Prolonged Water Soaking Pretreatment for Sawdust Substrate and Adding Wheat Bran Enhance Oyster Mushroom Productivity

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Abstract:
The current study involved two sequential experiments conducted in the mushroom research and production laboratory, Department of Horticulture, Faculty of Agriculture, Assiut University. Oyster mushroom, Pleurotus ostreatus, was used in all experiment. The first experiment was conducted to assess mushroom growth and basidiocarp yield on Moski-sawdust substrate as affected by water soaking pretreatment (24h vs. 72h). In this context, data showed that sawdust substrate soaking pretreatment for 24h was inferior to soaking for 72h concerning mycelia ramification and mushroom fruit bodies yield. The mushroom fungus grown on SD received 24h soaking pretreatment showed no colonization and consequently no fruits were produced. The spent weight suggested that a more biodegradation by the mushroom fungus occurred for sawdust substrate soaked for 72h. Subsequently, Moski-sawdust soaked in water for 72h was utilized in a second experiment to elucidate the effect of wheat bran added to different sawdust substrate recipes on improving productivity of oyster mushroom as compared to rice straw as reference substrate. This experiment comprised 5 treatments: as follows: 1) Moski-sawdust (MSD) supplemented with sucrose (SU, 2 g/kg), 2) MSD supplemented with wheat bran (WB, 5%) plus SU (2g/kg), 3) MSD supplemented with blackstrap molasses (BSM, 2 ml/kg), 4) MSD supplemented with WB (5%) plus BSM (2 ml/kg) and 5) Rice straw without supplements as a reference elite substrate. Substrate recipe of MSD supplemented with WB (5%) plus BSM (2 ml/kg) exhibited superiority for all studied mushroom vegetative and fruiting parameters. This substrate recipe produced as much as 1.5 and 1.2 times the yield produced by rice straw (reference treatment) in the first and second trials, respectively. This enhanced crop was produced from 2 flushes in shorter total production period of time. Fruiting bodies yield from cultures on rice straw substrate, while being lower, was produced from 3 flushes in longer total production period of time. The improved total crop from mushroom grown on substrate recipe of MSD supplemented with WB (5%) plus BSM (2 ml/kg) was accompanied by better fruit bodies' characteristics. This study may enhance local oyster mushroom productivity.

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mushroom production and encourage investing in this industry.

**Keywords:** agricultural waste recycling, biotechnology, blackstrap molasses, lignocellulosic materials, macrofungi, pinheads, *Pleurotus ostreatus.

**Introduction:**
Mushrooms are higher fungi called macrofungi as they produce large, easily observed and collected sporocarps. They have been used for human food long time ago (Mendez et al., 2005). Edible mushroom have received a great attention of nutritionists as a potential human diet (Mendez et al., 2005; Diez and Alvarez, 2001). Oyster mushroom (*Pleurotus ostreatus*) is one of the most widely cultivated edible mushrooms (Mendez et al., 2005; Sarangi et al., 2006; Sher et al., 2010). *Pleurotus ostreatus* can secrete enzymes cable to degrade complex components of the lignocelluloses (Ball and Jackson, 1995; Martínez-Carrera et al., 2000; Toyama and Ogawa, 1976; Shashirekha et al., 2002; Ulezlo et al., 1975). Therefore, mushroom cultivation is regarded as a useful biotechnological process to recycle agricultural and agro-industrial by-product wastes (Das and Mukherjee, 2007; Hayes, 1978). While mushroom fruits are food for human, spent substrate can be used in different ways (e.g., animal feeding and crop fertilization).

