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# INFLUENCE OF DIFFERENT CELLULOSIC SUBSTRATES ON BIOLOGICAL EFFICIENCY AND GROWTH OF DIFFERENT OYSTER MUSHROOMS

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**Agricultural wastes that were used in this research rice straw, sugarcane bagasse and cotton wastes. Also, five species of the genus *Pleurotus* (*P. ostreatus, P. columpinus, P.pulmonarius, P. sajor-cajue* and *P. floridanus*) were evaluated with the substrate mixture to ascertain their contribution to the biological efficiency (BE). Total yield and mean number of fruit body per flush were studied the experiment was set up as a complete randomized design with three replicates The period of spawn run was constant 21 days for all oyster mushroom species tested. The mycelial growth on liquid media exhibited the highest values at sugarcane bagasse, followed by rice straw, whilst the cotton wastes produced the lowest mycelial dry weight. On solid agricultural wastes media, rice straw produced the highest total yield for *P. columpains* and *P. sajor-cajue* where the BE was the highest recording 64.4% and total yield 225.4gm. On the other hand, sugarcane bagasse produced the highest total yield for *P. columpains* 215.8 gm and biological efficiency 61.6% whilst cotton wastes produced the highest total fruiting body yield for *P. flouridans* 215 gm and biological efficiency 61.4%. The first flush gave the highest mean number of fruit body and total fruit body weight, the third flush gave the lowest mean number of both traits and the second flush produced the second highest mean number of fruit body and total yield.**

**Keywords** Agricultural wastes, biological efficiency, oyster mushroom cultivation solid and liquid media, *Pleuroteus* species.

## 1. Introduction

Edible mushrooms have high nutritional and functional food value with medicinal properties, some of which also are of economic significance., mushrooms have significant organoleptic food properties as an individual experience via the senses like smell, taste, sight, and touch (**Chang and Miles, 2008; Ergonul *et al.*, 2013; Valverde *et al.*, 2015**). The cultivation of edible mushrooms offers one of the most feasible and economic method for the bioconversion of agro-lignocellulosic wastes ***(Gbolagade, 2005; Gbolagade,et al., 2006; Jonathan et al., 2008).***

The technology can also limit air pollution associated with burning agriculture wastes as well as to decrease environmental pollution due to unutilized agricultural wastes **Jonathan *et al.*, (2012)**. Most of the cultivated species of mushrooms belong to the phylum *Basidiomycota*, although some *Ascomycota* such as members from the genera *Morchella* or *Tuber* have also been successfully cultivated and commercially exploited (**Rubini *et al.*, 2014; Liu *et al.*, 2017; Carrasco *et al.*, 2018**). However, the most extensively cultivated mushroom worldwide is *Agaricus bisporus* (J. E. Lange) Emil J. Imbach., followed by *Lentinula edodes* (Berk.) Pegler and *P. ostreatus* (Jacq. ex Fr.) P. Kumm. *Pleurotus* genus is one of most extensively studied white-rot fungi due to its exceptional ligninolytic properties. It is an edible mushroom and it also has several biological effects, as it contains important bioactive molecules. The genus *Pleurotus* (Fries) Kummer (Basidiomycota, Agaricales) was defined by **Kummer (1871).**

It is a cosmopolitan group of mushrooms with high nutritional value and therapeutic properties, besides a wide array of biotechnological and environmental applications (**Knop *et al.*, 2015**). Usually regarded as oyster mushrooms, these edible basidiomycetes are among the most popular worldwide, as much as they achieved the third position in the production of edible mushrooms, behind the species of the genus *Agaricus* and *Lentinula* (**Fernandes *et al*., 2015)**. The most important *Pleurotus* species cultivated in large scale are *P. ostreatus* and *P. pulmonarius (*Fr.) Quél. (**Bazanella *et al*., 2013; Ergönül *et al*., 2013).**
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. Not to mention the fact that mushroom, enabling their use as a substitute for meat diet (**Kakon *et al*., 2012**). Mushroom proteins

are considered to be intermediate between that of animals and vegetables (**Gbolagade *et al*., 2006; Jonathan and Adeoyo, 2011**) as it contains all the nine essential amino acids required for human body (**Aina *et al*., 2012**).

Unlike plants, mushrooms are heterotrophic organisms which require external nutrients to grow; the vegetative mycelium (hypha network) supplies nutrients for the growth of basidiomes (reproductive stage), **(Taylor and Ellison, 2010)**.

