. But the means of lipid contents of oyster mushroom grown on wheat straws supplemented with cotton seed waste was non-significant ($p > 0.05$) differences within the treatments. The highest (35.64%, 35.53% and 35.44%) values of protein contents were recorded from oyster mushroom grown on T9, T4 and T1, respectively, on the other hand, the lowest values of crude protein content (30.5% and 30.21%) were obtained from oyster mushroom grown on T8 and T3, whereas, the maximum and minimum carbohydrate contents of oyster mushroom grown on wheat straws supplemented with cotton seed waste were 48.85% and 40.04%, which were recorded from T2 and T9 respectively.

Table 3. *Effects of different mixing amounts of wheat straws supplemented with cotton seed wastes on moisture, ash and crude fiber contents of oyster mushrooms.*

Treatments	%Mean nutritional contents		
	MC	AC	CF
T1	81.50^{bc}	5.52^{e}	8.13^{e}
T2	82.50^{ab}	5.97^{e}	10.54^{b-e}
T3	82.00^{bc}	6.90^{d}	12.29^{a-d}
T4	85.00^{a}	7.18^{dc}	9.68^{cde}
T5	84.00^{ab}	7.29^{dc}	9.11^{de}
T6	79.70^{c}	7.46^{dc}	11.58^{a-e}
T7	76.50^{d}	7.28^{dc}	12.62^{abc}
T8	76.00^{d}	7.93^{bc}	13.82^{ab}
T9	74.50^{d}	8.46^{ab}	12.85^{abc}
T10	79.50^{c}	8.98^{a}	14.645^{a}
M	80.11	7.29	11.25
CV	1.42	5.21	13.39
LSD (5%)	2.60	0.80	3.50
Sign.	**	**	**

MC = moisture contents, Ac = ash content, CF = crude fiber, M = mean, CV = coefficient variances, LSD = Least significant Differences, **= significant at 1%. Mean values with in a column sharing the same superscript letter (s) are not significantly different by using LSD test at $P \leq 0.05$.

Table 4. *Effects of wheat straws and waste paper supplemented with cotton seed waste on moisture, ash and crude fiber contents of oyster mushroom.*

Treatments	%Mean nutritional contents		
	MC	AC	CF
T1	83.01^{a}	6.42^{d}	7.31^{c}
T2	82.00^{a}	7.13^{c}	7.66^{c}
T3	81.70^{a}	6.16^{d}	6.85^{c}
T4	81.04^{a}	8.11^{b}	8.64^{b}
T5	81.995^{a}	9.17^{a}	9.59^{a}
Mean	81.95	7.4	8.01
CV%	2.73	3.65	4.01
LSD (5%)	6.23	0.70	0.89
Sign.	ns	*	*

MC = moisture contents, Ac = ash content, CF = crude fiber, M = mean, CV = coefficient variances, LSD = Least significant Differences, ns = non-significant, *= significant at 5%. Mean values with in a column sharing the same superscript letter (s) are not significantly different by using LSD test at $P \leq 0.05$.

For the oyster mushroom grown on wheat straws, waste paper and cotton seed waste, the means of protein contents had highly significant ($P < 0.05$) differences with the treatments while, the means of lipid and carbohydrates contents of oyster mushroom grown on this substrates were significantly ($p < 0.05$) different within the treatments (Table 6). In this trail, the highest and lowest protein contents of oyster mushroom grown on this substrate were 30.68% and 22.2%, respectively which were harvested from T3 and T5 whereas, the maximum lipid contents of oyster mushroom was 2.88% and 3.03%, respectively which were harvested from T4 and T5, but the minimum values were 1.81%, 1.92% and 2.27% which were recorded from T1, T2 and T3 correspondingly. The maximum carbohydrate contents of oyster mushroom harvested from different mixing amounts of wheat straws, waste paper and

cotton seed waste were 57.18% and 55.47%, respectively collected from T1 and T2, and minimum value was 46.59% which was recorded from T5.

The results of this study with regards to protein, lipid and carbohydrate were in line with the results reported in the literature; (26.9-37.2%) [21] and also disagree with the values (21.25-28.54%) reported by [29] for protein and for lipid the results were agree with [31] who reported that the crude fat content of oyster mushrooms contain 0.6–3.1% and also the result of carbohydrate contents of this study was different from [32] on Pleurotusostreatus as ranging from 45-77%, however, were similar to those of [33] which were reported as carbohydrate contents ranged between 16-85% for the same mushroom species on different types of substrates.