Oyster mushroom fungi can grow on different varieties of lignocellulosic materials (Khan and Chaudhary, 1989; Zhang et al., 2002). These include cereal straw, corn cobs, sawdust, bagasse, wood pulp, cotton and oil palm waste, banana leaves, coconut husks, poultry wastes, tree bark and leaves, and flax shive (Khan and Chaudhary, 1989). Availability of the substrate in the region (Cohen et al., 2002) where mushroom is intended to be produced is a factor set behind the wide range of the substrates investigated by researchers. Therefore, type of the lignocellulosic substrate is the theme that extensively studied by mushroom researchers (Zhang et al., 2002). Different lignocellulosic substrates compose of different portion of lignin, cellulose and hemicelluloses (McMillan 1994). Among the factors that affect digestibility of lignocellulosic substrates are C/N ratio (Azizi et al., 1990; Gupta and Vijay, 1991; Zadrazil and Kurtzman, 1982), proportional lignin and cellulose contents (McMillan 1994), crystallalty of celluloses (McMillan 1994) and mineral elements contents (Alemawor et al., 2009). Sawdust was shown to be inferior to other substrates for production of oyster mushroom (Banjo et al., 2004; Belewu et al., 2006; Dogan and Peken, 2003). There is an agreement on rice straw as one of the most productive substrates for cultivation of mushroom (Zhang et al., 2002).
It is presumed that sawdust contained high proportion of lignin and/or substance(s) inhibiting mushroom fungus growth. In this context, prolonging water soaking pretreatment with frequent water change may reduce such inhibitors and enhances productivity of mushroom grown on sawdust substrate. Availability of simple carbon source and different nutrient elements additives to lignocellulosic substrates, particularly poor ones, have been useful to enhance mushroom growth and yield (Alemawor et al., 2009; Banjo et al., 2004). In this context, adding either blackstrap molasses at rate of 2 ml/kg to moistened pasteurized substrate or sucrose at rate of 2 g/kg wet substrate (Soliman et al., 2011) has been effectively enhanced oyster mushroom growth and elevated fruit bodies yield. The present study was conducted to study the influence of: 1) different water soaking pretreatments for sawdust and 2) enriching with wheat bran for Moski-sawdust recipe containing simple carbon source on production of Oyster mushroom, *Pleurotus ostreatus*.

**Materials and Methods**

The current research trial involved two experiments conducted in the mushroom Research and production laboratory, Department of Horticulture, Faculty of Agriculture, Assiut University during Nov. to March 2009 and 2010. Production of oyster mushroom (*Pleurotus ostreatus*) basidiocarp (fruiting bodies) was elucidated for Moski-sawdust substrate used following a pretreatment of soaking in water for 24h vs 72h and with or without wheat bran enriching supplement. Spawn of *P. ostreatus* used in this study was obtained from Agricultural Research Center, Food Technology Research Institute, Giza.

**General Procedure**

**Preparation of culture medium and spawn inoculation:** Substrate utilized in the current study was moistened thoroughly by soaking in water. Then after the substrate was stuffed 2 h in hot water at 80°C for pasteurization (Bahukhandi and Munjal, 1989; Balasubramanya and Kathe, 1996). The pasteurized substrate was left to cool down and to drain excess water until mean moisture of 70%; calculated by drying 100 g pasteurized substrate samples in a fan electric oven at 60°C until constant weight. The pasteurized substrate was manually packaged into 20 X 40 cm clear polyethylene bags of mean thickness 0.2 mm containing 1 kg wet pasteurized substrate. The spawn was inoculated at rate of 5% (based on wet mass of the substrate).

**Culture conditions for spawn running and fruiting bodies formation:** The inoculated substrate was incubated for spawn running at 24-28°C in the darkness. The mushroom cultures were subsequently transferred into fruiting room for basidiocarp formation. Polyethylene bags were removed
and the cultures were kept at 23-27°C under light provided by cool white fluorescent tubes for 12 h / day. Electric fans were used 2 h and 4 h / day during incubation for spawn running and basidiocarp formation, respectively, to provide homogenous ventilation condition in the incubation room. The bags moisture was maintained by spraying with water 2 to 3 times a day during the whole cropping period. Mushroom fruiting bodies were harvested about a week after pinheads formation that was when the mushroom fruiting body was turned slightly darker at the cap margins. All experiments were conducted in randomized complete-blocks with 4 replicates. Each treatment was presented by 5 culture bags within replicate.

The data was recorded for spawn running index, days to visible pinheads (primordia) formation, days to fruiting body harvest, fruiting bodies yield (g), substrate weight after fruiting body harvest (spent weight, g), biological efficiency (%), weight (g), diameter (cm) and thickness (mm) of fruiting body and stem. Biological efficiency of substrates (BE) was calculated as follows: \( \text{BE (}) = (\text{Weight of fresh mushroom fruiting bodies/ Weight of dry substrate}) \times 100 \) (Ahmed, 1995; Kirbag and Akyüzyüz. 2008). Spawn running index was derived using a scale from 0 (no mycelia developed) to 1 (mycelia shown overall the substrate). All data were subjected to analysis of variance (Gomez and Gomez, 1984) and means were compared at 0.05 probability level.