Mushroom supplementation is an agronomic process which consists of the application of nutritional amendments to the substrates employed for mushroom cultivation. Different nitrogen and carbohydrate rich supplements have been evaluated in crops with a substantial impact on mushroom yield and quality; however, there is still controversy regarding the nutritional requirements of mushrooms and the necessity for the development of new commercial additives ***(Carrasco et al., 2018)***.

Furthermore, mushrooms require oxygen and a specific pH in order to develop a normal metabolism and to grow properly. C and N are the two main macronutrients required by fungi for structural and energy requirements; P, K and Mg are also considered macronutrients for mushrooms, in addition, trace elements such as Fe, Se, Zn, Mn, Cu and Mo appear to be needed for diverse functions (**Chang and Miles, 2004**).

The initial phase of mushroom production consists of a solid fermentation process. From spawning, the vegetative mycelium grows under controlled environment and aseptic conditions to colonize the mass of substrate before fructifying ***(Zervakis et al ., 2013). Carrasco et al., (2018)*** reported that the use of low-protein supplements based on carbon-rich sources such as cellulose and hemicellulose components improves the performance of the mushroom equally or even more than nitrogen addition**.**

The production of the sbstrates employed in mushroom cultivation are derived from agricultural by-products such as cereal straw, plant fiber/husk, manure, cotton wastes, sugarcane bagasse or sawdust, etc. as organic manure are being utilized. These crop residues results after harvesting in the farm are leaves, stem and shelves which are characterized as coarse plant byproducts and big size, chemically low in protein and fat contents. Also, it is high in lignin and cellulos contents. The problem of agriculture wastes becomes very obvious and aggregated after the harvest of summer crops. That is because at this time of the season, the farmer is in a rush to recultivate his land therefore getting rid of the wastes has his highest priorities, usually by burning. This method, burning not only is considered an economic loss but also has harmful effects on the environmen**t** Egypt contains agricultural wastes amount range from 30-35 million tons a year (**Shaban *et al*., 2010**) .

There is an enormous amount of wastes from field, agro-industry. Only using 25% of the yearly burned cereal straw in the world could result in a mushroom yield of 317 million metric tons (317 milliard kg) of fresh mushroom per year. The yearly mushroom production is only 6 milliard persons or 1 kg per year or 3 gm per day (**Courvoisier, 1999**). In fact counting the early available world waste in agriculture (500 milliard kg) and forestry (100 milliard kg), we can easily grow 360 milliard kg of fresh mushroom on the total of 600 milliard kg dry wastes. This would bring us a yearly mushroom food of 6 kg per head per year containing 4% protein in fresh mushroom and we know that 30% of the world population is protein deficient (**Ergonul *et al*., 2013**)

Accordingly the aim of preset investigation was to evaluate the efficiency of different agricultural wastes on of mycelia production as well as total yield and biological efficiency of five oyster mushrooms.

## 2. Materials and Methods

### 2.1 The substrates:

Agricultural wastes used the most common were rice straw, sugarcane bagasse and cotton wastes obtained from private farm from Assiut governorate and were utilized as growing media for the different *Pleurotus* spp.

### 2.1.2 Determination of moisture content of the agricultural wastes

10 Grams of sample were dried in oven at 105 °C for about 24 hours and then reweighted. The percentage of moisture content was then calculated according to the following equation

$M.C.\% = \frac{A-B}{A} x100$, where A and B are the weight before and after drying, respectively (**Makavona *et al*., 2018)**.

**2.1.3 Determination of Mineral content of the agricultural wastes**

Total nitrogen of dried agricultural wastes was determined using Kjeldahl digestion method as described by **Jackson (1973)**. Total phosphorus was determined in agricultural wastes spectrophotometrically (Specronic 200 Spectrophotometer**)** in the acid solution of the digested samples using ammonium molybedate and stannus chloride reagents as described by **Page *et al.* (1982)**. Total potassium of agricultural wastes was determined in the acid solution of the digested samples using flame photometric method according to **Page *et al.* (1982)**.

**2.2. Cultivation of mushroom:**

**2.2.1. Source of *Pleurotus* species cultures**

The spawn packets and cultures of five species of the genus *Pleurotus* (*P. ostreatus, P.columpinus, P. pulmonarius, P. sajor-caju* and *P. floridanus*) were used in the current research were obtained from Agricultural Research Center, Food Technology, Egypt.and were used .

