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Research article

MINERAL CONTENTS IN *PLEUROTUS* (OYSTER MUSHROOM): ASSOCIATION OF COOKING METHOD

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ABSTRACT: As conditions of mushroom producing has the great effect on their mineral contents and quality of nutritional value and also consumption and cultivation of mushrooms has been increased remarkably in recent years in Iran , this research builds upon: Determination and comparing essential mineral contents: Iron, Copper, Zinc, Selenium, Calcium and Manganese as the nutritional value in mostly consumed brands of packaged Oyster mushrooms (*Pleurotus)* samples purchased from Tehran markets and Investigation the effect of cooking method (raw, cooked, fried, micro waved), in mineral contents in Oyster Mushroom samples and find the best method of cooking. 880 samples from the 4 most famous brands of Oyster mushroom packaged were purchased in all different weight packaged available in market from creditable brands in Tehran, Iran in winter 2013 and 2014. The samples were analyzed by wet digestion method and standardized international protocols were followed for the preparation of material and analysis of the metal contents by Flame Atomic Absorption Spectrophotometer. Results revealed that even in the same season and same time of studying, there was a wide range of essential metal contents in different brands. The mean content of all studied essential elements in all samples would be decreased according to the microwaved cooking methods while frying method enhanced all of them. The reaction of Calcium content to microwaving was much higher than other elements (p 0.001).
Keywords: Oyster mushroom, *Pleurotus*, mineral contents, cooking method.

INTRODUCTION

Most mushrooms have high protein content, usually around 20-30% by dry weight. This can be useful for vegetarians or anyone looking to increase the protein content in their [1, 2]. Mushrooms are used in folk considered as one of the curiosities of nature and many of medicine throughout the world since ancient times as 'the mare widely consumed for their ultimate health food' [3, 4]. Mushrooms have long been appreciated as an important source of bioactive compounds of medicinal value [5, 6]. It was reported that trace element concentrations in mushrooms are considerably higher than those in agricultural crop plants, vegetables, and fruits [7, 8]. Effective compounds, present in the mushrooms possess antioxidant, antibacterial, immune enhancing, and stress reduction activities [9, 10]. In the world of medicinal mushrooms, *Ganoderma* is number one and has been considered as king of medicinal mushrooms followed by *Lentinula* and others including *Pleurotus*, the later produces oyster mushroom [4]. Tam and his collogues proved hypotensive activity of *Pleurotus* in mouse model in 1986 [11] and Nanba in 1993 shown the its anti-tumor property [12] and some other studies indicated medicinal potentialities of *Pleurotus* mushroom [13, 14]. Pleurotus sajor-caju inhibits hypertensive effects through its active ingredients, which affect the renin-angiotensin system [13,14]. *Pleurotus ostreatus* ameliorates atherogenic lipid in hypercholesterolemia rats [15]. P. *ostreatus* also possesses antitumor activity [16] and it has hypoglycaemic effects in experimentally induced diabetics [17] and human subjects [18]. *Pleurotus florida* has antioxidant and antitumor activities in experimental animals [19-20]. Methanol extracts of *P. florida* inhibits inflammation and platelet aggregation [20]. Water extracts of the fruiting bodies of P. sapidus have antibiotic activity especially on *Staphylococus aureus* [21].

Pleurotus cystidiosus is strong Antioxidant [22]. It is well known that a balanced diet is essential in maintaining good health. Hence, the Nutritional value of foods is an important aspect that should be considered especially with respect to metal intake such as iron, calcium, magnesium, potassium, sodium, selenium, Manganese, copper, chromium and zinc [23]. Successful mushroom production depends upon proper maintenance of pure culture and spawn capable of providing higher yield of quality mushrooms [24] and conditions of mushroom producing has the great effect on mineral contents and quality of nutritional value and the consumption and cultivation of mushrooms has been increased remarkably in recent years in Iran due to the high price of red meat, fish and other proteins [2, 25, 26], this research builds upon:

- Determination and comparing essential mineral contents: Iron, Copper, Zinc, Selenium, Calcium and Manganese as the nutritional value in mostly consumed brands of packaged Oyster mushrooms (*Pleurotus)* samples purchased from Tehran markets.
- Investigation the effect of cooking method (raw, cooked, fried, micro waved), in mineral contents in Oyster mushroom samples and find the best method of cooking.
- Investigation the relation of the level of mineral contents in famous brands of packaged Oyster mushrooms sold in Tehran markets by different production date due to find probable reasons of variable factors such as temperature and other physical factors.

