Plant Archives Vol. 19 No. 1, 2019 pp. 941-948 **e-ISSN:2581-6063 (online), ISSN:0972-5210**

EFFECT OF DIFFERENT ORGANIC NITROGEN SOURCES NUTRITION ON PRODUCTION, A SOME OF THE CHEMICAL COMPOSITION AND STORAGE ABILITY OF *PLEUROTUS OSTREATUS*

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Abstract

Two experiments were conducted in the project of fungi-Medicinal and Aromatic Plants Research Unit-College of Agricultural Engineering Sciences, University of Baghdad from 1/10/2013 to 30/3/2014. The spawn of white strain of oyster mushroom (*Pleurotus ostreatus* (Jacq. Fr.) was produced using tissue culture. Four different sources of organic nitrogen was added to theplastic bag after incubation stage at the following concentrations: Soybean seeds aqueous extract (F)concentrations 0 or 5% or 10% or 20% or Frenugreek seeds powder aqueous extract(HP)or Frenugreek seeds with out crush aqueous extract (HW) orThe fruit body powdered of oyster mushroom dryingeach concentrations following 0 or 3% or 6% or 9%. The results showed that the fresh and dry yield, the biological efficiency, dry matter percentage, production cycle, number of flashes, average of flash yield, %total sugar before storage, % protein and the phenolic compounds before storage significantly increased with using Frenugreek seeds powder aqueous extract (HP) 9% than control treatment. Also, using Frenugreek seeds powder aqueous extract (HP) 9% was recorded the lowest in percentage of protein loss (%), % dry matter loss, % total dissolved sugars loss, % weight loss and % total phenolic compounds loss after storage in fruit bodies of *Pleurotus ostreatus* than control treatment.

Key words : Nutrition, soybean seeds, frenugreek seeds and fruit body powdered of oyster mushroom drying, storage ability.

Introduction

Pleurotus ostreatus, commonly known as oyster mushrooms. It has been collected and consumed by people for thousands of years (Aroson, 2000; Staments, 2000). It is an edible mushroom, having excellent flavor, taste (Shah *et al*., 2004) and including a low content of calories and a high content of proteins, minerals and dietary fiber (Beluhan and Ranogajec, 2011). Oyster mushroom is becoming increasingly important and common in human diets, due to their nutritional (Bernas *et al*., 2006; Barros *et al*., 2008) and medicinal characteristics (Jedinak *et al*., 2010). Protein of oyster mushroom contains all of essential amino acids, which allows mushrooms to serve as meat substitute. As dietary food, mushrooms are comparable to vegetables. It has high vitamin B content and a low lipid content, which renders them nutritionally ideal for people, who have heart problems (Ghorai *et al*., 2009; Dundar *et al*., 2009). Agricultural residues used for oyster mushroom cultivation provide most of nutrients and vitamins for mycelium growth (AlBadray, 2010; Hassan, 2011; Upadhyay *et al*., 2002). Carbon is readily available from cellulose, hemicelluloses and lignin from straw but nitrogen occurs mainly in a bound form and is not available until it is enzymatically released (Lin *et al*., 2000). The nitrogen content of mycelium ranges between 3% to 6%. Cereal straw used for cultivation of oyster mushroom is a poor source of nitrogen (0.5-0.8%) and at the time of fructification when most of nitrogen is utilized for mycelium growth, the depleted nitrogen in the substrate becomes inadequate and limits mushroom yield (Upadhyay *et al*., 2002). Nitrogen is an essential elements for cellular functions for growth and various metabolic activities particularly protein and enzymes synthesis

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(Upadhyay *et al*., 2002; Nunes *et al*., 2012). The supplementation of the substrates with various sources of organic nitrogen, such as wheat bran, rice bran, maize waste water, soya cake powder and rice, has increased the biological efficiency (BE) of various species of basidiomycetes (Moonmoon *et al*., 2011; Loss *et al*., 2009). Frenugreek seeds considered good source of protein and carbohydrates because the chemical analysis of fenugreek seed showed that the contents of moisture, fiber, ash, protein, fat and carbohydrates were 4%, 6.50%, 3.20%, 28.55%, 4% and 62.48%, respectively (Elhadi *et al*., 2008). Table 1 shows the soybean seeds contents (Van Eys *et al*., 2004), so it was considered a good source of protein and carbohydrates which oyster mushroom was need for production. Organic sources of nitrogen can be easily used by fungi because the absorption of these molecules is more energetically efficient than synthesizing the molecules, which allow the fungi to obtain more energy for mycelium growth and mushroom formation (Nunes *et al*., 2012). The production of oyster mushrooms after the first flush is drastically reduced and there is a flush break of 10 to 20 days depending upon the species of oyster mushroom. In the present study, three aqueous water extract of different organic nitrogen materials were evaluated to found out their effect on yield ,storage ability and found out the optimum level of impact on production of oyster mushroom.