**2.2.2. Preparation mixtures of substrate**

The chopped substrates of different agricultural waste were soaked in water for 24 hours until the moisture content reached about 60-80%, then pasteurization of substrate was carried out by autoclaving (60°C for 4 hr ). The pasteurized substrate was left to cool down and to drain excess water. 350 gm of the substrate was thoroughly mixed with 10 gm calcium carbonate, 10 gm wheat bran and moisture content was kept at 80% (**Markson *et al*., 2017)**.

**2.2.3. Spawning**

The spawn material was distributed over the substrate at the rate of 17 gm. The spawn was thoroughly mixed with the substrate and then filled into plastic bags (**Birara *et al*., 2014)**. The mixtures of the spawn and organic substrates were bagged tightly in plastic sheet and covered with black sheet.

**2.2.4. Cultivation conditions and harvesting**

The inoculated bags were incubated in a cultivation dark room and maintained at 25-30 ºC with relative humidity of 85±5%, for ramification of the mushroom mycelia. Growth of mushroom was observed daily for all the treatments. When the bags covered with full of mycelium and pin-heads started appearing, the bags were mouth opened to facilitate the development of fruiting bodies and put it on a light room. As soon as the fruiting bodies developed and attained their full size, they were cut just above surface of the substrate with sterile sharp knife. The harvesting was done in 3 harvests. After the $2^{nd}$ harvest, the substrate was turned upside down and regularly watered to harvest the $3^{rd}$ harvests. The yields of mushroom were recorded (**Iqbal *et al*., 2005; Menaga, *et al*., 2012)**. After harvest, the mushrooms samples were cleaned by rubbing, scrapping and brushing for removal of all foreign matters. Thereafter they were cut in small pieces of around 2 to 3 cm across using a knife and then wrapped in newspaper and stored in moisture free open places. They were air-dried in shade that took 15 days or more (**Markson *et al*., 2017)**.

**2.2.5. Determination of biological efficiency**

Fresh mushrooms were harvested and the biological efficiency determined as the percentage of weight of fresh mushrooms to dry weight of substrate (**Salama *et al*. 2016)** at spawning as described by **Mueller *et al*. (1985), Banik and Nandi (2004) and Oseni *et al*. (2012) .**

Biological efficiency of mushrooms was calculated by dividing weight of fresh mushroom yield (in gm) by weight of air dried substrate (in gm) and multiplied by 100.

$$Biological\ efficiency = \frac{Yield\ of\ fresh\ mushroom\ in\ gm}{Total\ weight\ of\ dry\ substrate\ used\ (gm)} x100$$

**2.2.6. Cultivation of oyster mushroom on liquid media:**

Preparation of rice straw, sugarcane bagasse and cotton wastes, grinding, soaking for 24 hr sterilization and put it in sterilized conical flasks 1 liter. Added 10 gm of grinded straw, 100 ml distilled water, 5 gm $CaCO_3$, 5 gm of yeast extract and 5 gm of spawn, incubation at room temperature about 45 days avoid movement and light , then filtrate and weight of mycelium.

### 2.3. Statistical analysis:

The data were statistically analyzed following the Randomized Complete Block Design (RCBD) with arrangement of three replications and means were compared following Duncan's test at 5% level of probability for interpretation of results (**Gomez and Gomez, 1984**).

## 3. Results and Discussion

### 3.1. Agriculture waste properties

Based on oven dry method moisture content of rice straw was 8%, whereas moisture content of sugarcane bagasse was 29% and moisture content of cotton wastes was 14% as shown in (Table 1). Total nitrogen, phosphorus and potassium of rice straw has relatively high nitrogen and potassium contents by about 0.96% and 0.60%, respectively, while phosphorus was low (0.22%). But, sugarcane bagasse has total nitrogen (0.61%), P (0.48%) and K (0.60%). While, Cotton waste was the lowest of mineral content (0.21%, 0.13% and 0.24%) respectively (Table 1).

### 3.2. Mycelia growth rate

In the present investigation, the colonization of substrate was completed in 21 days which was concomitant with previous studies (**Iqbal *et al*., 2005; Kumari and Achal, 2008; Soniya *et al*. 2013**; **Yang *et al.*, 2013). Dahmardeh *et al*. (2010)** reported that the spawn running take three weeks and fruiting bodies appeared after 2-3 days.

