Nutritional Quality of some Species of Mushrooms Cultivated in Egypt

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Abstract

The chemical structure and nutritive value of two edible mushroom species (Agaricus bisporus A.B. and Pleurotus Ostreatus P.O.) were examined. The dried mushroom contained 33.85% and 26.07% crude protein in the A.B. and P.O., respectively. Amount of crude fat in mushroom kinds (A.B. and P.O.) were virtually equal and had 2.40% and 2.77% value, respectively. Also, different chemical structure measures were in the next ranges: water content from 11.80% to 9.65%, ash 7.89% - 5.84%, fiber 13.20% - 8.24% and carbohydrate 42.66% - 57.10% for (A.B. and P.O.) respectively. Protein in both of dried mushroom were somewhat decreased than **FAO/WHO (1973)** in total essential amino acids (EAA). The total EAA measurements of dried mushroom (A.B. and P.O.) were 44.97 and 39.37gm/ 16gm N, respectively. Also, dried mushroom A.B. and P.O. oils showed larger quantities of unsaturated fatty acids (UFAs). Total phenols and antioxidant activity in dried A.B. were greater than that in P.O. the findings suggested that nutrient rich mushroom powder under examination might be effective in the development of diverse diet items. Many studies have confirmed that the bioactive compounds isolated from A.B. are promising for drugs against some deadly diseases. Therefore, an increasing trend in the use of A.B. has been observed due to its robust medicinal properties like anticancer, antioxidant, anti-diabetic, antimicrobial and anti-obesity activity. The protein present in P.O. fruiting bodies has anti-HIV activity, whereas Laccase extracted from this fruit body is capable of inhibiting the entry of Hepatitis C virus into the peripheral blood cells.

KeyWords: Nutritional Quality – Species – Cultivated

Introduction

Mushrooms have been utilized as food and food-flavoring substance in soups and sauces for ages, owing to their distinctive and mild taste. The presence of large levels of protein, carbohydrates and fibers and low-fat levels is frequently cited in connection to their nutritive benefits **(Barbara *et al.*, 2008)**.

Mushrooms are important health foods as they are low in calories, lipids, and essential fatty acids (FA), and rich in vegetable protein's, vitamin and minerals **(Manzi *et al.*, 2001** and **Agrahar- Murugker and subbulakshmi, 2005)**.

Mushrooms have a longstanding history with people and give substantial biological and socioeconomic influence. From olden history, wild mushrooms have been utilized by people with care possibly, for their flavor and allure. **(Das, 2010)**.

According to the report of **krishnamoorthy, D. and Sankaran, M (2014)** mushrooms have significant dietary properties with high amounts of proteins, minerals, vitamins, and fiber. **Dipan *et al.*, (2018)**, revealed that mushrooms are represented as a necessary diet, which can bring health advantages further than usual nutrients they provide. **Amaal's, Mohammed. *et al.*, (2018)** reported that mushrooms, despite the enormous heterogeneity seen among species constitute an intriguing dietary component that can promote the formation of a well-balanced diet.

Mushroom *(Agaricus bisporus)* is highly in elements including carbohydrates, fats, amino acids (AA) and mineral, potentially protects from cancer, obesity, and inflammation and has antioxidant properties **(Muhammad Usman *et al.*, 2021)**.

Mushrooms have been one of the major significant sauces of useful diet and medications in current year **(Grimm, D. and Wosten, H. A., 2018)**.

Several nutraceuticals and medicinal mushrooms that have been developed to be beneficial to human healthcare as food, medicine, minerals, and drugs, among others, have made mushrooms a boon for advances in the fields of food, pharmaceutics, and joblessness in developing countries with a high biodiversity, such as index **(Wani *et al.*, 2010)**. This research was conducted to evaluate the approximate structure and nutritive values of two mushroom species.

Materials and methods

- **Materials**:

Mushroom specimens of the two distinct palatable mushroom types were utilized. *Agaricus bisporus* and *pleurotus ostreatus* were acquired from Food Technology Research Institute Agriculture Research center, Giza, Egypt.

- **Methods:**

Preparation of mushroom:

The two types of mushrooms were grown using the "layer spawning" technique. Recently collected, entire mushrooms were shade-dried for three days and **then** ground into a fine powder.

Analytical methods:

Gross chemical structure: **A.O.A.C. (2005)** procedures were utilized to measure water, protein, fat, fiber, ash, soluble carbohydrate profile which calculated by difference, and mineral contents.

AA determination: The AA analyzer LC 3000 was utilized to evaluate AA in hydrolyzate.