These experiments were conducted in the project of mushrooms production, Unit of medicinal and aromatic plants research, University of Baghdad, college of agricultural engineering sciences during 1/10/2013 to 30/ 3/2014. The pure culture of the oyster mushroom *Pleurotus ostreatus* strain PX22 from Jordan and simulated by fragmentation the tissue on potato dextrose agar to propagate and produce the mother culture (Oei, 2005). The fungal inoculums was headed on wheat grain media to produce spawn (Oei, 2005). The grinded wheat straw was used as media to grow the oyster mushroom. The wheat straw was dipped in 2% formaldehyde solution (concentration 37%) with Pavasten (antifungal) at 100 ppm (Oei, 2003; Muslt, 2002; with some modification), for 20 hrs. The wheat straw was dried in clean place to remove the excels humidity to get 50-60 relative humidity. Next day all wheat straw were bagged in clear polyethylene bags 30×51 cm, which contain 1 Kg of the straw 50-60% RH.

The spawn was inoculums at 5% to each bag at layer in the top of the bag and the either at the out side of the bag (Oei, 2005 with some modification). The poly ethylene bags closed and stored on the shelf's in raising room at 25±2 c to promote the growth with of mushroom mycelium and after the complement of growth, the bags open and lighting of 400 Lux was provided daily and ventilation for 4 hrs per day to reduce the CO_2 concentration during the production stage and also provide humidity suitable to the growth of the mushroom by using evaporator machine (80-90% RH). When the growth of the mycelium of mushroom reach the production stage, then we was carried the following experiments.

First experiment : The influence of different organic nitrogen sources nutrition on the production ability of oyster mushroom

This experiment was done when the mycelium growth on all bags were completed. We was prepared four different types of organic nitrogen aqueous water extracts according to Abdu-qader *et al*. (2014) method:

1- **Soybean seeds aqueous extract(F):** it was preparedby taking 1Kg of soybean seeds then were crushed by using coffee bean grinder, put the powder which was produced in medical gauze bag was added four liter of distil water to the bag, which put in aluminum container and left it 24 hrs after that was boiled the solution for 15 mins. After cooling,the solution pressed by hand. The resulting concentration of press was 20%(w/v). As follow as, the dilution were prepared : 0%, 5%, 10%, 20%.

2- **Frenugreek seeds powder aqueous extract (HP) :** It was prepared by taking 500g. of frenugreek seeds then were crushed by using coffee bean grinder, put the powder, which was produced in medical gauze bag was added two liter of distil water to the bag, which put in aluminum container and left it 24 hrs. after that was boiled the solution for 15 mins. After cooling, the solution pressed by hand. The resulting concentration of press was 9%(w/v) as follow as, the dilution were prepared : 0%, 3%, 6%, 9%.

3- **Frenugreek seeds with out crush aqueous extract (HW) :** It was prepared by taking 500gm. of frenugreek seeds with out crushed by using coffee bean grinder, put the seeds in medical gauze bag was added two liter of distil water to the bag which put in aluminum container and left it 24 hrs. after that was boiled the solution for 15 min. After cooling, the solution pressed by hand. The resulting concentration of press was 9%(w/v). As follow as, the dilution were prepared :0%, 3%, 6%, 9%.

4- **The fruit body powdered of oyster mushroom drying :** It was prepared by taking 500g. of fruit body of oyster mushroom drying then was crushed by using coffee bean grinder, put the powder in

medical gauze bag was added two liter of distil water to the bag, which put it in aluminum container and left it 24 hrs. after that resulting concentration of press was 9%(w/v). As follow as, the dilution were prepared :0%, 3%, 6%, 9%.

All these levels from different organic nitrogen sources aqueous extract were given to bag by Veterinary injector size 50 cm^3 after incubation stage was completed. The control treatment was injected with water only.

