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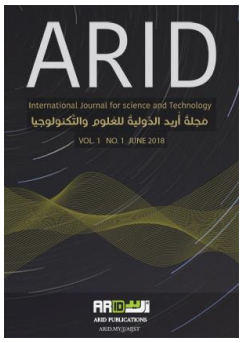

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THE EFFECT OF *CUMINUM CYMINUM* SEEDS IN INCREASING PRODUCTION AND IMPROVING THE QUALITATIVE AND QUANTITATIVE PROPERTIES OF IRAQI FUNGI *PLEUROTUS OSTREATUS*

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تاثير بذور الكمون *Cuminum Cyminum* في زيادة الكفاءة الإنتاجية وتحسين الخواص الكمية و النوعية للفطر المحلي العراقي *Pleurotus ostreatus*

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ABSTRACT

In this research, three different experiments were conducted to identify the effect of Cumin seeds water extraction on Iraqi local oyster mushroom *Pleurotus ostreatus* (ID: MF065714.1) regarding growth, production efficiency, and shelf life. The study found that improving antioxidant properties of the fungi played a positive role in raising production efficiency and prolonging storage age.

The first experiment was performed to identify the effect of different levels of water extraction from Cumin seeds powder (at concentrations of 5%, 10%, and 20%) on the oyster mushroom productivity. In the second experiment, storage capability for the fungi fruiting bodies was examined. The last experiment was done to study the effect of nutrition at the previous levels labeled (S0, S1, S2, and S3) in improving the antioxidant properties on the fruiting bodies before and after storage process.

The results of this research showed that nutrition content of cumin seeds water extraction (at a concentration of 20%) was the best in improving many properties such as wet weight (560.89 gm/ kg), dry weight (56.74gm/ kg), bioefficiency (56,08%), protein (30.60%), carbohydrates (38.20%) and phenolic substances percentage (0.424mg/g). In addition, nutrition content led to reduce the loss of weight percentage, protein percentage and carbohydrates percentage, as well as elongation fungus storage age by increasing its antioxidant capacity.

Keywords : Iraqi Fungi, *Pleurotus ostreatus,* , antioxidant , production efficiency, storage age.

الملخص

تم إجراء عدة تجارب للتعرف على تأثير المســـتخلص المائى لبذور الكمون في نمو وإنتاج الفطر المحاري المحلي العراقي *Pleurotus ostreatus* (ID:MF065714.1) . وقد تبين بشكل واضح الدور الإيجابي الذى يلعبه المستخلص المائي لبذور الكمون فى رفع كفاءة الإنتاج، وإطالة العمر الخزني للفطر المحاري في العراق من خلال تحسين فعلها المضاد للاكسدة.

في هذا البحث تم إجراء ثلاث تجارب مختلفة . التجربة الأولى : شملت دراسة تأثير التغذيه بمستويات مختلفة من المستخلص المائى لمســحوق بذور الكمون (5% , 10%, 20%) في القابلية الإنتاجية للفطر المحاري، والقابلية الخزنية للأجســام الثمرية للفطر كتجربة ثانية. بينما تناولت التجربة الثالثة تأثير التغذية بالمســتويات الســابقة والتى رمز لها(S3,S2,S1) في تحســين الفعالية المضادة للاكسدة للأجسام الثمرية الناتجة قبل وبعد عملية الخزن.

ومن خلال تلك التجارب تم التوصل إلى أن التغذية بالمستخلص المائي للكمون (في مستوى 20%) ساعد على تحسين العديد من الخصـــائص بدءًا من الزيادة الملحوظة فى كل من: الوزن الرطب (560,89 غم/كغم) , الوزن الجاف (56,74 غم/كغم), الكفاءة الحيوية (56,08%) , النســبة المئوية للبروتين (30,60%) الكاربوهيدرات (38,20%) والمواد الفينولية (0,42 ملغم/غم) . إضافة إلى تقليل نسبة الفقد فى الوزن و البروتين والكاربوهيدرات وصولاً إلى اطالة العمر الخزنى للفطر المحارى من خلال رفع قابليته المضادة للاكسدة.