In liquid media, the weight of mycelial growth varied depending on the type of agricultural wastes and oyster mushroom species. As illustrated in Table 2 Fig 1, the weight of mycelium cultivated on liquid media using the sugarcane bagasse exhibited the highest values, followed by Rice straw, while the cotton wastes produced the lowest mycelial dry weight. The highest weight of mycelia was observed in *P. floridans* and *P. ostreatus* (17.2 gm) on sugarcane bagasse. While, the lowest weight was observed in *P. pulmonarius* (11 gm) on cotton wastes. These variations could be explained by the fact that the texture and substrate formulations as well as nutrients in substrates possibly affected the composition of the final mushroom growth substrate and qualities such as water holding capacity and degree of aeration (**Reyes *et al.*, 2009; Kurtzman, 2010; Salama *et al*., 2016)**.

**3.3. Mushroom production**

Three different types of substrate were investigated to determine the yield and their quality of oyster mushroom as illustrated in ( Table 3 Fig 2) First flush gave the highest fresh weight, third flush 3 gave the lowest mean values of fresh weight and second flush produced intermediated mean of fresh weight. Moreover, the number of fruit bodies per harvest decreased from flush to flush as shown in Table ( 3), this may be ascribed to the nature and amount of nitrogen available in a substrate after each harvest affect the degree of cellulose degradation which in turn affects the yield (**Manso *et al*., 2011)**.

The main components of lignocellulosic substrate are cellulose, hemicellulose and lignin. *Pleurotues* mushrooms can biodegrade cellulose and lignin of lignocellulosic materials to get their carbon requirement (**Mohamed *et al*., 2016)**. Cotton wastes contain 59% cellulose, rice straw contains 33% cellulose **(Ukis, 1986**; **Sun *et al*., 2004)** and sugarcane bagasse contain from 44.7 to 45.9% cellulose. The ability of mushrooms to biodegrade the agricultural wastes reflected on fruiting body production. The results demonstrated in Table 3 showed that the highest total yield was for *P. columpains* and *P. sajor-cajue* on rice straw which recorded nearly 225.6g for each from 350 g waste compared with the other wastes. Also, *P. columpains* had the highest total fruiting body yield on sugarcane bagasse which gained nearly 215.8g / 350g compared to 215g from 350g on cotton wastes. The results of the present study are in agreement with those reported by **Abd El-Kawi (1989) and Abd El-Rehem , Nahed(1997)** who cultivated two *Pleurotus* species on three lignocellulosic materials namely sawdust, rice straw and water hyacinth. They found that the two species of *Pleurotus* gave the highest yield on rice straw substrate followed by sawdust and water hyacinth under Egyptian conditions. While, **El-Bagory (1997)** stated that the maize straw proved to be the most suitable substrate followed by rice straw and wheat straw then sugarcane bagasse.

Biological efficiency is the most important parameter in mushroom cultivation. It was found that the biological efficiency of these studied species ranged from 51.02% f or *P. Pmonarius* on sugarcane bagasse and 64.4% *for P. columpains* and *P. Sajor-cajue* on rice straw.

Generally, *P. ostreatus* recorded variable biological efficiency deponding upon.the employed waste where rice straw, sugarcane bagasse and cotton wastes had biological efficiencies of 64.4, 61.6 and 58.9%, respectively. *P. pulmonarius* registered biological efficiency of 61.2% on rice straw and 51.02% on sugar cane bagasse. On the other hand, the biological efficiency of *P. sajor-caju* was at the highest value on rice straw (64%) and around 57% for the remnant wastes. *P. floridans* recorded comparable biological efficiency values ranged from to 58.30-61.40% on the studied wastes. These results are agree with **Shah *et al*. (2004)., Iqbal *et al*. (2005)** and **Ananbeh and Almomany (2005)**.