Second experiment : The influence of different organic nitrogen sources nutrition on the storage ability of oyster mushroom : The experiment was design to investigate the influence of fruiting bodies of oyster mushroom, which were produced from experiment one, 100 g of fruit body were weighted and put in plastic containers covered with plastic films and was stored at 2 ± 1^0C for three weeks in incubators conditioned size 20 equipped with a thermal regulator (Thermostat).

The studied characters

1. **Total yield for fresh fruit body :** The total yield of the fruit body was calculated depending on the basis of the fresh weight of the fruit body which were produced from all flushes for each bag depending on the substrate culture g/kg.
2. **% Dry matter :** It was taken 100g from fresh fruit body from each replicate before and after storage, then they were cut and derided according to (Dundar *et al*., 2009). The percentage of dry matter calculated from this formula:

   % Dry matter = dry weight for fruit body/fresh weight for fruit body×100.
3. **Total yield for dry fruit body:** it was calculated from this formula:

   Total yield for dry fruit body= fresh yield × % of dry matter.
4. **Biological efficiency (B.E):** It was calculated according this formula:

   %B.E = fruit body fresh weight(g)/substrate dry weight (g)×100 (Chang *et al*., 1981).
5. **Production cycle :** it was calculated from first flash to last flash.
6. **Number of flashes**
7. **Average of flash yield**
8. **% protein before storage :** It was calculated according to this formula:

   % protein = %N×6.25
9. **% protein loss** = pre storage % protein of fruit bodies-post storage % protein of fruit
10. **%weight loss =** Pre storage weight of fruit bodies-post storage weight of fruit/pre weight ×100.
11. **% dry matter loss** = pre storage dry matter of fruit bodies- post storage dry matter of fruit bodies.
12. **The percentage of phenolic compounded loss in fruiting bodies** : It was calculated according to this formula:

    % Total phenol loss = Pre storage phenol content-post storage phenol content/pre storage phenol content×100 .
12. **Determination of total dissolved sugars :** They were determined according to Phenol-sulphuric acid method, then standard carve was prepared according to Mahadevan and Sridhar (1986).
13. **% total dissolved sugars loss** = pre storage total dissolved sugars of fruiting bodies-post storage total dissolved sugars of fruiting bodies /pre storage total dissolved sugars of fruiting bodies×100.

Experimental design

The statistical analysis of first experiment was as complete randomize design (CRD) with 5 replicates for each treatments. But the second experiment was CRD with three replicates for each treatments (Al-Rawi and KhalfAlah, 1980). The comparison between the statically mean was done using L.S.D using SAS (SAS, 2012).

Results and Discussion

The effect of different sources of organic nitrogen nutrition on total yield of fresh weight (g), total yield of dry weight (g), dry matter (%), biological efficiency (%) and the production cycle (day) on the fruit body of *Pleurotus ostreatus*.

There is a significant influence of different sources of organic nitrogen nutrition on total yield of fresh weight, total yield of dry weight, % dry matter, % biological efficiency and the production cycle on the fruit body of *Pleurotus ostreatus* (table 2). The best treatment was HP9%. F20% and HW9% in which the total yield of fresh weight were 952, 950.8, 908 g respectively, but the control treatment gave the lowest total yield of fresh weight 488g. The treatment HP9% gave the highest total yield of dry weight 140.68g compared to the control treatment and the treatment of P3% which were recorded decrease on the total yield of dry weight 39.24, 42.84 g, respectively. The treatment of HP9% and F20% gave the highest percentage on dry matter, which was recorded 14.8%, 14.4%, respectively but the control treatment and the P3% were recorded the lowest percentage on dray

Table 1 : Basic nutrient and content of minerals (g/kg) in soybean seeds (Van Eys *et al*., 2004).

Nutrient(%)	Minerals (g/kg)		
Crud protein	37.08%	Ca	2.62
Crud ash	4.86%	P	5.70
Crud fat	18.38%	Mg	2.80
Starch	4.66%	K	15.93
N-free extractive	24%	Na	0.29
Acid detergent fiber	7.22%		
Neutral detergent fiber	12.98%		
Carbohydrate	31.85%		

matter, which were 8%, 8.4% respectively. The highest biological efficiency was recorded in two treatment, HP9% and F20%, which were 95.2%, 95.1% respectively compared to the control and P3% treatments which were recorded 48.8%, 50.8% respectively (table 2). While the treatment HP9% recorded a lower production cycle, which was 28.8 days compared to the control treatment which was recorded a highest production cycle 65.4 days.

