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NUTRITIONAL COMPOSITION AND MORPHLOGICAL CHARACTERISTICS OF OYSTER MUSHROOM (PLEUROTUS OSTREATUS) CULTIVATED ON TW O AGRO-BASED LIGONCELLULOSIC SUBSTRATES

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ABSTRACT

Introduction: Pakistan's economy is mainly dependent on agriculture. Edible fungi act as natural recyclers by converting lignocellulosic wastes into protein and other nutrient rich foods. Nature has gifted Pakistan with varied climatic conditions suitable for the cultivation of edible of mushrooms. The climatic degradation caused by agro-based and industrial wastes are a challenge that is making Pakistan among the top most countries affected by climate change globally. By reducing the agro-based waste on one hand and the production of nutritious food on the other are the most cost-effective solutions to address both of the problems.

Objectives: (1) To assess the effects of two lignocellulosic substrate on the morphological and biological efficiency of Oyster mushroom (*pleurotus ostreatus*). (2) To analyze the impacts of growth mediums nutritional composition of *pleurotus ostreatus* (PO).

Methodology: An edible mushroom *pleurotus ostreatus* (PO) was cultivated on paddy straw and wheat straw without addition of any nutrient supplement. Both commercial spawn and mother spawn were used to grow mushrooms on both the substrates i. e. wheat straw and paddy straw and the results were compared. Efficiency, weight and average yield of mushrooms grown on wheat straw and paddy straw were determined. The proximate composition and the mineral composition of the cultivated mushrooms were also determined as per standard procedures.

Results: The mother spawn yielded greater efficiency (70%), and average yield(3500g) than the commercial spawn on wheat straw as compared to paddy straw. The moisture (43.07%), ash (2.498%), sodium (1.32%) and calcium (29.33%) content were greater in mushrooms grown on paddy straw than wheat straw while the protein (18.48%), fiber (1.33%), fat (1.42%), iron (33.43%), magnesium (11.80%) content was observed to be greater in mushrooms grown on wheat straw than paddy straw. Copper and zinc content was same in both cases (0.1%, 1.00%).

Conclusion: This study concludes that wheat straw yielded better results when used with mother spawns while there was no significant difference in the commercial spawns. Nutritional composition

was less affected by substrate variations indicating the best utilization of both the wheat straw and paddy straw as growth mediums for the cultivation of *pleurotus ostreatus* (PO).

KEY WORDS: Lignocellulosic substrates, Oyster mushroom of *pleurotus ostreatus* (PO), Biological Efficiency, Morphological properties, Nutritional composition

1. INTRODUCTION

Pakistan's food sources are majorly reliant on the agricultural sector. Despite the fact that the output of food has increased in recent years, there is still an alarmingly high rate of Pakistanis who are deprived of healthy food resources which is six out of every tenth Pakistani [1]. Over the years, Pakistan has become a food surplus country and a major producer of wheat which it distributes to needy populations through various mechanisms, including the World Food Programme [2]. However, the national nutrition survey 2018 showed that 36.9 percent of the population faces food insecurity [3]. The agricultural sector is considered to be the backbone of Pakistan's socio-economic development and growth. This sector gives employment opportunities to nearly half of the countries skilled labor as well as producing important materials for the manufacturing and industrial sector. In 2022, an estimated 36.43 percent of the workforce in Pakistan worked in the agricultural sector [4]. According to Pakistan Bureau of Statistics agricultural sector is responsible for almost 24% of Pakistan's GDP and gave employment to 37.4% of the country's labor force. [5]. Wheat with a production rate of 5.4%, sugarcane 2.8%, maze with 6.9% along with cotton and rice are other important crops produced by Pakistan's agricultural sector. Agriculture is not an isolated sector and others such as forestry and fisheries also contribute to the overall agricultural value [6]. Amid serious climatic challenges, inflation, security issues and many other such challenges Pakistan despite being an agrarian state is gripped with severe food insecurity and persistently high global acute malnutrition rates [7].