The highest number of primordia and fruiting bodies and the amount of fresh weight was obtained with sugarcane bagasse in all flushes as the lowest with mustard straw **Dey et al.(2008).**

An example of *Pleurotus* production was provided in plate 1 for *Pleurotus Sajor-cajue.*

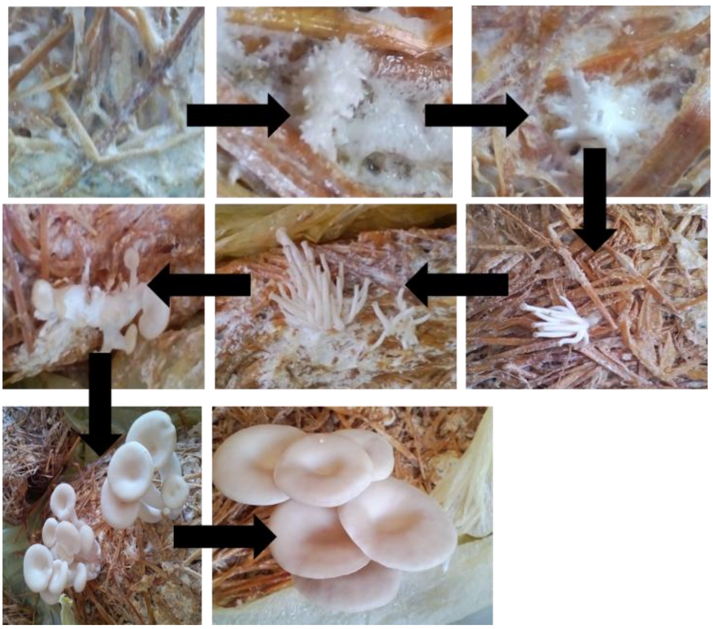

**Plate 1:** Different stages of production of *PleurotusSajor-caju***e.**

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

| Kind of wastes | Moisture content | N% | P% | K% |
|---|---|---|---|---|
| **Rice straw** | **8± 0.78%** | 0.96± 0.04% | 0.22±0.03 % | 0.60±0.05 % |
| **Sugarcane bagasse** | **29±1.13%** | 0.61±0.02 % | 0.48±0.02 % | 0.57± 0.02% |
| **Cotton wastes** | **14±0.98 %** | 0.21±0.01% | 0.13±0.02% | 0.24±0.01 % |

**Table2.** Weight of *Pleurotus* spp. mycelium cultivated on liquid media using rice straw, sugarcane bagasse and cotton wastes

| Kind of wastes | Oyster mushroom species | Weight of mycelium with gram |
|---|---|---|
| **Rice straw** | *P. ostreatus* | 13.2C ±0.85 |
| | *P. columpinus* | 15.0 B±0.98 |
| | *P. pulmonarius* | 15.0 B±1.19 |
| | *P. sajor-caju* | 16.2 A±1.14 |
| | *P. floridans* | 15.6 A±0.92 |
| **Sugarcane bagasse** | *P. ostreatus* | 17.2 A±0.82 |
| | *P. columpinus* | 15.80 A± 0.76 |
| | *P. pulmonarius* | 16.0 A±0.87 |
| | *P. sajor-caju* | 16.0 A ±0.99 |
| | *P. floridans* | 17. 2 A±1.12 |
| **Cotton wastes** | *P. ostreatus* | 12.40 ±0.98 |
| | *P. columpinus* | 14.40 B ±0.76 |
| | *P. pulmonarius* | 11.0 D ±0.88 |
| | *P. sajor-caju* | 13.0 C±0.96 |
| | *P. floridans* | 13.0 C±1.16 |

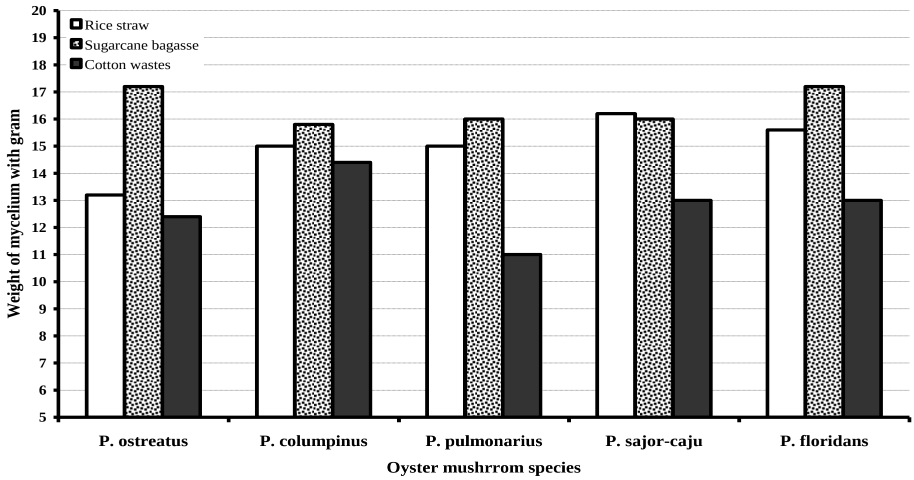


**Fig. 1.** Weight of *Pleurotus* spp. mycelium cultivated on liquid media using rice straw, sugarcane bagasse and cotton wastes