MATERIALS AND METHODS

Sampling method

Zinc, Copper, Manganese, iron, Calcium and Selenium contents in 880 samples were determined. Samples from the 4 most famous brands of Oyster mushroom were purchased in all different weight packages available in market from creditable brands in Tehran, Iran in winter 2013 and 2014. The Oyster mushroom samples from different brands purchased at the same day. Sampling was replicated twice within each month at intervals of two weeks. Due to this Descriptive Study the effect of cooking method, samples were studied in 4 different conditions: raw, cooked, fried, micro waved. Samples were randomly purchased for analysis and analyzed according to standardized international protocols by wet digestion method [27]. All necessary precautions were taken to avoid any possible contamination of the sample as per the AOAC guidelines.

Quantitative determination of Mineral Elements

The purchased fresh packaged samples were freed from foreign materials .Approximately 500 g of each brand of mushroom was washed firstly with tap water in order to remove sand and dirt and each mushroom sample rinsed with 300-350 ml deionized water and was divided into 4 portions and then followed by the procedure. One was retained fresh (raw), while the second portion of 100 gram was cooked by boiling deionized water [2]. The boiling process was done according to the each kind of sample, which was approximately about 5 minutes for conventional samples. The third portion of 100 gram was put about 3 minutes in olive oil preheated to 180^0 C till both sides of mushroom blushed . For preparing micro waved samples 100 gram of mushroom was cooked on high for 3 minutes for whole mushrooms. For essential metal analyses 50 gram of each prepared mushroom sample was weighed and oven-dried at 50^0C to a constant weight. Each oven-dried sample was ground in a mortar until it could pass through a 60 mesh sieve. The samples were stored in clean, dry, high density polyethylene bottles of 100 ml capacity with screw caps. Finally 5 gram of dried sample was weighed precisely on electronic balance (Shimadzu LIBROR AEX 200G). The samples were put in a 100 ml digestion flask and 20 ml of digestion mixture comprising of concentrated HNO_3 (65%) Merck and hydrochloric acid (70 %) Merck and hydrogen peroxide H_2O_2 (30%, Merck) in the ratio of 3:1 was added to it and heated on a hot plate in the fuming chamber. The flasks were firstly heated slowly and then vigorously till a white residue is obtained [28]. The residue was dissolved and made up to 10 ml with 0.1 N HNO3 in a volumetric flask. The samples were analyzed by Flame Atomic Absorption Spectrophotometer Model AA-6200 (Shimadzu, Japan) using an air-acetylene flame for metals, using at least five standard solutions for each metal .Blanks and samples were also processed and analyzed simultaneously. Application of concentrated HNO_3 along with thirty percent hydrogen peroxide H_2O_2 for mineralization of samples to the complete digestion of samples [28] following Environmental Protection Agency (EPA) Method 3052 was done [29].

Statistical Method

Time of purchasing differences on the basis of the type of mushroom and cooking method was determined by student t-test. Time of purchasing samples changes were calculated by one way ANOVAs and for analysis of the role of multiple factors univariate analysis was used by SPSS 17.Probability values of <0.05 were considered significant.

RESULTS AND DISCUSSION

The results were determined as mean ± SD of three replicates in each test. The samples were analyzed by wet digestion method and standardized international protocols were followed for the preparation of material and analysis of essential metal contents by Flame Atomic Absorption Spectrophotometer in Research Laboratory in Pharmaceutical Sciences Branch, Islamic Azad University. The results of Zinc, Iron and Copper mean contents in 880 samples of raw, cooked, fried and micro waved mushroom samples in 4 creditable and best sellers of packaged mushroom (*Pleurotus*) in Tehran, Iran market in winter 2013 and 2014 are shown in Figure 1 and the results of Calcium and Manganese contents are indicated in figure 2. The results revealed that heating process by microwaved reduced significantly all studied essential elements (p 0.005) while frying Oyster mushrooms enhanced Iron content (p 0.03).

