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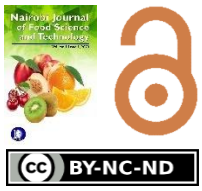

Short Communication: Determining the Optimum Conditions for Drying Mushrooms

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Abstract

This article focused on drying of Wild mushroom (*Termitomyces spp*) and Oyster mushroom (*Pleurotus ostreatus*) and their effect on nutritional composition of the product. It further, probed the effect of drying on storage and physical attributes of the mushrooms and also determined the most effective and efficient method for preserving *Termitomyces* spp and *Pleurotus ostreatus* and furthermore the optimum temperature for preventing nutritional loses while maintaining the quality of the mushroom. Consumer analysis was carried out to ascertain the organoleptic properties of the dried products by converting some portion into mushroom powder to evaluate farmers' practice of preservation. This research would assist the people of Kpelezo and its environs to use the ideal method to preserve the big haul of wild mushrooms they harvested during the peak season for future sales and use.

Keywords: dried mushroom, fungi, nutritional composition, wild mushroom

1.0 Introduction

Mushroom is a macro-fungus with a distinctive fruiting body, large enough to be seen with the naked eye and to be picked by hand (Chang and Miles, 1992). All mushrooms belong to the kingdom of Fungi, a group very distinct from plants, animals and bacteria (Oei, 2003). They lack chlorophyll hence depend on other organisms for food (Oei, 2003). Most of the cultivated mushrooms belong to the phylum, Basidiomycetes, which produce their spores on basidia while another important group are Ascomycetes, which produce their spores in asci (Oei, 2003; Arés *et al*., 2007). Mushrooms strive well at relative humidity level of around 70-80% and moisture level of 50-75%. There are about 69,000 known mushroom species of which 2,000 are regarded as edible mushrooms (Chang and Tropics, 1991). Edible mushrooms have been collected and consumed by people for over thousand years ago. Archaeological record reveals edible mushroom species associated with people living 13,000 years ago in Chile, but it was in China where consumption of wild fungus was first reliably noted several hundred years (Boa, 2004). Some wild species harvested in Ghana are *Termitomyces spp*, *Volvariella volvacea*, *Coprinus spp*, *Cantherellus aurantiacus* (Obodai, 2001). Total commercial mushroom production worldwide has increased more than 21 times in 35 years, from about 350,000 tons in 1965 to about 7.5 million tons in 2000 (Boa, 2004). From 2000 to 2009, global production increased to 67% excluding unofficial production figures emanating from China (Verma, 2013). Mushrooms are rich in non-starchy carbohydrates, proteins, dietary fibre, minerals, and vitamin-B and are quite low in fat value (Dunkwal *et al*., 2007). The proteins of mushroom are of high quality and rich in various essential amino acids. With regard to their good nutritional and high digestibility values mushrooms are gaining importance in today's healthy diet (Dunkwal *et al*., 2007). However, in the countryside and forest regions, several species of wild mushrooms are collected for consumption. During the onset of the rainy season, when mushrooms are abundant, most people in the rural areas collect them from the forests for home consumption and sell for extra income (Apetorgbor *et al*., 2005). Despite its importance, the figures for Ghana's mushroom production over the years were not known even after the introduction of the National Mushroom Development Project in 1990 (Sawyerr, 2000) to produce exotic mushrooms such as *Pleurotus* spp. The introduction only brought about small scale mushroom farms mostly for urban unemployed while the technologies developed for the straw mushroom, *Volvariella volvacea*, had not been adequately transferred to the rural communities (Apetorgbor *et al*., 2005). Due to its perishable nature, mushrooms are susceptible to a wide range of pests and diseases (Cha, 2004). Common pests of mushrooms include mites, midges,

millipedes and nematodes. Some of these pests damage the fruiting bodies and attack the mycelium in the soil while others like nematode tunnel through the stalk (Oei, 2003). Other factors such as dehydration and enzymatic browning affect mushroom quality.

2.0 Research design and Methodology

Two fresh mushroom varieties, *Pleurotus ostreatus* and *Termitomyces spp* were purchased from two farmers at Hohoe and Kpelezo and kept in separately covered plastic containers. The mushrooms were transported the same day to Noguchi Memorial Research Institute, University of Ghana for analysis. The mushrooms were washed under running tap water to remove soil particles and cut into small pieces. They were kept in plastic containers and stored in a refrigerator at 0^{o}C.