The superiority of F20%, HP9% and HW9% over the other treatments on total yield of fresh weight was due to chemical compositions of soybean seeds (table 1) and Frenugreek seeds (Van Eys *et al*, 2004; Elhadi *et al*, 2008). Carbon is readily available from cellulose, hemicelluloses and lignin from straw but nitrogen occurs mainly in a bound form and is not available until, it is enzymatically released (Lin, 2011). The nitrogen content of mycelium ranges between 3% to 6%. Cereal straw used for cultivation of oyster mushroom is a poor source of nitrogen (0.5-0.8%) and at the time of fructification when most of nitrogen is utilized for mycelium growth, the depleted nitrogen in the substrate becomes in adequate and limits mushroom yield (Upadhyay *et al*., 2002). Nitrogen is an essential elements for cellular functions for growth and various metabolic activities particularly protein and enzymes synthesis (Upadhyay *et al*., 2002; Nunes *et al*., 2012).

The organic nitrogen source helped to increase of total fresh yield and dry weight, bio-efficiency and dry matter percentage (Loss *et al*., 2009; Nunes *et al*., 2012). This was attributed to the fact that organic nitrogen is easier to absorb and represent by basidiomycetes fungi and the effective absorption capacity of these organic compounds were larger than their molecular synthesis energy, allowing fungi to have more energy to use for growth and the formation of fruit bodies (Nunes *et al*., 2012).

The superiority of F20%, over the other treatment on total yield of dry weight was due to chemical compositions of soybean seeds (table 1) (Van Eys *et al*., 2004; Upadhyay *et al*., 2002) were indicated that the addition of 1% of soybean seeds powder to the agricultural subs treat of the oyster mushroom gave an increase on the total yield of fresh weight and dry weight, % biological efficiency and % dry matter. Any concentration higher than 1% has a negative effect. The 1% can be used to release heat that harms the innate primordial and could lead to its death (Gurjar & Doshi, 1995; Upadhyay *et al*., 2002). This explains were decrease in total yield on the basis of fresh and dry weight. The results in this study disagree with the conclusions of Upadhyay *et al.* (2002) may be because we used the aqueous extract of soybean seeds so it could not be used to release heat that harms the innate primordial or may be the mycelium that growth on the agriculture substrate could be absorption all the nutrients in this aqueous extract without release any heat because the raw material was ready to use by the mycelium of this mushroom.

The production cycle is an expression of the number of days from the first flash to the last flash. In order to obtain a commercial product with a short production cycle, the percentage of nitrogen in the agricultural substrate should be 0.7-0.9% of the dry weight of the substrate (Yildiz and Karakaplan, 2003), so as not to adversely affect the work of enzymes decomposition like Laccases Mn-peroxidases (Jafarpour *et al*., 2010; Upadhyay *et al*., 2002). However, many studies have shown that the agricultural substrate of wheat straw used for mushroom cultivation is a low concentration of nitrogen, containing 0.5% nitrogen and 42.16% carbon (Dundar and Yildiz, 2009). This ratio of nitrogen in the wheat straw is consumed at the beginning of the growth of the innate primordial in the incubation stage (Upadhyay *et al*., 2002). This explains the length of the production cycle when treated with the addition of distilled water alone (control treatment), which negatively affected the work of enzymes decomposition of lignin, cellulose and semi-cellulose (Jafarpour *et al*., 2010; Upadhyay *et al*., 2002).

The effect of different sources of organic nitrogen nutrition on number of flashes (flash), average of flash yield (g), % total sugar, % protein and the phenolic compounds content (mg.g^{-1}) in the fruit bodies of *Pleurotus ostreatus*

There is a significant influence of different sources of organic nitrogen nutrition on number of flashes ,average of flash yield, % total sugar, % protein and the phenolic compounds content in the fruit bodies of *Pleurotus ostreatus*. The best treatments were HW9% and HP9% in which on number of flash were 4.4, 4.6 flash but the control, P9%, P3% and F20% were recorded the lowest number of flash 1.4, 1.4, 1.6, 1.6g

Table 2 : The effect of different sources of organic nitrogen nutrition on total yield of fresh weight (g).total yield of dry weight (g), dry matter (%), biological efficiency (%) and the production cycle (day) on the fruit bodies of *Pleurotus ostreatus*.