**Table 3** Total yield and biological efficiency of *Pleurotus* sp on rice straw, sugarcane bagasse, and cotton wastes

| Oyster mushrrom species | Kind of waste | Mean Table 3. Value | | |
|---|---|---|---|---|
| | | **First flush** | **Second flush** | **Third flush** |
| | | 28 days | 35 days | 45 days |
| *P. ostreatus* | **Rice straw** | 84.0 B±3.1 | 66.2 C±0.68 | 45.2 G±0.86 |
| | **Sugarcane bagasse** | 77.4 D±4.25 | 61.2 E±0.97 | 57.2 C±0.71 |
| | **Cotton wastes** | 82.4 C±3.25 | 70.4 B±2.10 | 51.4 F±0.66 |
| *P. columpinus* | **Rice straw** | 83.0 BC±4.18 | 78.8 A±1.78 | 63.6 A±0.63 |
| | **Sugarcane bagasse** | 81.4 C±2.16 | 74.4 BC±0.74 | 60.0BC±0.57 |
| | **Cotton wastes** | 83.8 B±3.17 | 67.8 C±0.86 | 45.8 G±0.59 |
| *P. pulmonarius* | **Rice straw** | 84.0 B±4.19 | 72.8 BC±2.17 | 57.4 C±0.63 |
| | **Sugarcane bagasse** | 69.6 E±1.14 | 62.2 E±0.98 | 46.8 G±0.46 |
| | **Cotton wastes** | 85.4 AB±2.16 | 76.8 A±2.15 | 41.0 H±0.78 |
| *P.sajor-caju* | **Rice straw** | 87.2 A±3.24 | 76.4 B±1.63 | 62.0 B±0.67 |
| | **Sugarcane bagasse** | 83.4 B±2.89 | 64.2 D±0.97 | 52.6 F±0.77 |
| | **Cotton wastes** | 81.6 C±3.15 | 67.0 C±1.99 | 55.0 E±0.64 |
| *P. floridans* | **Rice straw** | 84.4 AB±4.12 | 64.0 D±3.12 | 55.8 E±0.61 |
| | **Sugarcane bagasse** | 79.6 C±2.25 | 65.8 D±2.15 | 62.4 A±0.54 |
| | **Cotton wastes** | 84.6 AB±2.17 | 72.0BC±1.85 | 58.4 C±0.36 |