Approximately 16 per cent of the population is food insecure, 14 percent lacks access to essential services, including health care and nutrition, further exacerbating the nutritional challenges. Limited fiscal space in the government's budget further complicates the situation, and a surge in inflation rates leading to an estimated 38 per cent of reduced purchasing power for many [8]. Food insecurity and malnutrition bears long-term consequences on the health and over all well-being of the population. Vulnerable groups particularly children are extremely are at high risk of stunting, developmental issues and a weakened immune system. As reported, Pakistan's global acute malnutrition rate stands at 17.7 per cent, which exceeds the emergency threshold. The severe 6 per cent rate wasting is alarming and need to be addressed for urgent sustainable socio- economic growth for all the population groups including children under five, women and elderly [9].

Fungi have been a source of protein in man's diet for centuries [10]. Mushroom is one of the fungi and has properties of both plant and animal. Chang T E defined mushroom as a macro fungus with a distinctive fruiting body which can be either epigeous or hypogenous and large enough to be seen with the naked eye and can be picked with hand. They lack chlorophyll and consequently cannot use solar energy in manufacturing their food [11]. They play a major role with other fungi and bacteria to rid the environment of the litter, logs and wastes that would have clogged the cities and woods. Two types of mushrooms exist, i. e. edible and inedible, with the edible one discovered to be a good source of nutrients especially quality protein [12]. The economic importance of the mushroom lies primarily in its use as food for human consumption. Mushroom has a high content of high biological value proteins. Protein in mushrooms have 60-70% digestibility and contains all the essential amino acids [13]. The mushroom also contain high amount of B vitamins and potassium and uncooked/raw mushrooms are naturally cholesterol, fat, and sodium free [14]. The mushrooms also have very low caloric values. Around five medium sized button mushrooms added together only have 20 calories [15]. These mushrooms can be cultivated in green houses, growth chambers, ditches, caves, huts,

hovels, cottages, garages, sheds or shelters, bee hive shaped huts, thatched or meted roofs, thick tree groves and gardens, kitchens, bathrooms or other extra rooms of a house or any other vacant building [16].

Oyster mushroom (*Pleurotus species*) belongs to the family of *Tricholomataceae* and is the second widely cultivated mushroom worldwide after the *Agaricus bisporus* [17,18]. *O*yster mushroom is the third largest commercially produced mushroom in the global market [19]. These species are popular and widely cultivated throughout the world mostly in Asia, America and Europe because of their simple, low-cost production technology and high biological efficiency (BE) [20]. Moreover, the interest of oyster mushroom is increasing largely due to its taste, nutrient, and medicinal properties [21]. *Pleurotus* species can efficiently degrade agricultural wastes and they grow at a wide range of temperatures [17]. In comparison to other edible mushrooms, *Pleurotus* species need a short growth time and their fruiting bodies are not often attacked by diseases and pests [21,22]. *Pleurotus species* are a rich source of protein, minerals (P, Ca, Fe, K, and Na) and vitamin (thiamine, riboflavin, folic acid, and niacin) [23]. Large volumes of unused lignocellulosic by-products are available in Pakistan as a by-product of that often rot on the fields of burned as domestic fuel. Using locally available lignocellulosic substrates to cultivate oyster mushroom is one solution to transform these inedible wastes into accepted edible biomass of high market and nutrient values [18]. The current study was conducted to compare the effects of paddy straw and wheat straw (being the most common agro-wastes) on the growth, yield, and nutritional composition of oyster mushrooms.

2. MATERIALS AND METHOD

2.1. Selection of Substrate

Two lignocellulosic Substrates/ Straws i.e., wheat and paddy (rice) were procured from the local market. The substrates were machine cut about 1-2 inches.

2.2. Pasteurization/Sterilization of the Substrate Methods

Sterilization (Pasteurization) is a crucial step in order to kill unwanted microbes while retaining beneficial organisms. Both the substrates were sterilized in mesh bags by boiling in water in a large container (like a drum) to about 70-80°C for more than 06 hours and were then left submerged at 60-80°C (140-176°F) in that water for 1-2 hours. Afterwards the substrates were removed from the mesh bags and allowed to be cooled till at room temperature.