Treatment	Total yield of fresh weight (g)	Total yield of dry weight (g)	Dry matter (%)	Biological efficiency (%)	Production cycle (day)
Control	488	39.24	8	48.8	65.4
F5%	684.4	70.88	10.4	68.32	37.6
F10%	805.2	101.44	12.6	80.52	34.8
F20%	950.8	138.92	14.4	95.1	29.6
HW3%	658	61.16	9.6	65.8	38.8
HW6%	772	90.72	11.8	77.2	36.2
HW9%	908	126.2	13.6	90.8	31.2
HP3%	744	78.84	10.6	74.4	36.8
HP6%	836	105.16	12.6.	83.6	32.4
HP9%	952	140.68	14.8	95.2	28.8
P3%	508	42.84	8.4	50.8	55.4
P6%	596	62.44	10.8	59.6	47
P9%	704	79.64	11.6	70.40	39.6
L.S.D0.05	57.603	8.978	0.740	5.75	3.43

Table 3 : The effect of different sources of organic nitrogen nutrition on number of flashes (flash), average of flash yield (g), % total sugar before storage, % protein and the phenolic compounds ($mg.g^{-1}$) before storage in the fruit bodies of *Pleurotus ostreatus*.

Treatment	Number of flashes (flash)	Average of flash yield(g)	% total sugar	% protein	Phenolic compound ($mg.g^{-1}$)
Control	1.4	348.6	3.78	20.2	0.134
F5%	3.2	213.9	6.06	29.0	0.137
F10%	2.4	335.5	7.18	47.6	0.156
F20%	1.6	594.3	7.92	35.2	0.146
HW3%	2.4	274.2	5.66	25.6	0.131
HW6%	3.0	257.3	7.70	33.8	0.148
HW9%	4.4	206.4	7.92	45.4	0.141
HP3%	2.4	310.0	6.82	28.8	0.145
HP6%	3.4	245.9	8.04	33.2	0.153
HP9%	4.6	207.0	8.64	47.8	0.160
P3%	1.6	317.5	4.88	23.2	0.130
P6%	2.4	248.3	5.54	25.4	0.142
P9%	1.4	502.9	5.88	30.0	0.149
L.S.D 0.05	0.738	187.3	0.506	1.798	0.011

respectively. The best treatment was F20% in which on average of flash yield was 594.3 g, which compared with all the treatments which gave decreasing in average of flash yield. The best treatment HP9% in the percentage of total sugar, percentage of total protein and the phenolic compounds content which was 8.64%, 47.8%, 0.160 mg $.g^{-1}$, respectively but the control treatment gave the lowest percentage of total sugar, percentage of total protein and the phenolic compounds content 3.78%, 20.20%, 0.134 $mg.g^{-1}$, respectively.

The superiority of HW9% and HP9% treatment over the other treatment on the number of flashes were due to increase the nitrogen content in the substrate which the mycelium need for growth. The nitrogen content of mycelium ranges between 3% to 6%. Cereal straw used for cultivation of oyster mushroom is a poor source of nitrogen (0.5-0.8%) and at the time of fructification when most of nitrogen is utilized for mycelium growth, the depleted nitrogen in the substrate becomes in adequate and limits mushroom yield (Upadhyay *et al*., 2002). Nitrogen is an essential elements for cellular functions for growth and various metabolic activities particularly

Table 4 : The effect of different sources of organic nitrogen nutrition onpercentage of protein loss (%), % dry matter loss, % total dissolved sugars loss, % weight loss and % total phenolic compounds loss after storage in fruit bodies of *Pleurotus ostreatus*.

Treatment	%protein loss	%Dry matter loss	%Total dissolved sugars loss	% weight loss	% Total phenolic compounds loss
Control	7.33	4.33	5.00	4.67	4.433
F5%	4.17	3.33	3.37	2.67	3.500
F10%	3.00	2.33	2.90	2.53	3.133
F20%	2.33	1.67	2.33	2.33	2.367
HW3%	3.00	3.33	3.33	2.97	2.500
HW6%	2.33	3.00	2.87	2.00	1.767
HW9%	2.00	1.33	2.53	1.67	0.900
HP3%	3.33	4.33	3.17	4.00	3.133
HP6%	3.17	3.67	3.10	3.80	3.000
HP9%	1.67	1.33	1.33	1.50*	2.767
P3%	4.00	3.67	4.33	4.00	3.467
P6%	3.00	2.67	3.00	3.33	2.767
P9%	2.00	2.00	2.67	1.67	1.900
L.S.D 0.05	1.4220	1.3700	1.2530	1.3250	0.4481

protein and enzymes synthesis (Upadhyay *et al*., 2002; Nunes *et al*., 2012).