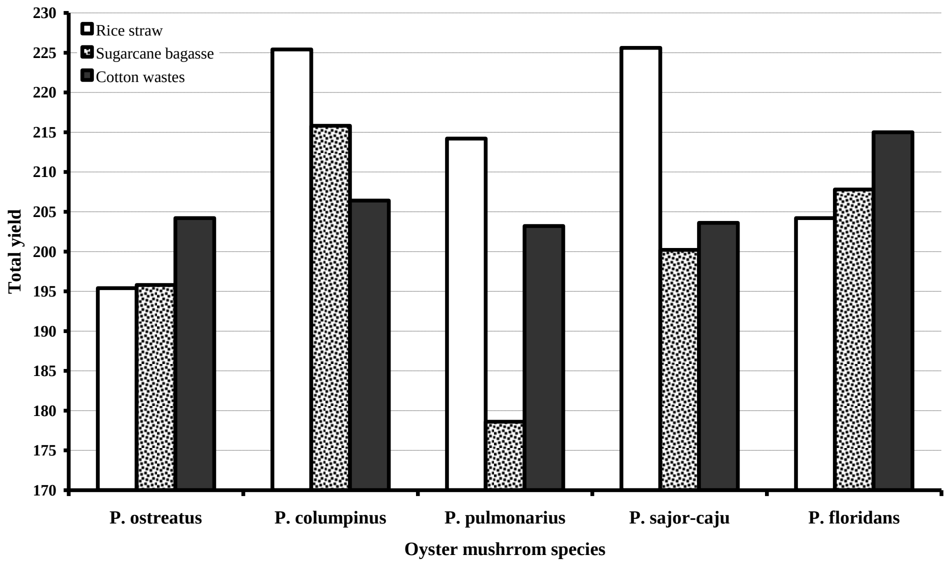


**Fig. 2.** Total yield of *Pleurotus* spp on rice straw, sugarcane bagasse, and cotton wastes

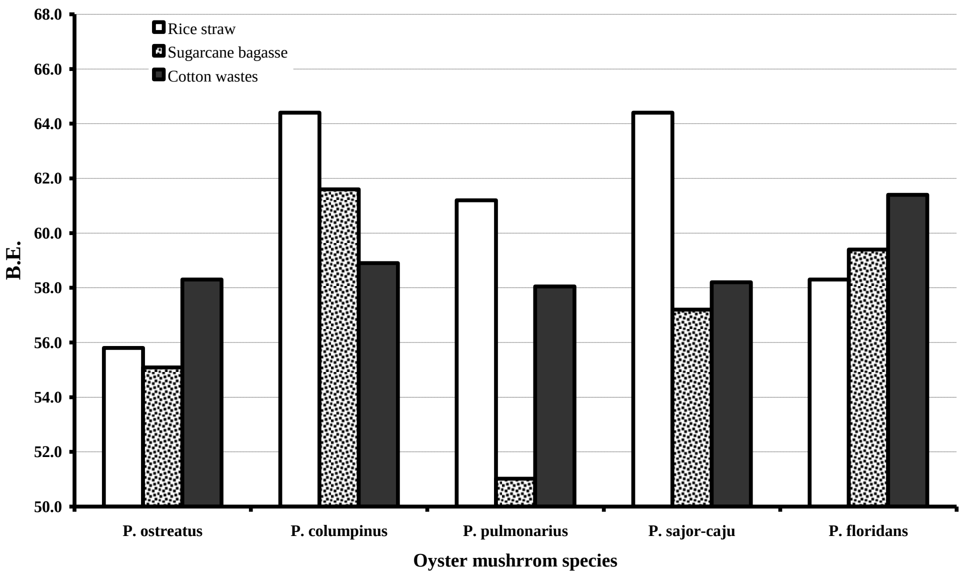


**Fig.3.** biological efficiency of *Pleurotus* spp on rice straw, sugarcane bagasse, and cotton wastes**.**

**Table 4 .** Mean value of fruit body per harvest.

| **Oyster mushrrom species** | **Kind of waste** | **Mean. Value** | | |
|---|---|---|---|---|
| | | **First flush** | **Second flush** | **Third flush** |
| | | 28 days | 35 days | 45 days |
| *P. ostreatus* | **Rice straw** | 11B±0.41 | 7B±0.11 | 5B±0.06 |
| | **Sugarcane bagasse** | 12A±0.36 | 8A±0.09 | 4C±0.07 |
| | **Cotton wastes** | 11B±0.98 | 6B±0.13 | 6B±0.12 |
| *P. columpinus* | **Rice straw** | 10B±0.16 | 8A±0.17 | 6B±0.09 |
| | **Sugarcane bagasse** | 12A±0.28 | 9A±0.19 | 7A±0.08 |
| | **Cotton wastes** | 13A±0.19 | 8A±0.21 | 5B±0.17 |
| *P. pulmonarius* | **Rice straw** | 11B±0.28 | 9A±0.27 | 4C±0.04 |
| | **Sugarcane bagasse** | 12A±0.26 | 6B±0.08 | 4C±0.03 |
| | **Cotton wastes** | 12A±0.63 | 9A±0.06 | 5B±0.02 |
| *P. sajor-caju* | **Rice straw** | 13A±0.95 | 8A±0.63 | 6B±0.07 |
| | **Sugarcane bagasse** | 12A±0.69 | 7B±0.27 | 8A±0.08 |
| | **Cotton wastes** | 10B±0.71 | 8A±0.13 | 7A±0.03 |
| *P. floridans* | **Rice straw** | 10B±0.56 | 8A±0.10 | 4C±0.01 |
| | **Sugarcane bagasse** | 10B±0.63 | 7B±0.14 | 8A±0.05 |
| | **Cotton wastes** | 11B±0.75 | 9A±0.52 | 5B±0.02 |