2.3. Inoculation

2.3.1: Production of media

(Potato Dextrose Agar) PDA extract medium was prepared from 200gm of dried potato, 20gm Agar powder and 20gm of Dextrose to make volume of one liter PDA. To avoid bacterial contamination, streptomycin was used into the sterilized medium at the rate of 1g/liter. PDA was poured in to test tubes still hot. About 10ml was filled/test tube then the test tubes were sealed with cotton plugs. The test tubes plus Agar were autoclaved at least 15 lbs. psi (121°C) for one hour.

2.3.2: Tissue culture and Inoculation

Fresh mushroom fruiting body were washed first, using sterile techniques on a small piece of mushroom. These small pieces were sterilized in test tubes containing PDA and were plugged with cotton and were incubated for 7-10 days in an incubator for mycelia production. The inoculated substrates were kept in an incubation room at 27℃ and 60~70% relative humidity under dark condition

2.3.4: Incubation for Mother spawn

For the production of mother spawn, the sterilized substrates were covered with the mycelium and plugged with cotton and the temperature was maintained at 24℃ and relative humidity of ≥ 90% or

above. These were autoclaved at 15 lbs. psi at 121°C for 1hrs. The bottles were cooled and placed the in incubator for 2 ~3 weeks for the complete colonization. For both the substrates three flushes of mushroom for each substrate were carried out.

2.3.4: Spawning for farming

To the base substrates (Wheat straw and paddy straw), 2% Lime and wheat bran was added as supplementary activator substances to increase mushroom yield as well as achieve faster growth. Initially, Wheat straw and paddy straw was water soaked to gain 75% moisture content (MC). The substrates were piled up, covered with plastic sheet and allowed to ferment for 5-6 days. Following the addition of the supplements to the fermented wheat straw and paddy compost, the material was filled in Polypropylene bags with sizes 16x22″; the bags were closed and tied up with the rubber bands and pasteurized at 65 ~70°C for 45minutes and spawning was done in each bag at the rate of 2 ~ 4% of wet weight of the substrate. Spawn was placed on the top of the compost and the bags were placed in the designated cropping rooms of the mushroom farm at the Nuclear Institute of Food & Agriculture.

2.3.5: Incubation

The bags were placed with the inoculated substrate in a dark, warm area (20-24°C) with good ventilation, indirect light and were allowed to incubate for 2-3 weeks until fully colonized by the mycelium (turns white).

2.3.6: Fruiting & Harvesting

Mushrooms were harvested from each of the culture bags when the in-rolled margins of the mushroom caps started to flatten. The time from inoculation to the first harvest and total harvesting time (from the first to the last harvest) were observed and recorded. The harvest was carefully removed by gently twisting or cutting the mushrooms at the base to avoid damaging the substrate to allow for multiple flushes (harvests). After each harvesting, the growing chambers were rehydrated by misting to encourage additional flushes of mushrooms.

After every flush, the harvested fruiting bodies/mushrooms were weighed and their sizes were measured. The length and thickness of stipe, diameter of cap, and number of effective fruiting bodies per bunch were measured at the first, second and third flush and the means were calculated later. At the end of the harvest period, the recorded data was used to calculate the total yield and the Biological Efficiency (BE). BE was determined as the ratio of fresh fruiting body weight (g) per dry weight of substrates (g). The high humidity and proper ventilation were maintained throughout until the substrates were exhausted.

2.3.7: Biological Efficiency (%)

Biological efficiency was determined by the following formula:

$$\text{Biological efficiency} = \frac{\text{Total biological weight (g)}}{\text{Total dry weight of substrate used (g)}} \times 100$$

2.4: Nutrient Analysis of the Oyster Mushrooms

2.4.1: Proximate Composition

For determination of proximate body composition, standard procedure and protocol of Association of Official Analytical Chemists was adopted (AOAC, 2012) for nutritional evaluations of *Pleurotus ostreatus* (mushroom) [24]. The percent macronutrient content (g/100g) for each replicate was calculated as per the following formulae and then mean and standard deviations were calculated for each slot.