FA determination: Gas liquid chromatography (GLC) was utilized to examine the FA content. Before GLC tests, the oil was etherified following the procedure outlined by **Stahle (1967).**

Determination of total phenolic:

Using Folin – Ciocalleu's reagent, the total phenolic content was calculated **(Obanda and Owuor, 1997** and **Singloetion and Rossi, 1965).**

Antiradical activity against DPPH:

Depending on the radical scavenging ability of the stable DPPH radical, the antioxidant capacity of a plant extract and a standard were evaluated **(Guendet, M.,** ***et al*****., 1997).**

Determination of total flavonoids:

Total flavonoids was measured based on **Kumar** ***et al*****., (2008).**

Determination of some vitamins:

Vitamin E, A, C and B were determined according to **Pyka and Sliwiok (2001), Noll, (1996), Romeu. Nadal** ***et al.,*** **(2006)** and **Batifoulier** ***et al.,*** **(2005).** Using HPLC**.**

Results and Discussion

Chemical composition ***of*** **dried mushroom varieties:**

The proximate structure of mushroom types (*pleurotus ostreatus* and *Agaricus bisporus*) are presented in **table (1)**. Dried *Agaricus bisporus* had more protein than *pleurotus ostreatus*. Dried. *A. bisporus* and *B. ostreatus* had 33.85% and 26.5% protein, respectively. This study may increase the attention in using dried mushroom types as a highly-protein dietary ingredient. In general, our findings were marginally superior to those published by **Sanmee** ***et al.,*** **(2003)**, for *P.ostreatus* (24.2%) and inferior to those published by **Vetter and Rimoczi (1993)** for P.O. (34.4%).

Various variables as mushroom strain / type, content of growing medium, timing of harvest, management practices, handling circumstances, and preparing of substrates have been documented to affect the protein content of mushrooms **(Manzi, *et al.*, 2001).** The fat content of (A.B and P.O) dry mushroom varieties was comparable at 2.40 and 2.77 %. These statistics are supported by **Bano and Rajarathanam. (1982)**, they discovered that the amount of crude fat of *Pleurotus* species ranges from 1.08 to 9.4%, with an average of 2.85%. In addition, **Hanj unathan *et al.*, (2011)** found that the fat content of four varieties of wild mushrooms varied from 0.74 to 2.25% by weight.

Agaricus bisporus had higher fiber and ash content than P.O. The measurements of fiber and ash were 13.20% and 7.89% for A.B., and 8.24% and 5.84 % for P.O. respectively. These measurements are generally consistent with those of **Bernas and Jaworska, (2010).**

Total carbohydrates were more in *pleurotus* than in *Agaricus*. P. had 57.40%, whilst A. contained 42.66%. According to Kumar et al. (2013), the carbohydrate content of 15 chosen Indian mushrooms varied from 32.43 to 52.07%. These findings are in line with their findings.

Table (1): Chemical composition of dried mushroom varities

Components %	**Mushroom varities**	
	Agaricus bisporus	**Pleurotus ostreatus**
Moisture content	11.80	9.65
Protein	33.85	26.05
Fat	2.40	2.77
Fiber	13.20	8.24
Ash	7.89	5.84
Total carbohydrates*	42.66	57.10

*Total carbohydrate by difference.

Minerals composition of dried mushroom varieties:

Elements structure of mushroom types (A.B. and P.O.) is presented in **table (2).** Differences were observed between A.B. and P.O. in their minerals content. Compared to A.B, P.O included more sodium, phosphorus, magnesium, and calcium. In all study specimen, A.B. had a greater potassium concentration (3867.5 mg/100 g) than P.O. (3133.9 mg/100 g) as the primary inorganic ingredient of the ash. These results concur with **Manjunathan et al. (2011)**, who observed a potassium content of 90.8% in the mineral content of farmed mushrooms. Consequently, dried mushrooms might be added to cereal flour in order to increase its Ca and K content.

Trace element levels across mushroom types are comparable and within recommended nutritional requirements. P.O. exhibited a greater concentration of all microelements (except potassium) compared to A.B. The A.B. variety exhibited a greater concentration of all macro-elements. Iron concentrations in all specimens varied from 40.8 to 55.9 mg/100 g. This information is consistent with that published by **Manjunathan et al (2011).** Selenium concentration varied from insignificant quantities in P.O. (8.5) to very increased ones in A.B. (12.1).

