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Usability of *Zea mays* and Sorghum bicolor on the growth and yield of oyster mushrooms

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Abstract. In this research, three agricultural substrates, *Zea mays*, Sorghum bicolor Horse S, and Sorghum bicolor Giza 115, were evaluated as growing media in commercial mushroom cultivation. *Zea mays* waste had the highest moisture content with a relatively high nitrogen, phosphorus, potassium, protein, and energy value compared with Sorghum bicolor Horse S and Sorghum bicolor Giza 115, so the results indicate that *Zea mays* waste cultivated with different species of *Pleurotus* tested gave high-production oyster mushrooms with the highest biological efficiency and also a high total number of fruit bodies. *P. floridans* cultivated in *Zea mays* waste gave the best production by 182 gm, biological efficiency of 36.4%, and also a high number of fruit bodies (28) followed by *P. pulmonarius* on Sorghum bicolor Horse S waste, which gave production by 180 gm and also a high number of fruit bodies (27).

Keywords: *Zea mays, sorghum bicolor, waste, mushroom, production, and Pleuroteus*

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1. Introduction

A mushroom is the reproductive structure of certain types of fungi, such as saprophytic, mycorrhizal, and parasitic fungi. These fungi belong to the order of Basidiomycetes and can also be Ascomycetes. Mushrooms obtain their nutrients by secreting enzymes that break down organic matter. There are approximately 3000 species of mushrooms, but only 30 have been successfully cultivated, and 12 are commercially grown worldwide (Poppe, 2004). Approximately 70% of the global mushroom production consists of button mushrooms (*Agaricus bisporus*), oyster mushrooms (*Plerutus ostreatuse*), and shiitake mushrooms (*Lentinus edodes*) (Dike et al., 2011). Nonetheless, there are comparatively few poisonous mushrooms—roughly 10%—and just 30 species are thought to be fatal (Yenealem et al., 2013).

Oyster mushroom can grow on different agricultural waste substrates containing lignin and cellulose, like horticultural crop wastes, cereal crop straws, sugarcane bagasse, and forest and cotton seed wastes. The amount of agricultural waste in Egypt ranges from 30-35 million tons a year from fields and agro-industry. Egypt contains a large amount of sorghum waste; there are more than 350 thousand feddans per year all over Egypt. These wastes, if carelessly disposed of in the surrounding environment by dumping or burning, will lead to environmental pollution and consequently cause health hazards (Girmay et al. 2016). Cultivation of oyster mushrooms is considered a suitable means for this waste because yearly mushroom production is only 6 milliard persons, or 1 kg per year or 3 grams per day (Martínez-Carrera et al., 2000). In fact, counting 500 milliard kg of agricultural dry waste and 100 milliard kg of dry forestry, we can easily grow 360 milliard kg of fresh mushrooms.

Mushrooms are highly regarded for their nutritional and functional worth and are also widely accepted as neutral foods. They are of significant interest due to their sensory appeal, medical qualities, and economic importance (Chang and Miles, 2008; Ergönül et al., 2013). According to Patel and Goyal (2012), the genus *Pleurotus*, usually referred to as oyster mushrooms,

consists of over 40 species, all of which are generally edible and easily accessible. Mushrooms are a rich source of non-starchy carbohydrates, containing a high amount of dietary fiber and moderate levels of proteins that provide essential amino acids for the human body. They also contain significant amounts of vitamin C and B-complex vitamins (such as thiamine, riboflavin, and niacin), as well as potassium, phosphorus, and sodium. The mushrooms contain high levels of lysine and tryptophan, which are two crucial amino acids that are lacking in grains (Manzi et al., 1999; Croan, 2004; Caglarirmak, 2007; Smiderle et al., 2012; Corrêa et al., 2016). *Pleurotus* species have numerous therapeutic properties, including antioxidant, immune-modulatory, antihypertensive, antigen-toxic, hypocholesterolaemic, anti-inflammatory, anti-tumor, antiplatelet aggregating, anti-hyperglycemic, antimicrobial, and antiviral actions (Smiderle et al., 2012). Oyster mushrooms possess the capacity to thrive in a broad spectrum of temperatures by utilizing diverse lignocellulosic substrates and converting them into edible food for humans, hence making cultivation a widespread practice (Sharma and Madan, 1993).