Moisture Content% = 100 (B- A) – (C- A) / (B – A) (i)

Percent Ash = weight of ash / weight of original sample x 100 (ii)

Nitrogen in sample % = $\frac{100(\text{A x B})}{\text{C}} 0.014$ (iii)

Crude Protein % = Nitrogen in sample x 6.25

Crude lipid content % = $\frac{100(B-A)}{\text{C}}$ (iv)

Crude fiber content % = $\frac{100(A-B)}{\text{C}}$ (v)

Carbohydrate % = (100 - Moisture% +ash% +fat% (vi)

+crude protein% +crude fiber%)

2.4.2: Mineral Composition

Elements/minerals in the seed samples were determined by wet digestion and atomic absorption spectrophotometer (AAS – Perkin Elmer – Analyst 700 (equipped with standard burner, air acetylene flame and solid-state detector). Samples were analyzed for three macro minerals calcium Ca, Na, Mg and three micro minerals Zn, Fe, Cu. As per standard procedure of AOAC 2003 [25].

3. RESULTS AND DISCUSSION

3.1: Effect of Substrate Variation on the Morphological Characteristics

Results of the effect of substrate variations on the morphological characteristics are given in Table 1. There were significant variations in the days taken for completion total colonization between means of both the substrates. Results regarding the days for completion of first harvesting day insignificant, however, the harvesting period (in days) for *pleurotus* grown on wheat straw was shorter (47.0±3.16) than the paddy straw (50.0±1.29) and this difference was significant (0.008) for all the replications. Similarly, the Cap Diameter (mm) for wheat straw **(**84.80±3.89) was bigger as compared to paddy straw (83.90±12.02) though the difference was non -significant. Similar results were recorded for Stipe thickness (mm), Stipe Length (mm), and number of fruits/bunches. The Mushroom weight g/Bunch was recorded to greater for wheat straw (42.35±9.24) than the paddy straw (41.5±9.93) and this difference was only slightly significant (p= 0.058). These results of the current study are in agreement with the findings of similar study carried at University of the Poonch Rawalakot, Pakistan and other such studies [26-28].

Table 1: Effect of Substrate Variation on the Morphological and Fruiting Characteristics of *Pleurotus Ostreatus*

ROWS	Total Colonization Period(Days)	First Harvest Day	Harvesting period Days	Cap Diameter (mm)	Stipe thickness (mm)	Stipe Length (mm)	No of fruits/bunch	Mushroom weight g/Bunch
WHEAT STRAW								
R-1	32.50±2.16	40±3.56	47.18±5.12	92.68±2.36	10.2±2.5	35.5±3.05	8.06±2.52	42.76±1.56
R-2	32.42± 2.21	44.3±2.16	48.82±4.71	83.89±2.04	10.06±0.46	38.2±1.63	8.25±1.16	41.81±4.28
R-3	33.87±1.73	44.6±4.09	47.5±2.86	83.7±4.14	10.41±3.21	38.24±1.78	8.16±2.28	39.91±4.57
R-4	48.08±1.69	43.5±3.21	45.22±5.78	82.87±1.49	10.50±3.06	35.6±4.52	8.07±5.36	45.1±2.14
R-5	30.26±4.46	40.3±2.05	48.62±2.47	84.93±2.57	11.68±5.49	38.20±4.37	7.97±4.92	38.9±7.88
MEAN±SD	33.96±7.50	42.5±8.79	47.0±3.16	84.80±3.89	10.26±5.45	38.19±6.18	8.52±5.44	42.35±9.24
P Value	0.07	0.04*	0.23	0.42	0.06	0.04*	0.06	0.014*
PADDY STRAW								
R-1	32.84±2.06	45.1±1.49	50.7±3.66	84.83±2.76	11.06	36.42±2.92	8.71±3.23	41.2±2.55
R-2	32.83±3.16	48.1±2.63	50.5±6.93	88.5±1.86	10.10	38.22±2.32	10.02±4.64	38.53±2.0
R-3	33.02±2.14	45.0±7.35	48.2±4.21	83.4±2.39	10.82	38.08±2.12	8.55±9.27	45.2±4.65
R-4	40.02±6.05	42.4±2.36	46.9±3.56	86.7±3.51	9.86	36.9±3.52	8.20±2.21	43.1±3.36
R-5	33.60±2.27	42.44±4.22	48.9±2.71	80.87± 1.51	10.29	39.2±3.80	8.86±3.90	42.31±6.12
MEAN±SD	32.84±6.23	45.06±3.29	50.0±1.29	83.90±12.02	10.84±1.87	38.22±4.18	8.84±7.92	41.5±9.93
P Value	0.05	0.096	0.059	0.03*	0.333	0.056	0.031*	0.006*
Paired “T” P Value	0.04	0.011	0.008	0.091	0.072	0.027	0.033	0.058