Table (2): Mineral contents of some dried mushroom varities (on dray weight basis)

Components (mg/l00g)	Agaricus bisporus	Pleurotus ostreatus
Sodium	30.9	45.9
Phosphorus	466.4	754.2
Potassium	3867.5	3133.9
Magnesium	118.2	147.8
Calcium	225.7	266.8
Manganese	5.1	1.1
Zinc	35.7	14.9
Iron	55.9	40.8
Selenium	12.1	8.5

Amino acids of dried mushroom varieties:

The AA composition of dried mushrooms is provided in **table (3)**. The AA makeup of P.O. and A.B dry mushroom varieties (excluding lucine, isoleucine, and Cysteine + Methionine) differed somewhat. P.O. and A.B protein concentrations of all essential amino acids (EAA) were marginally lower than **FAO / WHO (1973)** standards. A.B and P.O dry mushroom varieties had total EAA concentrations of 44.97 and 39.37gm/16gm.N, respectively. These findings were comparable to those of **Gupta and Sing (1991)**, who found that the total EAA content of P. *pleurotus* was 41.4%. P.O and A.B varieties of dried mushrooms have somewhat greater measurements than **FAO/WHO (1973)** published Tyrosine and phenylalanine as AA. Aspartic and glutamic were the major prevalent non- EAA in the two types, whereas glycine, arginine, and proline were the lowest. In P.O., these AA represented 11.40%, 16.05%, 5.19%, 5.30%, and 6.44% of total AA, however, in A.B, the proportions were as follows: 10.0%, 14.22%, 4.22%, 4.27%, 6.0%, and 5.70%. **Guo et al. (2007)** discovered that aspartic acid was the major prevalent non-EAA in dried *pleurotus* mushroom, accounting for 19% of total AA. Also, **Mattila et al. (2002)** revealed that P.O. mushrooms had greater aspartic acid contents than other edible mushrooms.

Table (3): Amino acid composition of dried mushroom varities:

Amino acids	Agaricus bisporus	Pleurotus osteratus	FAO/WHO (1973)
Histidine	3.66	3.56	2.60
Isoleucine	4.85	3.66	4.60
Leucine	8.22	5.80	9.30
Lysine	5.40	5.20	6.60
Cysteine +Methionine	3.55	2.40	4.20
Tyrosine + phenylalanine	8.50	8.39	7.10
Threomine	3.96	3.65	4.30
Tryptophon	1.88	1.84	1.70
Valine	4.95	4.87	5.50
Total essentially A.A	44.97	39.37	46.00
Arginine	6.00	5.30	
Aspartic	10.00	11.40	
Glutamic	14.22	16.05	
Serine	6.33	7.99	
Porline	5.70	6.44	
Glycine	4.27	5.19	
Alanine	8.98	8.50	
Total nonessentials A.A.	55.50	60.87	

Fatty acids composition of dried mushroom varities:

The composition of FA in A.B. and P.O dry mushroom varieties is presented in **Table (4)**. A.B. and P.O. varieties of dried mushrooms showed greater levels of unsaturated fatty acids (UFAs), accounting for 89.58 and 86.78% of total FA, respectively. The primary UFAs in A.B. and P.O. were linoleic 62.53-7.89% and oleic 23.5-10.66%, respectively. Compared to proteins and carbohydrates, mushrooms have extremely little fat. UFAs predominate among the lipids in mushroom fruiting bodies. The incresed concentrations of UFAs, particularly essential FA, enhance the nutritive benefits of mushroom oils.

Oils derived from mushroom types are high in both oleic and linoleic acids; these oils have great semi-drying qualities and may be utilized as a brilliant palatable cooking oil, salad oil, or in the production of margarine **(Gaafar, 1995).**

Table (4): Fatty acid composition of dried mushroom varities

Fatty acids	Agaricus bisporus	Pleurotus ostreatus
Myrisitic (14.0)	0.49	0.40
Palmitic (16.0)	12.40	10.10
Stearic (18.0)	4.79	2.66
Oleic (18.1)	10.66	23.51
Linoleic (18.2)	70.89	62.53
Linolenic (18.3)	0.44	0.88
Total saturated fatty acids	12.49	10.50
Total unsaturated fatty acids	86.78	89.58

Some vitamin content of dried mushroom varities:

Table (5) shows some vitamins profile in the dried mushroom varities. Dried mushrooms varities A.B. demonstrated the high vitamin content. D, E, and A (4,140, 0,690, and 3,490 mg/100 g) are higher than P.O. Alternatively, dried mushroom P.O has a high concentration of vitamins C., folic acid, and B6 (52,441, 120,210, and 78,110 mg/100gm, respectively). Mushrooms are a rich supply of vitamins, particularly vitamin B **(Mattila *et al.*, 2000)**. According to **Murcia et al. (2002)**, mushrooms contain relatively high levels of vitamin A, vitamin C, and beta-carotene, that possess beneficial benefits due to their antioxidant qualities.

Significant and well-documented biological functions of vitamins include their powerful antioxidant and free radical scavenging properties **(Grassman, *et al.*, 2002).** In addition, **Mattile et al. (2002)** stated mushrooms are the sole non-animal source of vitamin D, making them the only natural vitamin D supplement for vegetarians.