**Particular Experiment:**

**Expt. I- Sawdust substrate water soaking pretreatment:** Particular to this experiment sawdust substrate was moistened thoroughly by soaking in water for 24 h vs 72h. Water was changed every 24 h.

**Expt. II- Wheat bran supplement to sawdust substrate:** Based on the results of Expt.I, the substrate was moistened thoroughly by soaking in water for 72 h with water changed every 24 h. Particular to this experiment, wheat bran was added to sawdust recipe prepared to contain either blackstrap molasses at rate of 2 ml/kg moistened pasteurized substrate or sucrose at rate of 2 g/kg wet substrate (Soliman et al., 2011). In this context, moistened sawdust of each polyethylene bags was mixed thoroughly with 2 ml blackstrap molasses diluted in 100 ml distilled water or 2 g sucrose dissolved in 100 ml distilled water. The wet pasteurized sawdust substrate containing blackstrap molasses or sucrose without wheat bran was used as the control treatments. The blackstrap molasses and sucrose solutions were applied after being sterilized in electric autoclave for 20 min at 121°C under 1.2 kg/cm². Culture on rice straw without supplements was used as standard reference treatment. This experiment comprised 5 treatments. These were: 1)
Moski-sawdust supplemented with sucrose (2 g/kg), 2) Moski-sawdust supplemented with wheat bran (5%) plus sucrose (2g/kg) and, 3) Moski-sawdust supplemented with blackstrap molasses (2 ml/kg), 4) Moski-sawdust supplemented with wheat bran (5%) plus blackstrap molasses (2 ml/kg) and 5) Rice straw without supplements. Wheat bran was added and mixed thoroughly with the moistened substrate and then pasteurized.

Results:

**Expt. I- Sawdust substrate water soaking pretreatment:** Tables (1 A to D) present means of spawn running index, fruit bodies yield, spent weight and biological efficiency (%) for oyster mushroom (*Pleurotus ostreatus*) cultivated on Moski-sawdust (SD) received 24h vs 72h water soaking pretreatment. The mushroom fungus cultivated on SD received 72h water soaking pretreatment exhibited mycelia ramification over one third of the culture bags (Table 1A). The pinheads of the first flush were visible about 6 weeks after transferring into fruiting room and removing the plastic bags. The fruiting bodies of the first flush were harvestable about 7 weeks later. The cultures showed harvestable fruit bodies in a second flush about 3 weeks after collecting basidiocarps of the first flush. In contrast to cultures on SD received 72h water soaking pretreatment, the fungus on SD received 24h soaking pretreatment showed no coloniza tion. Consequently, no fruits were produced (Table 1B). Eventually, the spent weight (Table 1 C) was lowered when culturing the fungus on sawdust substrate pre treated with 72h water soaking indicating a more biodegradation occurred for the substrate. Saw dust substrate pretreated with 72h water soaking showed, therefore, a higher biological efficiency (Table 1 D).

**Expt. II- Wheat bran supplement to sawdust substrate:** The mushroom fungus cultivated on "MSD+2BS+WB" substrate recipes exhibited complete mycelia ramification over the culture bags (Table 2A). Mean spawn running index for "MSD+2SUC+WB" is significantly exceeding mean of "MSD+2SUC" suggesting influential role for wheat bran in the substrate recipe. The same effect for wheat bran is shown in contrasting "MSD+2BS" with "MSD+2BS+WB". Substrate recipe "MSD+2BS+WB" was competent to rice straw for mycelia ramification as shown by spawn running index. On rice straw substrate, characteristi cally, mushroom yield of fruiting bodies was produced in 3 flushes (Table 3 C). The pinheads of the first flush on rice straw substrate were visible about a week after transferring into fruiting room and removing the plastic bags (Table 3 A). Among the other treatments, the fewest number of days to pinhead appearance was for "MSD+2BS+WB" substrate recipe. This recipe developed visible primordia of the first flush.
in 2 weeks (Table 3 A). In the second flush, there were no differences whether mushroom was grown on rice straw substrate or "MSD+2BS+WB" substrate recipes. As presented in Table (3B), the fruiting bodies of the first flush were harvestable after about 2 weeks for cultures on rice straw and 3 weeks on "MSD+2BS+WB" substrate recipe. The substrate recipe "MSD+2SUC" was the latest to develop harvestable basidiocarp fruiting bodies.