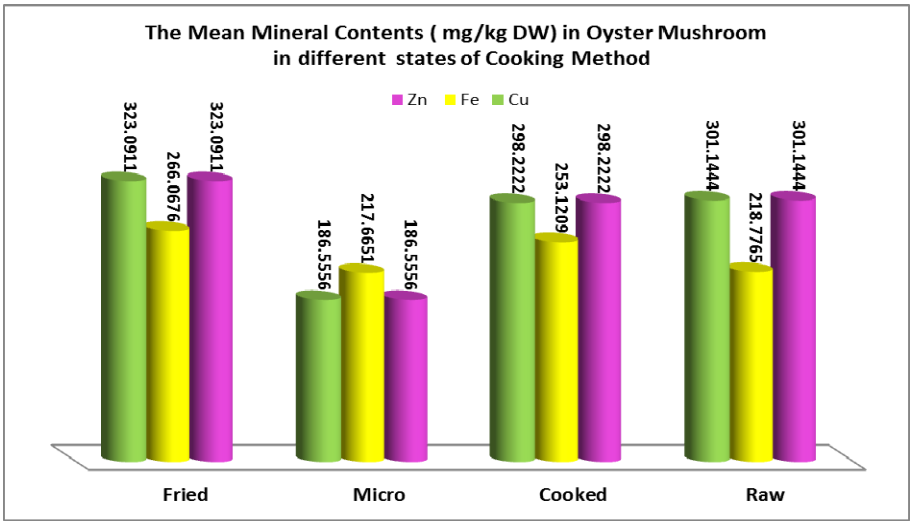

Figure 1- The Mean content of Cu, Zn and Fe in all Oyster mushroom samples in 2013 and 2014, regarding to different states of cooking methods.

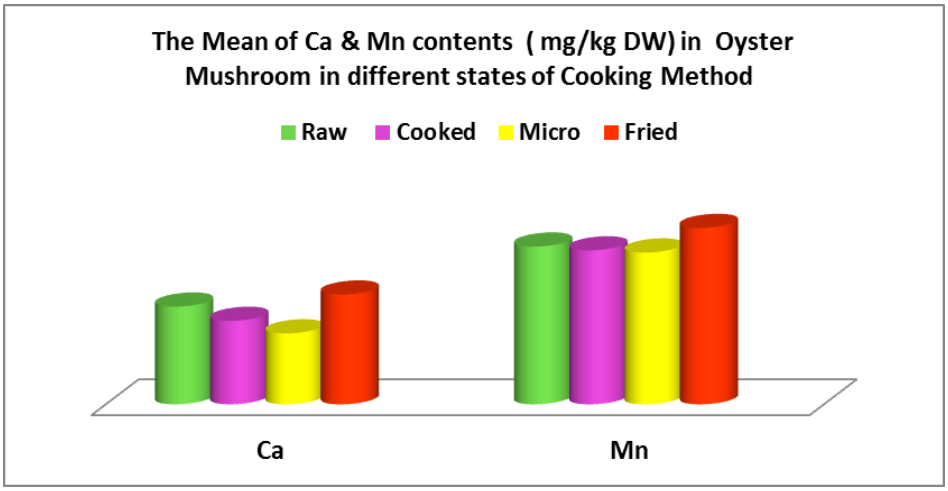

Figure 2- The Mean content of Calcium and Manganese in all Oyster mushroom samples in 2013 and 2014, regarding to different states of cooking methods.

Results also showed that even in the same season and same time of studying there was a wide range of essential metal contents in different brands. In figure 3, this wide range is represented for the mean Selenium content in purchased raw mushrooms in January 2014 and in figure 4, Zinc content in different brands was compared regarding to the studied months. Selenium contents in cooked and fried method respectively show the highest and microwaved the lowest point. Results showed no significant differences of the level of mineral contents in famous brands of packaged mushrooms sold in Tehran markets by different seasons and months of studying.