Table (5): Some Vitamin content of dried mashroom varities

Vitamins (mg/ 100g)	Agaricus bisporus	Pleurotus ostreatus
Vit. A	3.490	1.289
Vit. E	0.690	0.185
Vit D	4.140	0.299
Vit C.	39.080	52.441
Folic acid	110.00	120.210
Vit. B6	41.210	78.110

Total phenols, flavonoids and antioxidant activity of dried mushroom verities.

Table (6) shows total phenols, flavonoids and antioxidant activity of dried mushroom varities. (A.B. and P.O.) the findings demonstrated that total phenols in A.B were higher than that in P.O. The total phenols in A.B was 18.95 mg/ gm., meanwhile of P.O was 13.76 mg/ gm. In general, the measurements acquired in this investigation were somewhat decresed than those investigated by **Mau et al., (2002)**, who discovered the greatest total phenol concentrations in mushroom types varied from 64.45 to 68.24% however, our findings are consistent with **Barros et al. (2008)**, who discovered phenols were the most abundant antioxidant elements in the five *Agaricus sp*. Flavonoids are phenolic compounds that exist naturally in plants. It is known that flavonoids and related compounds contain powerful antioxidant effects (**Dziedzic and Hudson, 1983)**. There was no significant variance in flavonoids content among A.B. and P.O. dry mushrooms, according to these results. The same table displays the DPPH measurements obtained during tests for the antioxidant activity of A.B and P.O mushrooms. A.B was the most effective type in terms of antioxidant activity, with a value of 20.33, whereas P.O. exhibited lesser antioxidant qualities, 15.82, which are consistent with its lower phenol concentration.

Table (6): total phenols, flavonodes and antioxidant activity of dried mushroom varities

	Agaricus bisporus	**Pleurotus ostreatus**
Total polyphenol (mg/ g)	18.95	13.76
Flavonides (Mg.g)	3.99	4.84
DPPH	20.33	15.82

This research demonstrated that these mushroom varieties are rich in protein and carbohydrates. A number of beneficial minerals and AA have also been found, find it extremely helpful in several dietary combinations. Additionally, having a high total phenol level and significant antioxidant activity.

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الجودة الغذائية لبعض أصناف المشروم المنزرعة في مصر

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الملخص العربي

تم دراسة التركيب الكيماوي والجودة الغذائية لنوعي المشروم القابل للأكل والمنزرع في مصر (A.B. and P.O.)، حيث سجل البروتين الخام في نوعي المشروم المجفف (A.B. and P.O) 33.85 % ، 26.05% على التوالي، بينما سجل الدهن الخام 2.40% و 2.77% على التوالي لنوعي المشروم.

كما أظهرت النتائج التى تم التوصل إليها أن محتوى الرطوبة كان فى مستوى من 11.80% إلى 9.65% والرماد من 7.89% إلى 5.84% والألياف من 13.20% إلى 8.24% والكربوهيدرات من 42.66% إلى 57.10% في (A.B. and P.O.) على التوالي، كما لوحظ أن بروتينات نوعي المشروم المجفف كانت أقل قليلاً من (1993) FAO/WHO من مجموع الأحماض الأمينية الأساسية . كما بلغ إجمالي قيم الأحماض الأمينية الأساسية لنوعي المشروم المجفف (A.B. and P.O.) 44.97 و 39.37 جم /16جم نتروجين على التوالي.

وكانت الزيوت في نوعي المشروم المجفف أيضاً تحتوي على كميات أكبر من الأحماض الدهنية الغير المشبعة، وظهر أن إجمالي الفينولات والمواد المضادة للأكسدة النشطة في .A.B كانت أعلى من الموجود في.P.O. وقد أظهرت النتائج أن هذه المكونات الغذائية الغنية في مطحون المشروم قد تكون مفيدة في الحصول على منتجات غذائية جيدة.

قد أكدت العديد من الدراسات أن المركبات الحيوية النشطة المعزولة من .A.B ومعدة للأدوية ضد بعض الأمراض القاتلة ولذلك لوحظ اتجاه متزايد فى استخدام .A.B بسبب خصائصه الطبية القوية مثل مضاد للسرطان، مضاد للأكسدة، مضاد للسكرى، مضاد للميكروبات ومضاد للسمنة.

والبروتين المتواجد فى أجسام .P.O المثمره له نشاط مضاد لفيروس نقص المناعة البشرية فى حين أن اللاكاز المستخرج من هذا الجسم المثمر قادر على منع دخول فيروس التهاب الكبد C الى خلايا الدم.

الكلمات المفتاحية : الجودة الغذائية – أصناف – المنزرعة