The highest basidiocarp fruit yield (Table 3C) was obtained from mushroom cultivated on "MSD+2BS+WB" (Fig 1B) substrate recipe in the first flush of the first trial. Cultivation on rice straw clearly gave significantly lower yield in the first flush of the first trial. "MSD+2BS+WB" substrate recipe remained producing the highest yield in the second flush of the first trial and both flushes of the second trial. The second highest yield was obtained from cultures on rice straw substrate. On total, the "MSD+2BS+WB" substrate recipe produced as much as 1.5 and 1.2 times the yield produced by rice straw (reference treatment) in the first and second trials, respectively. Substrate recipe "MSD+2BS" did not increase the fruit yield compared to that of the rice straw. These results indicate an important role of wheat bran.

In addition, considering "MSD+2SUC" and "MSD+2SUC+WB" (Fig 1A) demonstrates that enrichment with wheat bran was accounted for 80% and 81% increase in fruit yield in the first and the second trials, respectively (Table 3C). For "MSD+2BS+WB" and "MSD+2BS", the wheat bran induce an increase of 67% and 66% in fruit yield in the first and second trials, respectively. The spent weight was the lowest for cultures of the fungus on rice straw indicating a more biodegradation occurred for the substrate (Table 2B). The second lowest spent weight was found for "MSD+2BS+WB" substrate recipe. Uniquely, rice straw showed the highest biological efficiency (Table 2C). Substrate recipe "MSD+2BS+WB" was the second for biological efficiency. The weight averaged per fruit in the first flush was significantly largest when the mushroom fungus was grown on "MSD+2BS+WB" substrate recipe (Table 4A). This substrate recipe produced significantly greater fruit weight comparing with rice straw. In the second flush, however, there were no sharp differences among these 2 substrates. This was almost true for fruits diameter (Table 4B). Average fruit thickness (Table 4C) in the first flush was the greatest for mushroom produced on "MSD+2BS+WB" substrate recipe. In the second flush, fruits of cultures on rice straw were comparable in this regard. "MSD+2BS+WB" substrate was consistently among the top treatments for stem weight, length and diameter (Tables 5 A, B and C).
Discussion

Production of mushroom crop is conditioned by several factors including fungus species and strain (Sanchez, 2004; Moonmoon et al., 2010), type and preparation of substrate (Anyakorah and Olatunji, 2001; Sanchez, 2004) spawn rate and quality (Zhang et al., 2002), incubation conditions (Shah et al., 2004; Sher et al., 2010) and cultural practices. Among these factors, however, type of substrate has received the most of the research attention (Anyakorah and Olatunji, 2001; Banjo et al., 2004; Belewu et al., 2006; Chang, 1984; Silva et al., 2002). Actually, mushrooms can grow on a wide range of lignocellulosic substrates due to their ability to produce hydrolyzing and oxidizing enzymes (Rajarathnam et al., 1979; Toyama and Ogawa, 1976; Ulezlo et al., 1975), to breakdown different components in such substrates. However, fruiting bodies yield may largely vary depending on the type of lignocellulosic substrates (Anyakorah and Olatunji, 2001; Belewu et al., 2006; Chang, 1984; Silva et al., 2002). Of the prominent factors affecting the differential potential of substrate for mushroom production is the substrate composition. The study of lignocellulose biodegradation analysis reported by Durrant et al., (1991), showed that the lignin fraction of substrate was degraded preferentially during the vegetative growth phase of the mushroom (mycelia growth) whereas cellulose degradation occurred after the emergence of the fruit bodies. Production of reducing sugars from cellulose in the lignocellulosic materials is usually catalyzed by cellulase enzymes. The factors that have been identified to affect this biodegradation process include porosity, i.e., accessible surface area of the waste materials, cellulose fiber crystallinity and lignin and hemicellulose content (McMillan 1994).