1. Introduction

Pleurotus species are edible mushrooms, commonly known as oyster mushrooms with excellent flavor and taste [1]. Usually, they are not attacked by both diseases and pests, and their cultivation does not require sophisticated control at the growing environment. However, they are cultivated in a cheap and easy way. In addition, the mushroom can be used for livestock feed, extraction of enzymes, and medicinal compounds [2].

Oyster mushroom grows widely in the tropical and subtropical rainforests, and its cultivation has increased tremendously throughout the world during the last few decades [3]. It contains a number of nonspecific lignocellulosic enzymes [4] which have a major impact on the development and growth of the mushroom. The nature and nutrient constituent of the mushroom substrate also have an effect on the mycelium growth, mushroom quality and crop yield. That means, the existence of useful substrates is essential to promote satisfactory yield of the mushrooms [5].The useful substrates should consist of nitrogen supplement and carbohydrates in order to promote rapid growth of the mushroom [6]. In most cases, the substrates do not have nitrogen which is required by the mushroom to grow optimally. Hence the need for nitrogen supplementation is important to achieve ideal growth [7].

Cumin Cyminum is considered an effective supplement in improving mushroom's productivity and nutritional value of (carbohydrates, protein, fat, fiber, vitamins and mineral elements) [8]. Extracts that are obtained from Cumin seeds are also of medicinal importance due to their content of inhibitory substance of bacteria such as Limonene, α- ,β pinenes and methyl eugenol. On the other hand, Cumin water extracts are considered as antioxidants [8], [9].

Therefore, the aim of this study was to highlight the utilizing of Cumin Cyminum as a supplement to improve quantity and quality of the Iraqi oyster mushroom *(Pleurotus ostreatus*).

2. Material and Method

1- The research was carried out at the Mushroom Laboratory of Medical and Aromatic plant unit and Food Sciences Department, University of Baghdad.

2- *Pleurotus ostreatus* (ID: MF065714.1) spawn were activated using tissue culture method [10],[11]. Fungal spawn was grown on solid wheat seeds.

3- Disinfectants were prepared using 2% commercial formaldehyde (concentration 37%) and Bavistin fungicide in a concentration of 100 ppm were added to water.

4- Wheat straw was prepared after soaking it in water and used as a medium contained 1g/L nitrogen from urea and 0.3g/l potassium from potassium sulphate as nutrients.

Soaking process of the wheat straw was continued (about 20 hours), next day the wheat straw was spread in a clean place to remove formaldehyde by evaporation. The straw was packed in transparent plastic bags with dimensions of 30 x 51 cm. Each bag contained one kilogram of sterile wet straw (moisture about 50%). The pre-prepared fungal spawn were added (5% to each bag). After fastening the incubation bags, they were placed on dedicated shelves in an incubation chamber. The temperature of the incubation chamber was fixed at 2 ± 25 ° C until the growth of fungal tissue was completed on all the wheat straw bags (3 weeks). After that, the following experiments were performed:

Experiment (1): Effect of different levels of nutrition substrates of water extraction on potential production of oyster mushroom:

Cumin water extraction was prepared by mixing 1 kg cumin seeds with 4 litters of distilled water in a glass beaker, and then placed in an ultrasound device for 60 minutes with frequencies 40 khz / min at 40°C[12].

The water extraction was filtered through Watman filtration paper No. 1, the filtered water extraction was concentrated using a rotary evaporator device. Three concentrates were prepared 5, 10, and 20%, indicated by S1, S2 and S3, respectively, as well as the control (comparison) which is indicated as S0.

These concentrations were used and added to the mushrooms production medium in the plastic bags (completed fungal Mycelium growth). The additive process of the concentrations above was done by injecting the medium with 50 ml of the extract from four sides to ensure homogeneous distribution of the extract in the medium. This experiment was compared with an experiment of the production of mushrooms without treatment. Fruiting bodies were harvested whenever a reasonable amount of them were formed.