3.2: Mycelium Production, Total Yield, and Biological Efficiency

Mycelium production total yield from the three flushes and biological efficiency (BE) of the mushrooms grown on wheat straw and paddy straw is given in Table 2 and Figure---. Results showed that mother spawn took 30 days while commercial spawn took 35 days for the completion of mycelium. Similarly, mother spawn took 38 days while commercial spawn took 42 days for pinhead formation. Total number of plucking fruit bodies was 4 days greater for commercial spawns. Total production (gm) indicated that total weight of mother spawn was 3500 gm and 2960 gm from commercial spawn. Total production from mother spawn was 540gm greater than the commercial spawn. Results of the paddy straw showed that mother spawn took 33 days while commercial spawn took 40 days for the completion of mycelium. Similarly, mother spawn took 40 days while commercial spawn took 43 days for pinhead formation. Total number of plucking fruit bodies was 3 days greater for commercial spawns. Total production (gm) indicated that total weight of mother spawn was 2880 gm and 1660 gm from commercial spawn. Total production from mother spawn was

1220gm greater than the commercial spawn. Biological efficiency showed wheat straw to be the best option for the production of both mother and commercial spawn while paddy straw can be used for the commercial production of oyster mushrooms. The present study showed that mother spawn can be successfully used in future for growing mushroom on both paddy and wheat substrates. These findings are in strong agreement with the finding of other similar studies [29, 30].

Table 2: Mycelium Production and Total yield from three Flushes *Pleurotus ostreatus* (PO)