Mushrooms rely on carbon, nitrogen, and inorganic compounds for their nutrition. They can utilize various organic materials that contain cellulose, hemicellulose, and lignin as substrate for growth and fruiting. Examples of suitable mushroom substrates include rice and wheat straw, cottonseed hulls, corncob, sugarcane bagasse, sawdust, waste paper, and leaves (Chang and Miles, 1989). Hence, the objective of this study is to utilize agricultural byproducts such as Zea mays and Sorghum bicolor to cultivate oyster mushrooms.

2. Materials and Methods

2.1. Collection of spawn

The spawn packets and cultures of *Pleurotus ostreatus*, *Pleurotus columbinus*, *Pleurotus pulmonarius*, *Pleurotus sajor-caju*, and *Pleurotus floridanus* used in this present research were obtained from the Agricultural Research Center, Food Technology, Giza (Mohamed et al. 2016).

2.2. Collection of wastes

Three agricultural substrates, *Zea mays* L, Sorghum bicolor Horse S, and Sorghum bicolor Giza 115, were evaluated as growing media for the mentioned *Pleurotus* spp. and obtained from three fields in Assiut governorate during seasons 2022-2023.

2.3. Preparation of substrate mixtures

The fragmented substrate derived from various agricultural residues was immersed in water for a duration of 24 hours (Markson et al., 2017) until the moisture level reached approximately 60-80% (Bhatti et al., 1987). Subsequently, the growth medium was subjected to pasteurization by autoclaving it at a temperature of 121 ºC for a period of 2 hours, maintaining a pressure of 1.5 units. Then pasteurized substrate was allowed to cool and remove any surplus water. The substrate was mixed with 500 grams, as well as 15 grams of calcium carbonate (Markson et al., 2017) and 15 grams of wheat bran. The moisture content was maintained at 80%.

2.4. Preparation of spawn

The culture spawn was evenly placed on the substrate at a rate of 17 grams. This spawn was meticulously blended with the substrate, with a portion positioned beneath the surface and a little quantity evenly scattered on top. Both spawn and organic substrates were carefully wrapped in plastic sheeting and covered with a black sheet.

2.5. Cultivation conditions and harvesting

The bags containing the inoculation material were placed in a dark chamber specifically designed for cultivation. Temperature was carefully controlled to be between 25-30 ºC, and the relative humidity was maintained at 85±5%. This environment was conducive for the growth and branching of the mushroom mycelia. Regular monitoring of mushroom growth was conducted for each treatment on a daily basis. Once the bags were completely filled with mycelium and pin-heads began to emerge, they were opened to allow for the growth of fruiting bodies and placed in a well-lit room. After the fruiting bodies reached their full size, they were severed slightly above the surface of the substrate using a sterilized sharp knife (Markson et al., 2017). Harvesting was conducted in three successive batches. Following the second flush, the substrate was inverted and consistently irrigated to collect the third flush. Mushroom yields were documented by Iqbal et al. (2005) and Menaga et al. (2012).

Following the harvest, the mushroom samples underwent a thorough cleaning process involving rubbing, scraping, and brushing to eliminate any extraneous substances. Subsequently, the items were sliced into small fragments measuring around 2 to 3 cm in width using a knife (Markson et al., 2017). Following that, they were enveloped in newspaper and stored in dry, well-ventilated areas to prevent moisture accumulation. The items were dried naturally in a shaded area for a period of at least 15 days.