Experiment (2): Effect of nutrition substrates of the cumin seeds water extraction at different levels on the reservation capability of the oyster mushroom fruiting bodies:

100 g of homogeneous fruiting bodies obtained from the first experiment were taken and placed in plastic containers prepared for this purpose and sealed with transparent plastic films. Then, plastic films were stored in temperate incubators prepared for this purpose for two weeks at a temperature of 1 ± 2 ° C to determine the fruiting bodies storage ability. The required measurements were taken at the end of the storage period.

Experiment (3): Effect of nutrition substrates of the Cumin seeds water extraction at different levels in improving fruiting bodies antioxidant action before storage (experiment1) and after storage (experiment 2) by following the steps bellow:

a- Drying of Fruiting bodies: Fresh and stocked mushrooms fruiting bodies (from experiment 1 and 2) were cut into small pieces, and placed in perforated paper bags, then dried using thermal

ovens with air fan at 50°C till reaching weight stability. After that, the dried fruiting bodies were crushed using an electric mill. The powder was saved in sealed plastic bags.

b- Preparation of Water extraction: the method of Chechan and others [10] were followed by mixing 10 g of oyster mushrooms powder with 200 ml of distilled water and put in a shaker incubator for 24 hours at a temperature of 52°C. The solution was filtered through Watman NO 4 filter paper using funnel with discharge. The extraction was concentrated using rotary evaporator, and the obtained extraction was dried in a petri dish and put in an electric oven at 37 °C. Dried powder was scrapped and collected in clean and dry bottles and refrigerated.

c- Performance evaluation of dried extracts of oyster mushroom as an antioxidant:

Thiobarbituric acid (TBA) was estimated before and during storage according to the Abood method and others [13],[14]. The incubated mixture was prepared by mixing 100 ml of ethanol at a concentration of 95%, fatty acid linolenic at a concentration of 0.042 molar, 100 ml of phosphate buffer (PH 7), and 50 ml of distilled water. The mixture was placed in an incubator at 50 ° C for 15 days. This mixture represented zero experimental mixture.

The incubated mixture of the four extracts of the oyster mushrooms S1, S2, S3 and S0 obtained from (Experiment 1 and Experiment 2) consisted of the same previous content by adding 2 ml of each to 50 ml of distilled water.

Mononaldehyde concentration was estimated by mixing 5 ml of incubated mixture with 5 ml of TBA reagent (prepared by dissolving 0.2883 g TBA in 100 ml acetic acid in a test tube with stirring and heating in boiled water bath for 35 min). Optical absorption was read on a wavelength 538 nm, and the concentration was calculated using following mathematical equation:

Mononaldehyde concentration (ml/kg) = Optical absorption× 7.8

Characteristics studied:

1- Total fresh wet of fruiting bodies g/kg: This was done by collecting all the fruit bodies produced from one plastic bag containing half a kilogram of dry hay (1kg wet) and it was expressed on the basis of a gm / kg medium.

2- Percentage of dry material %: The dry material ratio was extracted using the following equation [15]:

% dry material = dry weight of fruiting bodies / fresh weight of Fruiting bodies × 100

3-Biological Efficiency %: This was measured according to the following [6]:

Biological Efficiency= fresh weight of Fruiting bodies / dry weight average × 100

4-Total dry weight (gm/kg) = Total fresh weight × percentage of dry material / 100

5-Harvesting number: Fruiting bodies were harvested whenever they were ready to be harvested. It was indicated as (number of harvesting per each duplicate).

6- Weight of fruiting bodies (gm): it was measured according to the following equation:

Weight average of a fruiting body = the total weight of fruiting bodies (gm)/ number of total fruiting bodies per each duplicate.

7-**Average of one harvesting yield (gm):** this was measured according to the following equation:

Average of one harvesting yield= the total of harvestings produced from one kg medium/ number of harvesting.

8-Production cycle (day) = number of the days from the first harvesting until the last harvesting per bag.

9- Percentage of protein%: The percentage of protein was estimated according to the method mentioned in [16]

10- Phenolic substances content of Fruiting bodies before and after storage: Phenols were estimated according to the method mentioned in [11].