Pleurotus ostreatus

Termitomyces spp

2.1 Pretreatment

Pretreatment

The two varieties of fresh mushroom were sliced into small pieces with knife. 1000g of each mushroom variety was weighed for each treatment, making a total weight of 8000g for the two varieties. Each variety was subjected to two pretreatments, namely, blanching and grilling prior to the actual dehydration. Blanching was done by dipping the mushrooms in hot brine solution at 100^{o}C for 15 minutes. This solution contained 20g of sodium chloride dissolved in 500ml of water. Grilling was done by spreading the mushrooms on wire mesh and placed over burning charcoal. The mushrooms were turned periodically for 15 minutes. For the 4 treatments used, each sample was dried from an initial moisture content of 80 – 85 percent on fresh weight basis to the final moisture content of 10 percent on dry weight basis. The treatments and drying methods employed were done according to the procedure proposed by Rai and Arumuganathan (2008).

2.2 Sun Drying

The two varieties of the mushroom were spread on two separate porcelain trays and sun dried. The atmospheric temperature during the 7 days drying period ranged between 30 – 33^{o}C and relative humidity ranged from 65 – 70 percent.

2.3 Mud Oven Drying

The two varieties of the mushroom were spread on stainless steel trays and kept in a mud oven at 80^{o}C for 2 hours. The samples were removed from the oven and allowed to cool at room temperature.

2.4 Packaging

Two types of packaging material, rubber bag and plastic container, were used. The dried samples were packaged in these materials for proximate analysis at days 0, 10 and 20.

2.5 Storage Procedure

The dried *Termitomyces* spp was divided into 2 main parts. Each part was sub-divided into 8, giving a total of 16. The same procedure was used to divide the *Pleurotus ostreatus*. Four processing techniques were used such that each species was packaged in 4 rubber bags and 4 plastic containers. This resulted in having 4 rubber bags and 4 plastic containers packages for each species under each storage condition. Since 2 storage conditions (i.e. storing at 4^{o}C and 30 – 33^{o}C) were employed, 16 samples (8 for each species), in each storage condition were used. The entire storage duration was 20 days. 10 days storage intervals were allowed before the samples were analyzed for proximate composition. The composition analysis was repeated after another 10 days storage intervals.

3.0 Proximate Analysis

3.1 Determination of Protein

3.2 Digestion

Five grams each of the dried mushrooms samples was weighed into a digestion flask and digested by heating in the presence of concentrated sulphuric acid and catalysts (copper sulphate and potassium sulphate at a ratio of 1:10). The digestion converts nitrogenous compound into ammonium sulphate, and other organic matter to carbon dioxide (CO_2) and water (H_2O). Ammonia gas is not liberated in an acid solution because the ammonia

is in the form of the ammonium ion (NH_4^+) which binds to the sulphate ion (SO_4^{2-}) to form $(NH_4)_2SO_4$.

3.2 Neutralization

After the digestion was completed, the digestion flask was connected to a receiving flask by a tube. The solution in the digestion flask was made alkaline by the addition of concentrated sodium hydroxide, which converts the ammonium sulphate into ammonia gas. The ammonia gas formed was liberated from the solution and removed into the receiving flask – which contained an excess of H_2SO_4. The low pH of the solution in the receiving flask converts the ammonia gas into the ammonium ion, and H_2SO_4 to the sulphate ion.

3.3 Titration

The nitrogen content was estimated by titration of the ammonium sulphate formed with standard sulphuric acid, using a suitable indicator to determine the end-point of the reaction. The concentration of hydrogen ions (in moles) required to reach the end-point is equivalent to the concentration of nitrogen that was in the mushrooms. The nitrogen content in the food was determined using the equation below:

$$\%N = \frac{H_2SO_4\ Vol. - NaOH\ Vol. \times \left(Normality\ of\ H_2SO_4\right) \times 14100}{Wt\ of\ sample\ in\ mg}$$

The nitrogen content was converted to protein content by multiplying with a conversion factor of 6.25. That is $\%Protein = \%N \times 6.25$

4.0 Conclusion

This study concluded that various forms of processing techniques used revealed that mud oven drying of the mushrooms provides the best result by maintaining the nutrient composition in the mushrooms better than the rest of the processing methods. Blanching (in salt solution) and sun drying method maintain mushroom colour but had negative effect on the nutrient composition of the processed product as most of the nutrients might have leached into the salt solution. Sun drying was found to be easiest and cheapest method in terms of labour involvement. *P. ostreatus* sun dried maintained its original colour and better flavour but had higher moisture content hence further drying in oven

at a lower temperature for a minimum of 2 hours to reduce the moisture content to about 8% is required. The rest of processed product produced creamy and brown colour.

5.0 Recommendations

Research should be carried out to ascertain whether low mud oven drying temperatures of mushrooms for longer period could influence the nutritional content of the product.

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