2.6. Determination of moisture content

A 20-gram sample was subjected to drying in an oven at a temperature of 105 ºC for approximately 24 hours, after which it was weighed again. The moisture content percentage was subsequently determined using the equation provided by Hashem et al. (2013).

$$M.C.\% = \frac{A - B}{A} x100$$

Where A and B represent the weight before and after drying, respectively.

2.7. Determination of biological efficiency

The process involved the collection of recently grown mushrooms, followed by the calculation of biological efficiency. This was done by determining the percentage of weight of fresh mushrooms in relation to the dry weight of the substrate at the time of spawning. The methodology used for this calculation was detailed by Banik and Nandi (2004), and Oseni et al. (2012). Biological efficiency of mushrooms can be calculated by dividing the weight of the fresh mushroom yield (grams) by the weight of the air-dried substrate (grams), and then multiplying the result by 100.

2.8. Determination of agricultural wastes

The Kjeldahl digestion method (Jackson, 1973) was employed to determine the total nitrogen content of dried agricultural wastes. Spectrophotometric measurement of total phosphorus was conducted in an acid solution of the digested sample using ammonium molybdate and stannous chloride reagents (Page et al. 1982). Similarly, the flame photometric method was utilized to determine the total potassium content in the acid solution of the digested samples.

2.9. Chemical analysis of fresh oyster mushrooms

The fresh fruit bodies underwent proximate analysis to determine their crude fat, fiber, protein, and ash content. Analysis was conducted following the standard procedure outlined in AOAC (1990). To convert nitrogen to protein, a factor of 6.24 was used for calculating the crude protein content. Total amount of carbohydrates was calculated by subtracting the quantities of ash, protein, and fat from the overall total, using the process outlined in the At Waters method. This involves multiplying the sum of protein by four, carbs by four, and fat by nine, as specified in the AOAC (1990) guidelines.

2.10. Statistical analysis

The data were subjected to statistical analysis using the Randomized Complete Block Design (RCBD) with three replications. Mean values were compared using Duncan's Multiple Range Test (DMRT) at a significance threshold of 5% for result interpretation (Gomez and Gomez, 1984).

3. Results

3.1. Determination of agricultural wastes

Results showed that the moisture content of *Zea mays* waste was highest at 24%, with relatively high nitrogen, phosphorus, and potassium contents of about 1.10, 0.56, and 0.79%, respectively, compared with other wastes, followed by sorghum bicolor Horse S in moisture content (18%) and also in nitrogen (0.9%), phosphorus (0.41%), and potassium (0.47%) contents, and the lowest one was sorghum bicolor Giza 115 (**Table 1** & **Figure 1**).

Figure 1. Showing the different *Pleurotus* spp.

Table 1. Mineral content of nitrogen, phosphorus, and potassium in agricultural wastes

Kind of wastes	Moisture content (%)	N (%)	P (%)	K (%)
Zea mays L.	24±1.3[a]	1.1±0.01[a]	0.56±0.01[a]	0.79±0.03[a]
Sorghum bicolor Horse S	18±0.9[b]	0.91±0.07[b]	0.41±0.02[b]	0.47±0.02[b]
Sorghum bicolor Giza 115	12±0.8[c]	0.71±0.06[c]	0.33±0.01[c]	0.34±0.01[c]

Note. N: nitrogen, P: phosphorus, and K: potassium. [z]Results are presented as the mean ± standard deviation of three independent measurements. Tukey's test indicates that values separated by letters in a column are statistically distinct from one another ($p \leq 0.05$).

3.2. Vegetative growth of the mushroom on substrates (mycelia extension)

Results demonstrated that the cultivation of *Zea mays* L waste with several mushroom species resulted in a substantial yield of oyster mushrooms, exhibiting the highest biological efficiency and a significant total count of fruit bodies. The highest yield achieved was 182 grams of *Zea mays* L waste cultivated with *P. floridans*, exhibiting a biological efficiency of 36.4% and a substantial number of fruit bodies (28). Subsequently, 180 grams of Sorghum bicolor horse S waste cultivated with *P. pulmonarius*, which exhibited a substantial number of fruit bodies (27), was introduced.