11- Carbohydrate substances content of Fruiting bodies before and after storage: Total carbohydrates were estimated in the fruiting bodies according to the method mentioned in [16].

12- Weight loss after storage%: This was calculated according to the following formula:

Weight loss = the weight of fruiting bodies before storage - the weight of fruiting bodies after storage / the weight of fruiting bodies before storage x 100.

13- Damage after storage %: it consisted of the percentage of fruiting bodies that are not suitable for marketing; these damages were calculated according to the following equation:

% damage after storage= the weight of damaged fruiting bodies / Total fruiting bodies weight x 100.

14-The loss of dry materials after storage% = dry material percentage before storage - dry material percentage after storage.

15 Average weights of fruiting bodies (gm): This was calculated using the following equation:

Average weight of fruiting bodies (gm)= total weight of fruiting bodies / the number of fruiting bodies.

16- Protein loss after storage % = Percentage of protein before storage - Percentage of protein after storage.

17-Phenolic materials loss after storage = Fruiting bodies content of phenolic materials before storage - Fruiting bodies content of phenolic materials after storage.

18- Colour Change of fruiting bodies after storage: The change in the colour of the fruiting bodies was observed apparently by naked eye, the colours were divided into six degrees as follow:

1/ white, 2/ yellowish - white, 3/ creamy- yellow, 4/ creamy -brown, 5/ brown, 6/ dark brown. The fruiting bodies were considered physically damaged by the effect of undesirable coloration when its grade was more than 5 to 6 degrees.

19- The loss of carbohydrate content of the f**ruiting bodies** = carbohydrate Content of fruiting bodies before storage - carbohydrate Content of fruiting bodies after storage.

Experimental Design:

Experiments 1, 2 and 3 were analyzed according to the Completely Randomized Design (CRD) using five replicates for the first experiment, and three replicates for both second and third experiments. The averages were measured by least significant difference test (LSD) Significance level was considered as 5% for the tests using the SAS.

3. Results and discussion:

Results on wet and dry total weight, biological efficiency, and dry material percentage are illustrated in table (1). It was found that the total yield based on wet and dry weight increased by increasing the concentration of the water extraction of cumin seeds which reached 560.8, 56.74 g / kg medium in a concentration of 20% (S3). Due to the natural components of the cumin seeds, the increase did not reach saturation level. Also, an increase in the concentration of more than 20% was shown to cause difficulty in cumin seeds powder extraction by ultrasound. The result of the values of biological efficiency and dry material percentage showed continuous increase to 56.08 and 10.18% respectively in a concentration of 20%. This happened after mycelium growth at the end of the incubation stage and the beginning of the fruiting bodies formation, while the control treatment (S0) reached 37.22% and 6.50% respectively at the same concentration. Generally, the increase in the values of dry material and dry yield is an important issue for market needs when the product becomes dry, in this case it is sold as a dry product. This is how many farmers act when the production is increasing comparing with the market needs [5].

Table (1): Effect of nutrition at different levels of cumin seeds water extraction in improving the total yield of the oyster mushroom fruiting bodies before storage

Treatments	Total wet weight gm/kg medium	Total dry weight gm/kg medium	Biological Efficiency B.E%	Dry Material %
Control (S0)	372.2	33.18	37.22	6.50
Concentration 5% (S1)	372.8	25.34	37.28	8.72
Concentration 10%(S2)	416.8	32.98	41.68	8.02
Concentration 20%(S3)	560.8	56.74	56.08	10.18
L.S.D 0.05	150.07	14.332	15.007	1.313

The increase in the values of total wet and dry weight, biological efficiency, and dry material percentage were attributed to several factors; firstly, the nutrient content of cumin seed water extraction. The nutritional content is generally necessary for growth; this content includes protein, carbohydrate and mineral constituents, flavonoids, and alkaloids [8]. It has been detected by several researchers that organic nitrogen-based supplementations had a role in raising overall yield values based on the values of wet and dry weight, biological efficiency, and dry material percentage [16].