The presence of lignin and hemicellulose makes the access of cellulase enzymes to cellulose difficult, thus reducing the efficiency of the hydrolysis. *Pleurotus ostreatus*, the oyster mushroom, is an active lignin degrader in the forests and lignin breakdown is a necessary step for making cellulose (the most abundant carbon biopolymer) accessible to further enzymatic processes. To achieve the biodegradation of lignocellulosic substrate, mushroom hyphae (i.e., mycelium) produce a wide range of extracellular enzymes capable of degrading complex organic material (Martínez-Carrera et al., 2000). As reported by Ball and Jackson (1995), a range of lignocellulose-degrading enzymes can be recovered from extracts of spent mushroom compost including peroxidases, the xylan-debranching enzymes acetylsyterase and arabinofuranosidase, and the cellulose-degrading activities endoglucanase, cellobiohydrolase and β-glucosidase. The behavior of the mushroom fun-
The growth of mushroom during vegetative growth and fruit cropping on sawdust medium in the current study imply to an existence of high lignin component and relatively poor cellulose content in this substrate (Chang, 1984). Worthwhile to mention that sawdust substrate used after 24h water soaking pretreatment in the present study showed no mycelia growth and consequently did not produce fruiting bodies at all. However, cultures had spawn running and yielded fruiting bodies on the same substrate when water soaking pretreatment was prolonged to 72h with water changed every 24h. Evidently, therefore, the sawdust may contain substance(s) inhibiting mushroom fungus growth. Soaking for 72h in water changed every 24h seemed to reduce such inhibitors. However, this does not exclude existence of remains that could be accounted for lower productivity of mushroom grown on this substrate.

As indicated by Soliman et al. (2011), the superiority of sawdust supplemented with sucrose or molasses comparing to the substrate lacking these additives could be attributed to enhanced productivity of enzymes for lignin biodegradation by mushroom hyphae. This could occur as result of availability of simple carbon source of energy provided by sucrose or molasses additives. Thus cellulose may become available for fruiting bodied to develop and grow. The growth of Pleurotus on lignocellulosic materials depends largely upon Carbon: Nitrogen ratio in the substrate and addition of nitrogen may be useful to enhance the yield performance of mushroom species (Azizi et al., 1990; Gupta and Vijay, 1991; Zadrazil and Kurtzman, 1982). Nitrogen is an important basic nutrient for microorganisms, being required for protein and nucleic acid synthesis. Good growth and better yield of mushroom can be achieved when spent substrates are supplemented with starch, peptone and wheat bran (Sharma and Jandaik, 1985). Wheat bran contains protein in addition to nutrient elements and carbohydrate. Data of the present study demonstrate enhancement occurred in growth and fruit yield when sawdust containing sucrose or molasses was enriched with wheat bran. Total yield of fruiting bodies on this medium was competitive (similar or even better) to the yield produced on rice straw. The highest total fruit yield on sawdust was produced when enriched with wheat bran in addition to supplements of 2ml molasses. It is noticeable that fruit yield produced on sawdust containing wheat bran when supplemented with molasses was appreciably higher as compared with substrate supplemented with sugar. Molasses contains nutrient mineral elements (manganese, copper iron, calcium, potassium, magnesium and selenium) and vitamin B6 in addition to carbohydrates. Mn supplementation, for example, was found to be
critical in improving bioconversion of cocoa pod husk by *P. ostreatus* (Alemawor et al., 2009). Therefore, the element components of molasses can be accounted for enhance mushroom capability to degrade lignocelluloses. Due to its high fruit yield, substrate enriched with wheat bran plus 2ml molasses per kg substrate gave the highest biological efficiency in the two trials. Adding 2g sucrose per kg substrate was the second in order.

Clearly, the higher the fruit yield the better the fruit quality was found. Increased fruit weight, diameter and thickness were obtained from substrate enriched with wheat bran plus 2ml molasses per kg substrate in both flushes of the two trials. These fruits had stems with increased weight, diameter and thickness. Noticeably, however, the fruiting bodies yield on enriched sawdust was obtained in 2 flushes while on rice straw was collected in 3 flushes. Again this suggests the poor cellulose content in sawdust. The fungus seems to depend largely upon the supplemented substances (sucrose or molasses plus wheat bran) that are easy to digest. Therefore, the mushroom consumed these supplements faster. This postulated fungus behavior is evidently supported by data of both spent weight and spawn running index.