Table 2: Total yield and biological efficiency of *Pleurotus* spp. on *Zea mays* L, Sorghum bicolor Horse S, and Sorghum bicolor Giza 115 S

Oyster mushrrom species	**Kind of waste**	**Mean Value**			**Total yield**	**B.E.%**
		First flush	Second flush	Third flush		
		28 days	35 days	45 days		
P. ostreatus	Zea mays L	62±2.1[c]	52±1.6[b]	36±1.3[c]	150±4.1[de]	30±0.8[ab]
	Sorghum bicolor Horse S	56±3.2[d]	50±1.2[bc]	37±1.2[c]	43±2.1[h]	28.6±1.3[b]
	Sorghum bicolor Giza 115 S	47±1.6[f]	44±1.6[c]	34±0.8[c]	125±3.6[g]	25±0.8c
P. columpinus	Zea mays L	74±3.4[a]	55±1.7[b]	42±0.7[b]	171±4.1[b]	34.1±1.1[a]
	Sorghum bicolor Horse S	71±2.8[b]	56±0.9[b]	43±0.6[b]	170±5.1[b]	34±1.6[a]
	Sorghum bicolor Giza 115 S	70±3.6[b]	48±1.3[bc]	36±0.9[c]	154±3.6[d]	30.8±1.2[ab]
P. pulmonarius	Zea mays L	66±1.2[bc]	60±2.4[ab]	47±1.2[ab]	173±3.4[b]	34.6±1.3[a]
	Sorghum bicolor Horse S	68±1.8[bc]	64±1.9[a]	48±1.3[ab]	180±4.1[a]	36±1.2[a]
	Sorghum bicolor Giza 115	51±1.1[e]	52±2.3[b]	45±2.1[b]	148±5.1[e]	29.6±1.6[ab]
P. sajor-caju	Zea mays L	63±1.4[c]	54±1.2[b]	45±2.4[b]	162±6.3[c]	32.4±0.9[ab]
	Sorghum bicolor Horse S	61±0.9[cd]	53±1.7[b]	41±1.7[b]	155±3.2[d]	31±0.7[ab]
	Sorghum bicolor Giza 115	54±1.6[d]	44±0.8[c]	38±1.2[c]	136±4.1[f]	27.2±0.6[b]
P. floridans	Zea mays L	69±2.2[b]	62±0.6[a]	51±1.6[a]	182±5.4[a]	36.4±1.2[a]
	Sorghum bicolor Horse S	64±1.7[c]	58±1.4[ab]	47±1.3[ab]	169±3.6[b]	33.8±1.3[ab]
	Sorghum bicolor Giza 115	59±2.3[cd]	52±1.6[b]	43±0.9[b]	154±1.7[d]	30.8±0.9[ab]

[z]Results are presented as the mean ± standard deviation of three independent measurements. Tukey's test indicates that values separated by letters in a column are statistically distinct from one another ($p \leq 0.05$).