Secondly, effective absorption ability of organic supplements helped the fungi to have larger energy used in the growth and fruiting bodies synthesis [17]. Lastly, enzymatic system activity that is responsible for Mycelium growth on the medium was not affected negatively due to its content of organic supplements which did not cause any differential of the medium pH [6].

Table (2): The effect of nutrition at different levels of Cumin seed extract in the improvement of the harvesting, average of one harvesting yield, the number and average weight of fruiting bodies, and the production cycle before storage.

Treatments	No. of Harvestings (Harvestin)	Average of One Harvesting Yield (g)	Number of Fruiting Bodies (Body)	Fruiting Bodies Average Weight (g)	Production Cycle (Day)
Control (S0)	3.6	107.1	36.4	10.24	91
Concentration 5%(S1)	3.0	154.4	30.6	16.14	79
Concentration 10%(S2)	2.4	188.74	26.0	18.36	76
Concentration 20% (S3)	2.0	230.54	15.8	23.18	66
L.S.D 0.05	1.1803	65.922	9.0051	2.7339	6.3526

It can be observed from Table (2) that harvesting number decreased with the increase of the concentration of cumin seeds water extracts. At a concentration of 10% and 20%, the increase reached 2.4 and 2.0 harvestings respectively. While the harvestings number reached 3.6 in the control treatment. It was also observed that the use of high concentrations of cumin seed water extraction led to decrease of fruiting bodies number reached to 15.8 bodies at a concentration of 20%. On the other hand, the control treatment recorded a highest number of fruiting bodies reached to 36.4.

Table (2) also shows that the average of harvesting yield and fruiting bodies weight were increased by increasing the concentration of cumin seeds water extraction reached to 230.34 and 23.18 gm g respectively. While the previous values in the control treatment decreased to 10.24 and 107.1gm respectively. Moreover, the production cycle recorded a positive decrease by increasing the

concentration of cumin extract reached to 66 days at a concentration of 20%. Conversely, the production cycle was higher and recorded to be 91 days in the control treatment.

The above results can be explained according to the action of the important nutritional compounds of cumin seeds content including protein, carbohydrates and mineral elements [8]. In addition, these compounds played an important role in increasing the wheat straw medium decomposition process and exhausting its contents in a short time comparing to the control treatment.

The results in Table (2) are consistent with the findings of [18]. As these results confirmed that nutritional supplements added to the wheat straw medium had a positive role in raising the average of fruiting bodies weight and one harvesting yield, shortening the production cycle time, and reducing production costs. Carbon and nitrogen sources were variant, like molasses, crushed kernel dates, wheat bran, soybean meal, sugarcane, and consumed and none consumed licorice roots.

Table (3): The effect of different levels of nutrition of the Cumin seeds water extraction in improving the percentage of protein, carbohydrates and phenolic substances in the oyster mushroom fruiting bodies before storage

Treatments	Protein%	Carbohydrates%	Phenolic Substances mg/gm
Control (S0)	22.60	27.78	0.196
Concentration 5% (S1)	27.74	34.02	0.212
Concentration 10%(S2)	29.00	38.02	0.388
Concentration 20% (S3)	30.60	38.20	0.424
L.S.D 0.05	0.514	0.511	0.0095

In table (3), it is obvious that there was a significant increase in the nutrition content of the fruiting bodies; protein, carbohydrate and phenolic substances by the increase of the concentration of the Cumin seeds water extraction before storage. The values reached to 30.60, 38.20% and 0.424 mg / gm dry weight respectively in a concentration of 20%.

The above results were found by many researchers. On another word, the high nitrogen content obtained from wheat straw, crushed date kernel, soybean, and Bean seeds water extract, led to increase in the protein proportion in the fruiting bodies of the oyster mushroom [19].

Carbohydrates were found in fruiting bodies in various forms such as Chitin and hemicelluloses like mannans, xylans and Glucan. Carbohydrates played an important role in forming fruiting bodies which are very important to health and many treatments in humans [20]. Besides, the proportion of carbohydrates in fruiting bodies was found to be affected by the ratio and type of nutrients added to the medium. This also explained the reason for the increase in these components when using Cumin seeds.