The nitrogen element has an effective role in the synthesis of protein and enzymes responsible for the analysis of the straw and the formation of fruit bodies. Therefore, many studies recommended that optimal concentrations of aqueous extract and dietary supplements should be used to avoid inhibition of the growth of mycelium due to heat generated by increased metabolic processes (Abdul-Qader *et al*., 2014; Jafarpour *et al*., 2010; Upadhyay *et al*., 2002). The superiority of F20% treatment over the other treatments on the average of flash yield was due decreasing number of flashes in the seam treatment (table 3). The superiority of HP9% treatment in recording high total sugar percentage, total protein percentage and the phenolic compounds comparing with control treatment, which was recorded the lowest in sugar percentage, total protein percentage and the phenolic compounds may be because frenugreek seeds with out crush aqueous extract contents which was the best for mycelium developed fruit body production and the fruit bodies chemical composition from protein ,total sugar and phenolic compounds content in it before the storage.

The effect of different sources of organic nitrogen nutrition on percentage of protein loss(%), %dry matter loss, % total dissolved sugars loss, % weight loss and % total phenolic compounds loss after storage in fruit bodies of *Pleurotus ostreatus*

There is a significant influence of different sources of organic nitrogen nutrition onpercentage of protein loss (%), % dry matter loss, % total dissolved sugars loss, % weight loss and % total phenolic compounds loss after storage in fruit bodies of *Pleurotus ostreatus* (table 4). The best treatment were HP9%, P9%, HW6%, F10% and HW9% in which on protein loss percentage after storage were 1.67%, 2%, 2% 2.33, 2.33% respectively but the control treatment recorded highest in percentage of protein loss after storage of fruit body which was 7.33%. While the best treatments were P6%, F10%, P9%, F20%, HW9% and HP9% in which on percentage of dry matter loss after storage were 2.67%, 2.33%, 2%, 1.67%, 1.33%, 1.33% respectively compared with control treatment which gave highest in percentage of dry matter loss which was 4.33%. The best treatment HP9% in the percentage of dissolved sugar loss,percentage which was 1.33 but the control treatment gave the highest percentage of dissolved sugar, percentage 5%. The best treatments were HP9%, HW9%, P9% and HW6% in which gave the lowest on percentage of weight loss after storage were 1.50%, 1.67%, 1.67%, 2% respectively while the control treatment was recorded highest in percentage of weight loss after storage was 4%. The best treatment was HP9% in which gave the lowest percentage of phenolic compounds loss after storage was 0.900% compared with control treatment, which was recorded highest in percentage of phenolic compounds percentage after storage in fruit bodies, which was 4.433%.The superiority of HP9% treatment over the other treatments onpercentage of protein loss (%), % dry matter loss, %

total dissolved sugars loss, % weight loss and % total phenolic compounds loss after storage in fruit bodies of *Pleurotus ostreatus* compared with control treatment which was recorded highest in all attributes studied after storage. Loss of dry matter after storage is due to increased breathing speed (Madan *et al*., 1987; Suslow and Cantwell, 2006). In general, it can be said that the increase in fresh and dry yield and bio-efficiency when using the nutrition with the organic extract was not accompanied by an increase in the percentage of protein loss, loss of dry matter, total dissolved sugarsloss, loss of weight and loss of phenolic compounds content after storage (table 1).

These results confirm that the increase was not the result of water absorption only, but the increase was accompanied by an increase in dry matter and an increase in the proportion of protein in the fungi bodies (tables 2, 3), which improved the quality of the oyster mushroom as a result of nutrition with different sources of organic nitrogen. With several researchers reaching the conclusion that the use of support to the agricultural communities to produce the fungi helped to increase the protein in the fruit bodies of the fungi and reduced the percentage of protein loss after storage (Gurjar and Doshi, 1995; Wang *et al*., 2001; AL-Badrany, 2010; Abdul-Qader *et al*., 2014).

Conclusion

The best organic nitrogen sources in this research was HP9% treatment due to an effective on the production,a some chemical composition before storage and storage ability of oyster mushroom fruiting bodies.

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