Table 3. Mean value of fruit body per harvest

Oyster mushrrom species	Kind of waste	Mean Value			Total number of fruit body
		First flush	Second flush	Third flush	
		28 days	35 days	45 days	
P. ostreatus	Zea mays L.	14±0.05^{a}	9±0.03^{ab}	3±0.01^{ab}	27±2.1^{a}
	Sorghum bicolor Horse S	11±0.03^{ab}	7±0.02^{b}	4±0.02^{a}	22±1.6^{c}
	S0rghubicolor Giza 15	13±0.04^{a}	7±0.04^{b}	2±0.01^{b}	22±1.3^{c}
P. columpinus	Zea mays L	13±0.02^{a}	8±0.01^{ab}	4±0.01^{a}	25±1.7^{b}
	Sorghum bicolor Horse S	14±0.03^{a}	9±0.03^{ab}	4±0.02^{a}	27±1.3^{a}
	Sorghu bicolor Giza115	11±0.01^{ab}	8±0.03^{ab}	3±0.02^{ab}	22±1.4^{c}
P. pulmonarius	Zea mays L	12±0.04^{ab}	9±0.04^{ab}	3±0.01^{ab}	24±1.6^{b}
	Sorghum bicolor Horse S	13±0.11^{a}	10±0.11^{a}	2±0.01^{b}	25±1.2^{b}
	Sorghum bicolor Giza 115	11±0.05^{ab}	7±0.07^{b}	5±0.03^{a}	23±1.4^{bc}
P. sajor-caju	Zea mays L	11±0.07^{ab}	12±0.08^{a}	4±0.02^{a}	27±1.3^{a}
	Sorghum bicolor Horse S	13±0.08^{a}	6±0.06^{b}	3±0.01^{ab}	22±1.2^{c}
	Sorghum bicolor Giza 115	9±0.03^{b}	7±0.04^{b}	2±0.01^{b}	18±1.6^{d}
P. floridans	Zea mays L	12±0.05^{ab}	11±0.05^{a}	5±0.03^{a}	28±1.1^{a}
	Sorghum bicolor Horse S	13±0.07^{a}	7±0.03^{b}	4±0.02^{a}	24±1.4^{b}
	Sorghum bicolor Giza 115	14±0.08^{a}	9±0.02^{ab}	2±0.01^{b}	25±1.2^{b}

[z]Results are presented as the mean ± standard deviation of three independent measurements. Tukey's test indicates that values separated by letters in a column are statistically distinct from one another ($p \leq 0.05$).

3.3. Chemical analysis of fresh oyster mushrooms

The results showed that, in general, *Zea mays* L waste cultivated with different species of mushrooms tested had the highest moisture content, protein content, and energy value of the other wastes. Also, *Zea mays* L waste cultivated with *P. floridans* contains the highest fat (3.9 mg/100g) and the lowest ash (4.8 mg/100 g), while *P. columpinus* on *Zea mays* L waste has the highest total carbohydrates (59.3 mg/100g) (**Table 4**).

Table 4. Chemical composition of oyster mushrooms fruit bodies

Oyster mushrrom species	Kind of waste	Moisture content (%)	Protein (mg/100g)	Fat (mg/100g)	Ash (mg/100g)	Total carbohydrates (mg/100g)	Energy value (K cal/100g)
P. ostreatus	Zea mays L	91^{a}	18.5^{a}	3.4^{a}	4.5^{a}	55.9^{a}	332.2^{a}
	Sorghum bicolor Horse S	88^{b}	18.0^{a}	3.8^{a}	4.3^{a}	54.3^{a}	323.4^{b}
	Sorghum bicolor Giza 115 S	85^{c}	17.7^{a}	3.7^{a}	4.6^{a}	52.7^{b}	314.9^{c}
P. olumpinus	Zea mays L	89^{a}	20.3^{a}	3.5^{a}	4.4^{a}	59.3^{a}	329.9^{a}
	Sorghum bicolor Horse S	87^{b}	19.7^{a}	3.3^{b}	4.3^{a}	54.9^{b}	328.1^{a}
	Sorghum bicolor Giza 115 S	87^{b}	18.2^{a}	3.2^{b}	4.4^{a}	53.2^{b}	314.4^{b}
P. pulmonarius	Zea mays L	90^{a}	19.9^{a}	3.2^{b}	4.3^{b}	54.1^{a}	324.8^{a}
	Sorghum bicolor Horse S	86^{b}	19.2^{a}	3.4^{a}	4.6^{a}	53.4^{b}	323.8^{a}
	Sorghum bicolor Giza 115	87^{b}	18.3^{a}	3.5^{a}	4.7^{a}	52.3^{b}	312.7^{b}
P. sajor-caju	Zea mays L	90^{a}	21.0^{a}	3.4^{a}	3.8^{a}	52.9^{a}	326.2^{a}
	Sorghum bicolor Horse S	88^{b}	18.3^{b}	3.5^{a}	4.1^{a}	53.2^{a}	317.5^{b}
	Sorghum bicolor Giza 115	85^{c}	19.1^{b}	3.2^{b}	4.2^{a}	52.3^{a}	314.4^{c}
P. floridans	Zea mays L	86^{a}	20.7^{a}	3.2^{b}	3.2^{b}	51.6^{a}	324.3^{a}
	Sorghum bicolor Horse S	85^{a}	17.5^{b}	3.7^{a}	3.9^{a}	52.0^{a}	311.3^{b}
	Sorghum bicolor Giza 115	84^{a}	16.9^{b}	3.9^{a}	3.7^{a}	51.9^{a}	304.0^{c}