Phenolic compounds are the most complex chemical compounds in fruits and they are important components of the fungus. These components are of medical benefits as antioxidants, antimicrobial agents, and antiviral drugs [12]. A group of researchers concluded that Cumin seeds water extraction also contained clicosides group. This explains the results obtained in this study that the increase in phenolic substances in the fruiting bodies was correlated to the increase of the concentration of Cumin seeds water extraction when it was used for the fungus nutrition.

Table (4) shows that different levels of Cumin seeds water extraction treatments recorded a significant decrease in the weight loss rate, dry material loss rate, protein loss rate, percentage of damage, phenolic materials loss, fruiting bodies change colour, and carbohydrate loss after storage: This was inversely proportional to the increased levels of Cumin seeds water extraction compared

to control treatment. The decrease in the studied traits was noticeable in the treatment with Cumin seeds water extraction at a concentration of 10 % and 20%, with a decrease in weight loss rate of 14.3% and 13.8 % respectively.

(S3) treatment with Cumin seeds water extraction showed lowest percentage of dry material loss after storage which reached to 2.2% compared to the control treatment, which recorded a significant increase in dry material loss after storage reached to 3.8%. (S3) treatment was significant among the other treatments as it helped to reduce the percentage of protein loss after storage reached to 1.53%. This treatment also contributed in reducing the damage rate of the fruiting bodies after storage to 0.3%. Also, the treatment with concentration of 20% Cumin seeds water extraction significantly exceeded the remaining levels of nutrition with Cumin seeds water extraction in preventing colour change of the fruiting bodies (Figure 1) after the process of storage which reached to 1.3. That means, fruiting bodies' white colour survived after storage process, while, control treatment showed a noticeable variation in the fruiting bodies colour (3.7 Creamy Brown) after storage.

Table (4): Effect of nutrition at different levels of Cumin seeds water extraction in weight loss percentage, dry material loss percentage, protein loss percentage, damage percentage, phenolic substances loss, change in body colour, and carbohydrates loss in the oyster mushroom fruiting bodies after storage.

Treatments	weight loss after storage %	dry material loss after storage %	protein loss after storage %	fruiting bodies damage after storage%	phenolic substances loss after storage %	colour change after storage	fruiting bodies carbohydrates loss after storage
Control (S0)	21.0	3.8	3.27	11.7	0.122	3.7	8.00
Concentration5%(S1)	15.1	3.3	2.43	4.3	0.080	2.7	3.8
Concentration10%(S2)	14.3	3.0	2.17	1.0	0.067	1.7	2.0
Concentration20%(S3)	13.8	2.2	1.53	0.3	0.047	1.3	1.8
L.S.D0.05	6.48	0.62	0.54	3.12	0.021	1.09	0.13

Figure (1): the colour of the oyster mushroom' fruiting bodies

It was also noticed that the value of phenolic materials in the treatment with a concentration of 20% was 0.047 mg / g dry weight. This value was significantly lower than the other nutritional treatments included control treatment after storage.

As for shelf life of the edible fungi, including *Pleurotus ostreatus*, it is considered short comparing to the other vegetables. The short shelf life of the fungi is due to many reasons; high rate of respiration, inability of the fungi to tolerate the high temperature after harvest, and lack of a waxy layer which usually protects fungi from physiological or microbial changes or water loss [21]. After storage process, major changes occurred for the following; weight loss, dry material, protein, fruiting bodies' colour change, phenolic substances, and damage. Evaporation and dry material consumption during breathing were the main cause of weight loss after storage. However, it can be confirmed that increasing in the concentration let to reduce the loss in dry material, weight, and protein after storage. As a result, chitin concentration of the oyster mushroom cells walls was increased [8]. This happened because of the positive correlation between the low percentage of weight loss and the increase in the nutrition concentration of Cumin seed extraction.