Type of spawn used	Rs	No of contaminants	Appearance of Mycelium	Days for completion of mycelium (Spawn running)	Days for Pin heads formation	Plucking day for fruiting bodies	NO OF FLUSHES 1st flush g/ 5bag	2nd flush g/ 5bag	3rd flush g/ 5bag	Mean Total Yield
WHEAT STRAW										
Mother spawn	R-1	Nil	03 ±0.17	30 ±1.2	38 ±1.36	44 ±2.56	1800 ±5.44	1000 ±6.67	700 ±12.4	
	R-2	02	05 ±1.02	29 ±1.25	35 ±2.24	44 ±2.43	2100 ±6.58	960 ±6.97	689 ±20.13	
	R-3	Nil	03 ±1.04	31 ±0.90	35 ±2.47	48 ±2.40	1800 ±6.25	1050 ±6.34	700 ±31.44	
	R-4	Nil	03 ±0.40	30 ±1.89	38 ±1.59	47 ±2.10	1950 ±6.82	1020 ±8.11	820 ±11.85	3500
	R-5	Nil	03 ±0.64	30 ±1.91	38 ±2.14	40 ±2.66	1800 ±5.88	990 ±11.36	690 ±12.61	±17.49
Commercial spawn	R-1	02	05 ±1.33	35 ±1.39	38 ±1.60	42 ±3.07	1460 ±5.24	870 ±8.11	630 ±9.95	
	R-2	03	05 ±0.86	32 ±1.51	40 ±2.74	48 ±2.49	1487 ±5.31	889 ±13.18	595 ±19.59	
	R-3	Nil	06 ±0.89	35 ±1.98	40 ±2.40	35 ±2.98	1326 ±6.12	850 ±12.29	650 ±13.15	
	R-4	02	04 ±0.63	32 ±1.60	38 ±1.74	43 ±2.48	1500 ±5.99	910±9.94	625 ±8.85	2960
	R-5	02	05 ±0.28	33 ±1.45	38 ±1.06	42 ±2.30	1280 ±6.12	930±18.39	654 ±11.44	±27.63
PADDY STRAW										
Mother spawn	R-1	Nil	05 ±1.08	33 ±0.96	40±1.26	47 ±2.07	1540 ±7.60	740 ±20.16	600 ±8.33	
	R-2	Nil	04 ±0.34	30 ±2.15	42 ±2.17	47 ±3.03	1610 ±6.89	810 ±10.46	589 ±9.94	
	R-3	Nil	05 ±0.61	32 ±3.11	41 ±2.36	45 ±1.98	1560 ±6.78	690 ±12.77	523 ±9.44	
	R-4	Nil	05 ±1.51	35 ±2.33	40 ±1.67	45 ±2.37	1490 ±5.70	830 ±11.36	635 ±10.63	2880
	R-5	Nil	05 ±0.44	30 ±14.07	40 ±2.54	43 ±3.05	1500 ±4.98	841 ±14.11	671 ±9.95	±21.60
Commercial spawn	R-1	02	06 ±0.09	40 ±11.6	43 ±3.74	50 ±3.26	810 ±2.1	510 ± 11.80	340 ±16.67	
	R-2	02	05 ±0.23	40 ±2.95	45 ±2.06	50 ±3.21	822 ±11.4	600±19.17	425 ±6.89	
	R-3	01	05 ±0.35	45 ±9.58	58 ±2.14	62 ±2.82	795 ±10.19	525 ±11.53	330 ±19.17	
	R-4	03	06 ±0.56	48 ±14.3	54 ±2.47	60 ±3.29	930 ±3.07	630 ±14.08	325 ±20.24	1660
	R-5	Nil	06 ±0.95	48 ±3.69	50 ±2.36	55 ±3.99	795 ±8.80	610 ±9.31	379 ±20.64	±31.38

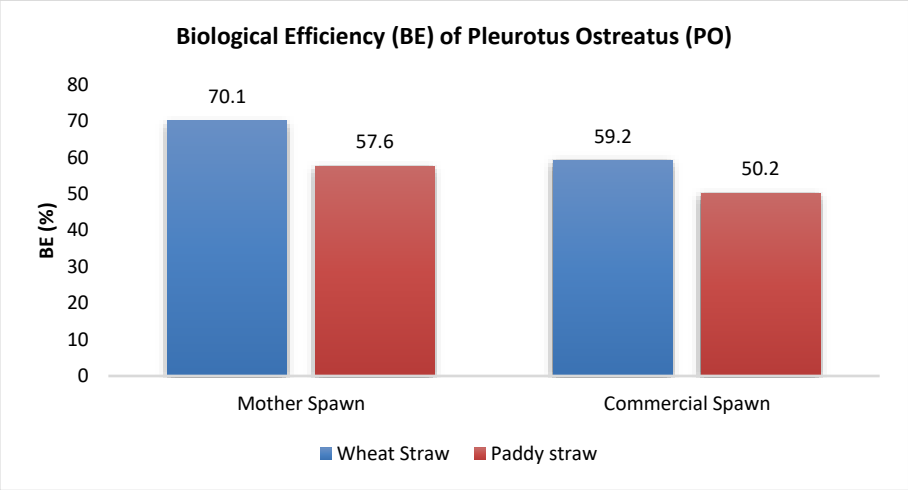

Figure: Biological Efficiency (BE %) of the *Pleurotus ostreatus* (PO) cultivated on varied Substrates

3.3: Macro Nutrient Composition of the Pleurotus Ostreatus (PO)Grown on two Lignocellulosic Substrates