[z]Results are presented as the mean ± standard deviation of three independent measurements. Tukey's test indicates that values separated by letters in a column are statistically distinct from one another ($p \leq 0.05$).

4. Discussion

Egypt is renowned for its abundance of agricultural residues. The accumulation of a substantial amount of agricultural waste poses a significant challenge, resulting in many forms of environmental contamination. Disposing of such large numbers could effectively address potential pollution issues and lead to the depletion of important resources that can be used to meet various national requirements. Oyster mushrooms possess substantial nutritional and functional food value, along with medicinal properties. Additionally, these mushrooms exhibit noteworthy organoleptic properties, which are experienced through the senses

of smell, taste, sight, and touch. These characteristics have both individual and economic importance (Ergönül et al., 2013; Valverde et al., 2015).

Agricultural residues are deemed to be a suitable substrate for the production of oyster mushrooms. The objective of this study was to explore the feasibility of cultivating oyster mushrooms. Cultivating edible mushrooms provides a practical and cost-effective approach for converting agro-lignocellulosic wastes into biofuel, as demonstrated by Gbolagade (2005), Gbolagade et al. (2006), and Jonathan et al. (2008). Agricultural residues serve as the primary reservoir of lignocellulosic biomass, which is both renewable and cost-effective. The following materials are suitable for high production capacity of oyster mushrooms: paddy straw, maize stalks/cobs, vegetable plant residues, bagasse, wheat straw, cotton waste, waste paper, and cotton stalks (Badshah et al., 1992; Marimuthu, 1995; Hassan et al., 2011). The primary constituents of the lignocellulosic substrate consist of cellulose (a glucose homopolymer), hemicellulose (a xylan and mannans heteropolymer), and lignin (a complex phenolic polymer). The oyster mushroom (*Pleurotus* spp.) has the ability to break down lignocellulosic materials, which are mostly composed of cellulose, hemicellulose, and lignin, found in agricultural fields and forests in order to obtain the carbon they need (Mohamed et al., 2016). The residues of Sorghum bicolor and *Zea mays* contain cellulose, as stated by Sun et al. (2004). Mushrooms' ability to inhabit solid substrates is linked to their capability to produce enzymes in a low water activity environment. Given that lignocellulosic, protein, or starchy residues are typically used as substrates for solid-state fermentation (SSF), the enzymes synthesized by mushrooms in SSF predominantly consist of cellulases, xylanases, laccases, proteases, and amylases. Further investigation can be conducted on the synthesis of lipases, pectinases, and phytases. These enzymes are often synthesized in the initial phases of mycelial growth and possess the capacity to break down crop residues, specifically the cell-wall components cellulose and lignin (Rowel et al., 2000, Mohamed et al. 2016; Díaz-Godínez et al., 2017).