The decrease in protein loss was attributed to the content of cumin seeds of nutrition components [9] which were positively reflected on the fruiting bodies content of protein before storage. In general, the crop is considered damaged after storage if there is an apparent microbial or phylogenetic agent, such as cracking, secondary growth, colour change, or water collapse [10]. The treatment of 20% exceeded other treatment in reducing the fruiting bodies 'damage. This happened because of the substance content of cumin seed extract that inhibits the action of the bacteria responsible for damage during storage process.

After storage, the decline in phenolic materials was due to two reasons. Firstly, an enzyme which is responsible for coloration, this enzyme formed melanines by phenol oxidation through combining O-quinones. Secondly, brown colouring in the fruiting bodies led to a decrease in Phenolic substances content, the appearance of browning was thought to be caused by Polyphenol oxidase [22]. Other studies suggested that Tyrosinase was responsible for fruiting bodies browning after storage.

The results above might also due to the inhibitory substances for the oxidation enzymes action. Cumin seeds water extraction is commonly considered an antioxidant substance, because of the direct correlation between the content of the seeds of vitamin A, C, E and cumin seeds extracts capability as an antioxidant to reduce the activity of electrolytes or known as free radicals that causing browning. This led to a reduction in colour change by reducing phenolic materials loss ratio during storage [8].

In figure (2) the effect of the pre-storage samples for the treatments S0,S1,S2,S3 as antioxidants is shown, by estimating the value of thiobarbituric (melonaldehyde (mg) / of linoleic acid (kg). Generally, TBA method is a common method to measure and follow the progress of oxidation and the formation of Malonaldehyde compound. The estimation was done based on a complex composition between mononaldehyde and TBA, in which the red color increased with the increase of oxidation [14].

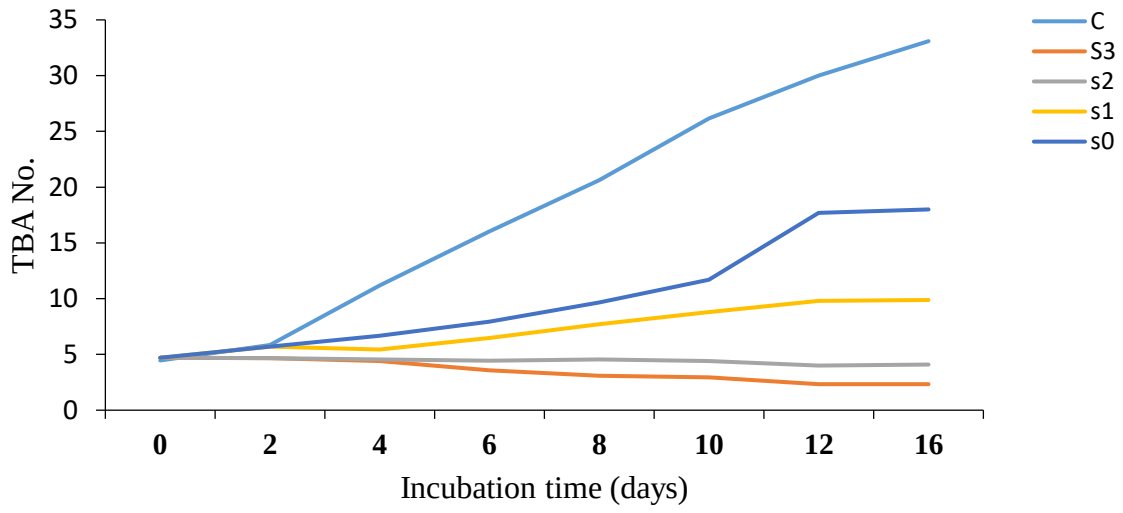

Figure (2): Values of thiobarbituric acid in linolenic acid, added to oyster mushroom sample Pre-storage treatment (S0, S1, S2, S3) (under study)