The proximate composition (Table 3) for moisture was recorded to be 42.14% on wheat straw while and 43.07% for paddy straw, which showed efficiency of utilization of paddy straw for moisture content as compared to the wheat straw. The results obtained from my study were against the study of Patil et al who found out the moisture content to be 88.59 % for paddy straw and 88.51% for wheat straw [29]. The crude ash content was recorded as 1.079% for wheat straw and 2.498% for paddy straw and this difference was significant. The crude protein content (18.75±0.15 wheat and 18.32±0.5 paddy

straw) showed that the protein content for *pleaurotus ostreatus* was non significantly different. The obtained results were in contrast to the study of Patil et al [31] who reported the protein content to be 23.40% but were in agreement with the findings of other such studies [32, 33]. It was observed in the current study that the fat content *in pleurotus ostreatus* grown on wheat straw (1.42±0.023) and paddy straw (1.41±0.023) were non-significantly different. The crude fiber, fat, carbohydrate and energy content/100 were also not significantly different for both the substrates and were in agreement with the findings of other studies [29, 33- 34].

Table 3: Proximate composition of *pleurotus ostreatus* (g/100g dry weight)

	Proximate value	Wheat straw Mean ± SD	Paddy straw Mean ± SD	Difference (%)	P Value*
1.	Moisture %	42.14±0.96	43.07±0.24	-0.95(-2.25)	0.441
2.	Ash %	1.08±0.23	2.49±0.65	-1.43(127.2)	0.036
3.	Protein %	18.75±0.15	18.32±0.5	+0.43(2.293)	0.452
4.	Fiber %	1.33±0.063	1.2± 0.025	+0.13(9.77)	0.423
5.	Fat %	1.42±0.023	1.41±0.023	0.01(0.71)	0.529
6	Carbohydrates	52.9±1.51	55.1±3.83	-2.2(-4.1)	0.781
7	Energy (Kcal)	305.5±3.63	299.9±6.86	5.6(+1.86)	0.228

*P≤0.05

3.4: Effect of Substrate Variations on the Mineral Contents of *Pleurotus Ostreatus'*

The data regarding the mineral composition of the mushrooms grown on wheat and paddy straw is given in Table 4. The copper and zinc content (mg/100 g dry weight) were observed to be same in mushrooms grown on both the substrates used. the sodium content was non-significantly higher in the mushroom grown on paddy straw sample than wheat straw.

The magnesium and iron content of the *pleaurotus* grown on_wheat straw was higher while the sodium content of mushrooms from paddy straw was higher although these differences in the current studies were not significant except magnesium. Such Differences in the mineral content of mushroom were also reported and these variations are not only dependent on mushroom species but also depended on substrates used [29]. The results of the mineral content of this study are similar to the findings of Ahmed et al. [34] for the Fe content but lower for Zn & Cu to the findings of Hoa et al [29] and other studies who proposed that mineral absorption by the mushrooms from are affected by C/N ratio, Electrolyte conductivity (EC) and pH level of the substrates during the whole period of mushroom cultivation [34-38].

Table 4: Mineral composition of mushroom (mg/100 g Dry weight) of

	Mineral composition	Wheat straw Mean ± SD	Paddy straw Mean ± SD	Difference (%)	P Value
1	Sodium %	1.12±	1.32±	+0.2 (17.85)	0.143
2	Calcium %	28.60±	29.33±	-0.73 (2.55)	0.510
3	Magnesium %	11.80±	10.25±	+1.55 (13.35)	0.053
4	Iron %	33.43±	31.70±	+1.73 (5.17)	0.27
5	Copper %	0.1±	0.1±	0	0
6	Zinc %	1.00±	1.00±	0	0

4. Conclusion

The current study is concluded on the facts that both wheat straw and paddy straw that are wasted as agricultural by-products or burned for fuel can be very effectively utilized for the cultivation of *Pleurotus ostreatus* across the many agroclimatic conditions of Khyber Pakhtunkhwa where these crops are grown over a vast agricultural belt. The utilization of both of these substrates will help in adding to nutrient diversity of the diets particularly of the marginalized population and can be a source of income generation through SMEs if promoted effectively.

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