Table 5. *Effects of different maxing amounts of wheat straws supplemented with cotton seed waste on proximate protein, lipid and carbohydrate contents of oyster mushrooms.*

Treatments	Nutritional contents %		
	PC	LC	CC
T1	35.44^{a}	2.25^{ab}	48.68^{ab}
T2	32.91^{abc}	1.77^{b}	48.82^{a}
T3	30.50^{c}	2.62^{ab}	47.69^{abc}
T4	35.54^{a}	2.10^{ab}	45.52^{abc}
T5	34.85^{a}	2.94^{a}	45.82^{abc}
T6	32.47^{bc}	3.03^{a}	45.47^{abc}
T7	32.94^{abc}	2.68^{ab}	44.49^{dc}
T8	30.22^{c}	2.81^{ab}	45.22^{cb}
T9	35.64^{a}	3.01^{a}	40.04^{e}
T10	32.22^{bc}	3.10^{a}	41.06^{de}
M	33.52	2.62	45.03
CV	4.43	18.00	2.37
LSD (5%)	2.88	1.07	3.55
Sing.	*	ns	*

M = means, CV = coefficient variance, LSD = least significant differences, PC = protein contents, LC = lipid contents, CC = carbohydrate contents, ns = non-significant, *= significant at 5%. Mean values with in a column sharing the same superscript letter (s) are not significantly different by using LSD test at $P \leq 0.05$.

Table 6. *Effects of different mixing amounts of wheat straws and waste paper supplemented with cotton seed waste on proximate protein, lipid and carbohydrate contents of oyster mushroom.*

Treatments	% Nutritional contents		
	PC	LC	CC
T1	25.04^{c}	1.81^{b}	57.18^{a}
T2	28.77^{b}	1.92^{b}	55.47^{a}
T3	30.68^{a}	2.27^{b}	54.16^{ab}
T4	30.24^{a}	2.88^{a}	51.05^{bc}
T5	22.20^{d}	3.03^{a}	46.59^{c}
Mean	27.38	2.38	58.89
CV%	2.4	8.76	4.11
LSD (5%)	1.82	0.58	3.04
Sing.	**	*	*

PC = protein contents, LC = lipid contents, CC = carbohydrate contents, CV = coefficient variance,*significant at 5%, ** significant at 1%, LSD = least significant differences, mean values with in a column sharing the same superscript letter (s) are not significantly different by using LSD test at $P \leq 0.05$.

5. Conclusions

The functional foods like mushrooms serves as nutritionally balanced and medicinally useful food items are becoming important in today's communities, where there have been a number of old age related and degenerative diseases are recurrent. Oyster mushroom is one of the widely cultivated mushrooms all over the world due its ability to grow on different substrates and wide ranges of environmental conditions and becoming nutritional and medicinally important. In this article different substrate compositions were evaluated for the different nutritional contents of the oyster mushroom and resulted in the different amount of nutrient of the oyster mushroom fruiting bodies. In experiment one which composed from wheat straw and cotton seed waste the highest protein content was measured from T1 (35.44) and T9 (35.65) while for the second experiment which were composed from the substrates (wheat straw, cotton seed waste and waste paper) highest protein content was measured from T3 and T4 (30.68; 30.24%) respectively which were lower than the first experiment. The highest fiber content was measured from T10 (9.59) of the first experiment and T5 (9.59) of the second experiment, the highest carbohydrate was measured from T2 (48.82) of the first experiment T1 (57.18) of the second experiment. Over all the nutritional content of the oyster mushroom grown on different substrate composed from wheat straw, cotton seed waste and waste paper revealed that the possibility of the production of high nutritional containing mushroom fruiting bodies from these wastes which also indicates the possibility of improving the food security of the community by converting the abundantly available organic biomass into mushrooms' fruits.

Conflict of Interest

All the authors do not have any possible conflicts of interest.

Acknowledgements

We would heartedly like to thank Almighty God for giving us strength and wellbeing to successfully complete the study. We also want to thank Ambo University for all support. Finally, all the reference materials used in this paper are dully acknowledged.

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