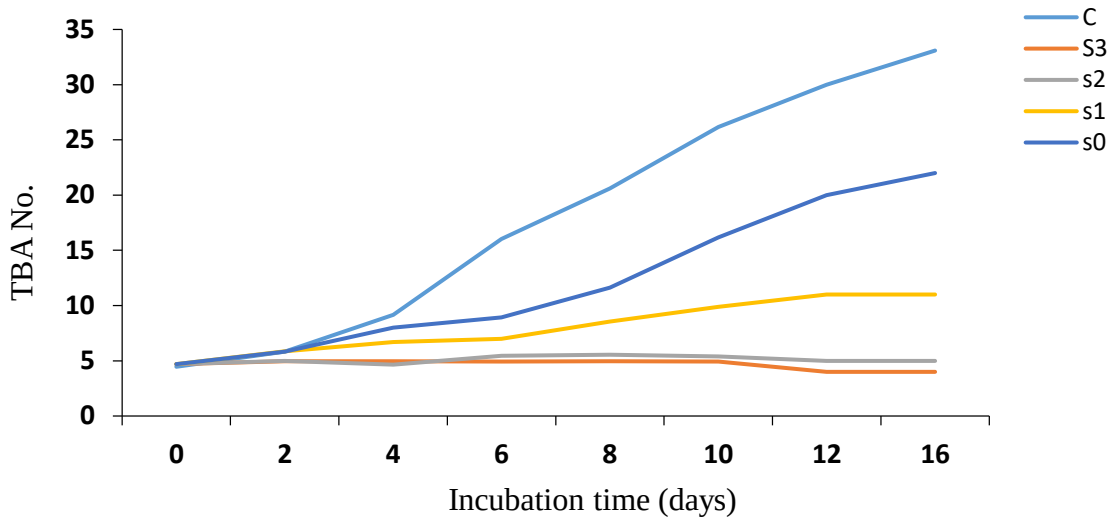

Figure (3): Values of thiobarbituric acid in linolenic acid, added to oyster mushroom samples After storage treatment (S0, S1, S2, S3) (under study)

The oxidation process of unsaturated fatty acids was done by incubating the sample in a suitable temperature (high heat) of 50°C.To study the resistance of the incubated mixture and their ability to prevent oxidation, the incubation process continued for 16 days at the temperature above. It can be also seen from the figure a reduction in TBA for the fatty acid mixture and the S3 treatment with 3.32melonaldehyde (mg) /fatty acid (kg) during 6 days of incubation. Before incubation, the value was 4.7melonaldehyde (mg) / fatty acid (kg). The reduction in TBA continued to reach 2.22Malunaldehyde (mg) / fatty acid (kg) after 16 days of incubation compared to control treatment(C), which showed a continuous increase in the value of thiobarbituric acid amounted to 32.22 melonaldehyde (mg) / fatty acid (kg) in day 16.

(S3) treatment was found to be a superior treatment compared to the control treatment in reducing the TBA value of the fatty acid with the same samples of the fungus (Experiment No. 2), in which the fungus was subjected to storage. (S2) treatment reached to 3.88 melonaldehyde/ (kg) after 16

day of incubation. TBA value of the control treatment after the same incubation period was 32.22melonaldehyde (mg) / fatty acid (kg).

In conclusion, the results obtained from this study indicated that nutrition with cumin seeds water extraction at a concentration of 20% for oyster mushroom raised its antioxidant action. The cumin seeds were characterized by its high content of antioxidant properties, and many phenols which enriched the fruiting bodies. Phenols usually act as materials for hydrogen electron, which works to curb the free radicals, as well as its role as substances corrosive to minerals (9). These were the characteristics of the mushroom samples, which were fed with cumin seeds water extraction in a concentration of 20% to be a natural source in effective antioxidants

4. Conclusions:

Our study suggests using Cumin seeds water extract at level 20% and its role on the growth and production of Iraqi local oyster mushroom *Pleurotus ostreatus.* was helpful with improving many properties such as wet weight, dry weight, bioefficiency, protein,carbohydrates and phenolic substances percentage. In addition, nutrition content led to loss reduction in weight percentage, protein percentage and carbohydrates percentage, as well as elongation fungus storage age by increasing its antioxidant capacity.

List of Abbreviations

Thiobarbituric acid	TBA
Completely Randomized Design	CRD
least significant difference test	LSD
Control	(S0)
Concentration 5%	(S1)
Concentration 10%	(S2)
Concentration 20%	(S3)

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