In conclusion, wheat bran supplement is an effective enriching material to enhance oyster mushroom crop from cultures on Moski-sawdust recipe containing sugar cane molasses. Based on the present study, it is recommended to thoroughly mix 50 g wheat bran per kg substrate of moistened sawdust with 2ml molasses added. From the crop production point of view, use of 5% wheat bran added to sawdust recipe containing blackstrap molasses at rate of 2 ml/kg moistened substrate is advantageous in terms of both higher fruit bodies yield and shorter time period of production cycle (~ 40 days) compared to cultures on rice straw. Essentially, sawdust should be moistened thoroughly via soaking in water for 72 h with water changing every 24h before pasteurization.

**References:**


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Mohamed et al. 2011


ظاهرة فترة نقع نشارة الخشب في الماء وإضافة الردح تحسن انتاجية عيش الغراب (المشروم) المحاري
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أجريت هذه الدراسة بمحور ونتائج عيش الغراب قسم البياتين - كلية الزراعة أسيوط- أهراء 2008- 2010. واستخدم فيها عيش الغراب المحاري نوع بلووريس Pleurotus وكان الغرض من هذه الدراسة هو تأثير فترة النقع في الماء لنشارة الخشب وإضافة الردح لرفع إنتاجية عيش الغراب في المواد العضوية الفقيرة. ونحو هذا الهدف تم إجراء تجارب كنما ت آراء مرتين:

التجربة الأولى: استخدمت فيها نشارة الخشب التي نقعت لمدة 24 ساعة في الماء في مقابل تلك التي نقعت لمدة 22 ساعة مع تغيير الماء كل 24 ساعة وظهرت نتائج هذه التجربة عدم نمو بيولوجي الفطر وبالتالي عدم الحصول على محصول من نشارة الخشب عندما زرت على نشارة الخشب التي نقعت في الماء لمدة 24 ساعة وان هذه فترة النقع مكنت الفطر من التموdale المكصول ثمر الفطر، مما يرجع أن هذه فترة النقع في الماء مع تغييرها كل 24 ساعة ربما أن ادى إلى إزالة بعض المواد العضوية لنمو الفطر وال موجودة في الخشب.

التجربة الثانية: بدأنا على نتائج التجربة الأولى فقد استخدمنا فيها لنشارة الخشب التي نقعت في الماء لمدة 24 ساعة مع تغيير الماء كل 24 ساعة، وتم اختيار تأثير إضافة الردح على تحسين خواص بيئة الزراعة وإنتاجية المشروم و تكونت هذه التجربة من خمسة معاملات:

1- نشارة الخشب مضافة لها 2 جرام سكرورز / كجم نشارة مبصلة بالإضافة إلى 5% ردة (من وزن نشارة الخشب المبصلة )
2- نشارة الخشب مضافة لها 2 جرام سكرورز / كجم من النشارة المبصلة (معاملة مقارنة)
3- نشارة الخشب مضافة لها 2 مل مولاس قصب السكر / كجم نشارة مبصلة بالإضافة إلى 5% ردة (من وزن نشارة الخشب المبصلة )
4- نشارة الخشب مضافة لها 2 مل مولاس قصب السكر / كجم نشارة مبصلة (معاملة مقارنة)
5- شرز أرز (معاملة قياسية مرجعية)

وقد أظهرت نتائج هذه الدراسة أن المعاملة من وزن نشارة الخشب المبصلة كانت أفضل المعاملات وتفوقت على المعاملة القياسية، نشارة الخشب المبصلة بالإضافة إلى النقع أثرت محصولها في جمعين فقط، وفترة انتاجية أقصر من المعاملة القياسية مما يمكن من الحصول على نتائج كثيف. وقد أشارت البيانات التي توقع البيانات المضاف إليها الردح مقارنة بناfel الاضافات، إلى تأثيرها على الزيادة في زيادة الإنتاجية وبالتالي وترجح إلى احتوائها على بروتينات وأحماض أمينية أدت إلى تحسين نمو الفطر وإنتاجيته إضافة إلى مصدر الكربوهيدرات المضاف (السكرورز ومولاس قصب السكر).

الفائدة التطبيقية للدراسة: هذه الدراسة تطبيًا مثالاً للإمكانية تحسين إنتاجية المواد العضوية الفقيرة عند استخدامها في نشارة عيش الغراب المحاري مما يرفع من كفاءة تدوير المخلفات الزراعية ويشجع الاستثمارات الصغيرة لأنتاج غذاء صحي وغير تقليدي