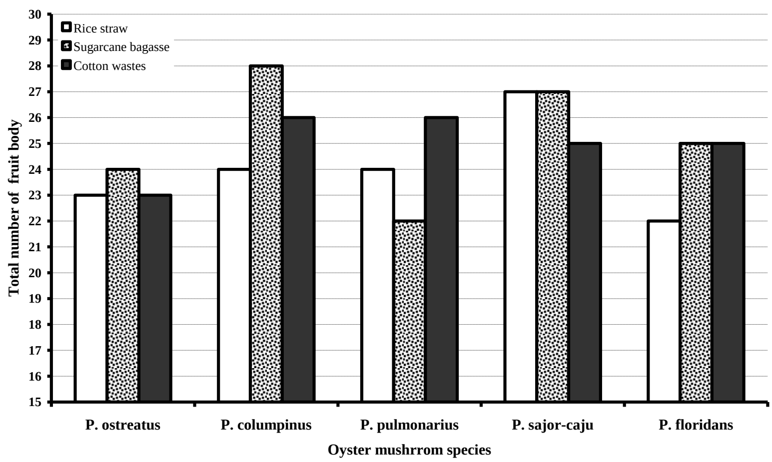


**Fig. 4:** Mean value of fruit body per harvest

## CONCLUSION

The mycelial growth on liquid media exhibited the highest values on sugarcane bagasse, followed by rice straw, whilst the cotton wastes produced the lowest mycelial dry weight. On solid agricultural wastes media, rice straw produced the highest total yield for *P. columpains* and *P. sajor-cajue*, the biological efficiency were the highest and recorded biological efficiency of 64.4% and total yield 225,4 gm. On the other hand, sugarcane bagasse produced the highest total yield for *P. columpains* 215.8g and the biological efficiency was 61.6%, whilst the cotton wastes produced the highest total fruiting body yield for *P. flouridans* by about 215 g and the biological efficiency was 61.4%**.**

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# تأثير المواد السيلولوزيه المختلفه على الكفاءه البيولوجيه ونموانواع محتلفه من عيش الغراب المحارى

يعتبر **عيش الغراب** المحارى هدية الطبيعة للفقراء ومحدودي الدخل وخصوصاً في الدول النامية لما يتميز به من قيمه غذائيه عاليه وصحيه كما أنه ينمو علي المخلفات الزراعية التي تعتبر ملوثة للبيئة فبزراعة **عيش الغراب المحارى** تحل مشكلة المخلفات الزراعية والاستفادة منها واستخدامها لزراعتة الذى يعتبر غذاء صحيا متكامل وكذلك انتاج واستخلاص بعض المركبات الحيويه الهامه واستغلالها فى مجالات الطب والزراعة .

في هذا البحث تم زراعة **عيش الغراب** المحاري علي أوساط غذائية صلبة وسائلة ففي الأوساط الصلبة يتم تجميع المخلفات الزراعية وهي مخلفات قصب السكر – حطب القطن – قش الأرز لزراعة خمسة انواع من **عيش الغراب** المحاري وهي

five species of the genus *Pleurotus* (*P. ostreatus*, *P.columpinus*, *P. pulmonarius*, *P. sajor-cajua* and *P. floridanus*)

تم تقديرالانتاج الكلى للمشروم بالجرام فى الوسط الغذائى الصلب وكان **عيش الغراب المحارى** *P. sajor- cajue* **و** *P. columpinus* , علي قش الأرز هو الاعلى بوزن ٢٢٥.٦ جرام يليه ***P. columpinus*** , على قصب السكر بوزن ٢١٥.٨ جرام واخيرا ***P. floridanus*** على مخلفات القطن بوزن ٢١٥جرام.

تم حساب الكفاءة البيولوجية. وقد وجد أن الكفاءة النسبية الأعلي **لعيش الغراب** المحاري هي:*P.columpinus*و
*P. sajor-cajue*على قش الأرز ٦٤.٤% بينما علي مخلفات قصب السكر كان ***P.columpinus*** ٦. ٦١% ثم ا***P. floridanus*** علي مخلفات القطن ٦١.٤%.

أما في الوسط الغذائي السائل فتم تنمية **عيش الغراب المحارى** بغرض الحصول علي مركبات حيوية من الوسط الغذائي أو الميسليوم باستخلاص مركبات حيوية من الميسيليوم أو الوسط السائل فقد اظهرت النتائج ان وزن ميسيليوم الاعلى هو ***P.sajor-cajue***١٦,٢جرام علي قش الأرز بينما ***P. floridanus*** علي قصب السكر ١٧,٢ جرام ثم*P.columpinus* علي حطب القطن ١٤,٤ جرام .