The fundamental factor in mushroom cultivation is biological efficiency. This study indicates that *Zea mays* is the most effective substrate for cultivating *Pleurotus* spp. These results are consistent with the findings of Shah et al. (2004) and Ananbeh and Almomany (2005). According to El-Bagory (1997), the most appropriate substrate was found to be maize straw, followed by rice straw, wheat straw, and lastly sugarcane bagasse.

In this study, *Zea mays* had the greatest percentage of total nitrogen and potassium (1.1% and 0.56% respectively), followed by Sorghum bicolor Horse Silveira et al. (2008). The nitrogen content of the straw in Sorghum bicolor was 5.8%, which represented a 63% reduction compared to the supplemented and sterilized substrate. This value exceeds the findings of the current study as well as the results provided by Mintesnot et al. (2014). The addition of more nitrogen to agricultural wastes led to a considerable increase in the growth and productivity of oyster mushrooms. This increase in nitrogen content stimulated the fungi to develop and produce more vigorously (Nunes et al. 2012, Ashraf et al. 2013). The nitrogen-rich growth substrate leads to increased protein production in fruiting bodies (Ahmed et al., 2009; Abdul-Qader et al., 2019).

The substrate colonization process was successfully accomplished within a period of 21 days in this experiment. The findings are consistent with those of Tan (1981). Dahmardeh et al. (2010) documented that the process of spawn running lasted for a duration of three weeks, followed by the emergence of fruiting bodies within a span of 2-3 days. The authors Iqbal et al. (2005), Kumari and Achal (2008), and Yang et al. (2013) reported that the colonization of the substrate was finished within a period of 20 days after inoculation. The duration for a spawn to fully colonize a certain substrate varies depending on the fungus strain, growth circumstances, and substrate type (Chang and Miles, 2008). The variance mentioned refers to the differences in the chemical composition and carbon to nitrogen ratio (C:N) of the substrates utilized (Bhatti et al., 1987).

This study examined three distinct substrates to assess the productivity and quality of oyster mushrooms. First harvest yielded the maximum fresh weight, while the third harvest had the lowest average fresh weight. The second harvest provided an intermediate average fresh weight. Additionally, the quantity of fruit bodies per harvest declined from one flush to another. This can be attributed to the kind and quantity of nitrogen present in the substrate after each harvest, which impacts the extent of cellulose breakdown and thus influences the yield (Frimpong-Manso et al., 2011).

The total mean yields obtained from the various treatments in the present experiment varied from 125 to 182 g/bag from 500 g dry substrates. Pathmashini et al. (2008) reported the average yields of sorghum, kurakkan, maize, and paddy spawns as 45.69 g, 55.37 g, 29.83 g, and 21.57 g, respectively. Oei (1996) states that the increase in mushroom production is dependent on the presence of nutrients and the inclusion of supplements contained in substrates. This can be ascribed to the fact that lignocellulosic materials found in garbage often have low protein content, which is inadequate for mushroom production.

The observed variations in these parameters can be attributed to the influence of factors such as texture and substrate formulations, as well as the presence of nutrients in the substrates. These factors potentially impact the composition of the final

mushroom growth substrate, as well as its qualities such as water holding capacity and degree of aeration (Reyes et al., 2009; Kurtzman, 2010).

5. Conclusions

The objective of this study was to assess the applicability of *Zea mays* L and Sorghum bicolor in relation to growth and yield parameters of oyster mushroom. These findings indicate that cultivating oyster mushrooms (*P. ostereatus*, *P. columpains*, *P. pulmonarius*, *P. sajor-caju*, and *P. floridans*) on *Zea mays* L wastes is more favorable and productive compared to Sorghum bicolor. Overall, using *Zea mays* L as a primary substrate for mushroom production is a viable option for reducing agricultural residues in the environment. This approach helps prevent pollution caused by the emission of greenhouse gases during the burning of these residues.

Conflicts of interest. The authors mentioned that none of them have a conflict of interest when it comes to this article.

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