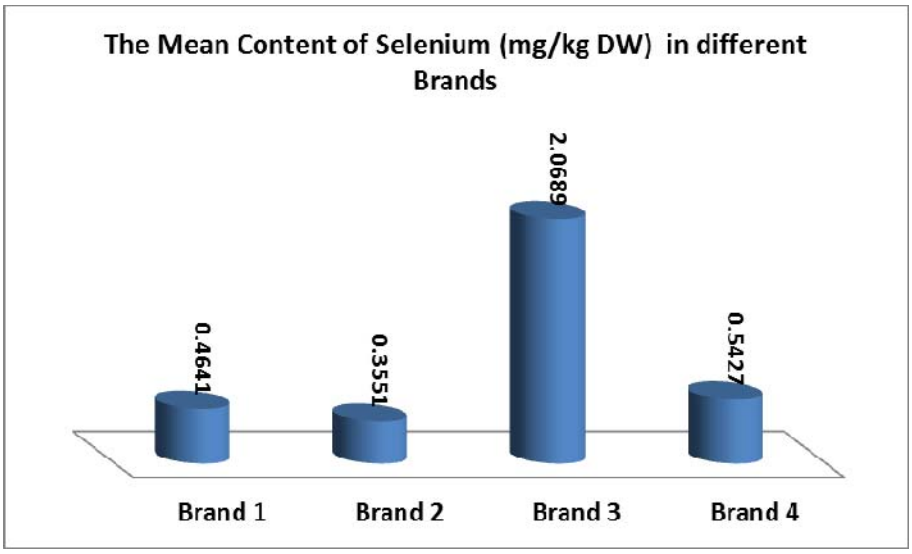

Figure 3- The mean selenium Content (mg/kg DW) in different popular brands purchased in January 2014.

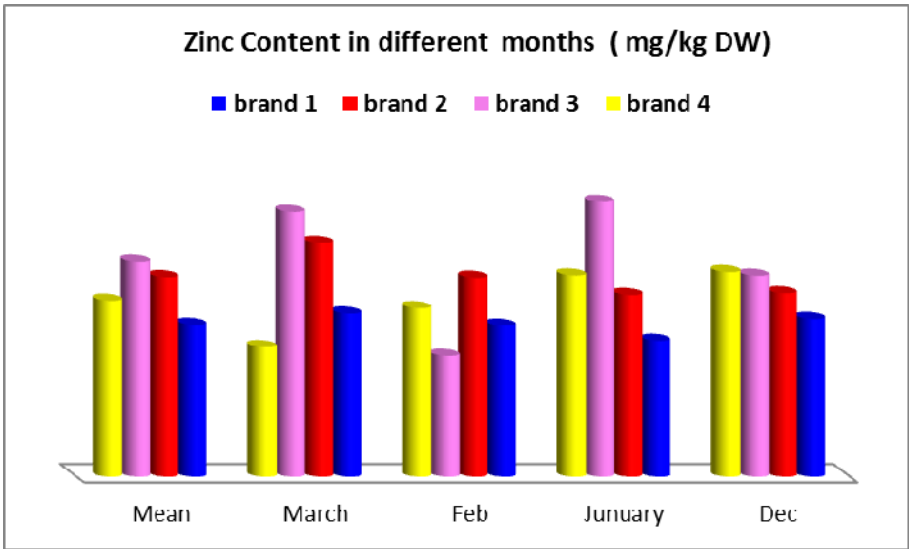

Figure 4- The mean Zinc Content (mg/kg DW) in different popular brands purchased in different months of study.

Results of the effect of cooking method

The mean values of Zinc and Copper content between raw and cooked, raw and fried, raw and micro waved samples were analyzed by one – way Analysis of variance (ANOVA). The difference was considered statistically significant at the level of $p<0.01$. The response of Oyster mushroom samples to the experimental cooking method was the same as *Agaricus bisporus* for the examined elements [2, 25, 26].

CONCLUSION

Results revealed that mean content of all studied essential elements in all samples would be decreased according to the microwaved cooking methods while frying method enhanced all of them. Due to the effect of thermal and non-thermal food processes and cooking methods, the levels of the mineral elements have been measured as follows:
Se content: Cooked> Fried > Raw> Micro
Cu and Fe contents: Fried > Cooked> Raw> Micro
Zn content: Fried >Raw> Cooked >Micro
Mn and Ca contents: Fried > Raw >Cooked> Micro

The reaction of Calcium content to microwaving was much higher than other elements (p 0.001) which means this kind of cooking will ruined calcium amounts in Oyster. As the location of mushroom producing was different, the mean values of the elements between Tehran – county and Karaj–county was analyzed by (ANOVA) too and revealed that the highest concentration of essential elements was detected in Oyster mushroom samples in Karaj producing factories. Fortunately more and more people around the world are starting to appreciate mushrooms and the various delicious dishes prepared with them. Used on their own or mixed with cultivated mushrooms, however, as the latest scientific studies and more developed research methods may reveal new, previously unknown facts about mushrooms and their safety and traditional knowledge should be checked and brought up to date from time to time. While canned foods are often regarded as less nutritious than fresh or frozen products, the Rickman and his claques research revealed that this is not always true [30]. The effects of processing, storage and cooking are highly variable by commodity.

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