



## Research Article

# Effect of Pre-Treatments and Drying Methods on the Chemical Quality and Microbial Density of Wild Edible Oyster Mushroom

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## Abstract

This study was carried out to evaluate the effect of pretreatments and drying methods on the chemical quality and microbial density of wild edible oyster mushroom. The mushroom samples were pretreated by steeping in 0.5% citric and sodium metabisulphite at room temperature for 10 minutes before being subjected to sun and cabinet drying until a constant weight was reached. The dried samples including the control samples (Samples not pretreated with chemicals) were evaluated for proximate, mineral composition and microbial density. The proximate analysis (protein, ash, fat, moisture and fibre) showed that untreated mushroom samples (both sun and cabinet dried) had the overall best results followed by samples pretreated with 0.5% sodium metabisulphite while samples pretreated with 0.5% citric acid had the lowest values. The mineral analysis (calcium, sodium, magnesium and potassium) of the mushroom samples followed the same trend as the proximate analysis. The microbial density of the samples showed that samples pretreated with 0.5% citric acid had the lowest count followed by samples pretreated with 0.5% sodium metabisulphite while the untreated samples had the highest microbial density. This implies that pretreatment with citric acid and sodium metabisulphite reduced the microbial density which may invariably extend the storage life of the edible oyster mushroom.

## Introduction

Oyster mushroom of the genus *Pleurotus* comprises some most popular edible mushrooms due to their favourable organoleptic and medicinal properties, vigorous growth and undemanding difficult cultivation conditions. Mushroom (*Pleurotus ostreatus*), which is consumed in many countries, is a popular and delicious product with high protein, vitamin, fibre, saccharide and mineral contents, while being and almost free of fat [1]. It is also suitable for consumption by patients with diabetes or cardiac diseases, and offers various valuable biological effects, including antitumor, anti-aromatase, antimicrobial, immuno-modulatory, anti-inflammatory and antioxidant activities. It can be cultivated on log and a wide variety of agroforestry (by-products), weeds and wastes for the production of food, feed, enzymes and medicinal compounds, or for waste degradation and detoxification [2]. Its popularity has been increasing due to the ease of its cultivation on various unfermented lignocellulosic wastes, its high yield potential, high nutritional values, as well as medicinal values [3]. Various *Pleurotus* species have been shown to possess a number of medicinal properties, such as antitumour, immunomodulatory, antioxidant, anti-inflammatory, hypocholesterolaemic, antihypertensive, antiplatelet-aggregating, antihyperglycaemic, antimicrobial and antiviral activities (Benou et al. 1992). The

mushrooms of the *Pleurotus* genus are more delicate and sensitive than the *Agaricus* genus and they start deteriorating immediately within one day after the harvest.

Fresh mushrooms tend to lose quality after harvest, mainly because of their high respiration rate and the fact that they have no epidermis to protect them from water loss [4]. Mushrooms' shelf-life is limited to a few days under normal refrigeration conditions, which is a constraint on the distribution and marketing of fresh product, making extension of mushroom's shelf life a constant quest [5]. Mushrooms are extremely perishable in nature and may not be kept for more than one day after harvesting at ambient conditions. Various physiological and morphological changes occur after harvest, which make these mushrooms unpalatable for consumption [6]. Drying of mushrooms is done to remove free water to such a level such that the biochemical and microbial activity are checked due to reduced water activity [7]. Conventional air drying is one of the most frequently used techniques for mushroom dehydration, which involves thermal and /or chemical pretreatment and drying at temperature maintained between 50 and 70°C. Due to long drying time and overheating of surface during hot air drying, the problems of darkening in colour, loss in flavour and decrease in rehydration ability occur [8]. Sun drying is suitable for tropical and sub-tropical regions where plenty of sunshine is present. Farmers can use sun drying on farm without any sophisticated equipments, provided the climate is hot, relatively dry and short of rainfall. Solar energy is diffuse in nature and provides low-grade heat which is good for the drying at low temperature [9], conducted the studies on dehydration of mushroom by sun drying, thin layer dryer, fluidized bed dryer and solar bed drying. Trials with natural convection solar cabinet dryer showed a drying time of 7h, when the ambient temperature varied between 29 and 32°C. The objective of this study is to determine the effect of different pre-treatments and drying methods (sun and cabinet drying) on the chemical quality and microbial density of wild edible oyster mushroom (*Pleurotus ostreatus*).

## Materials and Methods

### Collection of mushroom

The fully matured oyster mushrooms were collected from roadside farms in Uso and Ogbese communities in Ondo State. The mushrooms were firstly identified before transport to the Department of Food Science and Technology Laboratory, Rufus Giwa Polytechnic, Owo, Nigeria where they were prepared (sorted, cleaned, washed and halved) before been subjected to different pretreatments and drying methods.

### Authentication and identification of mushroom

The wild mushroom specimens together with the empty fruit bunch were collected and authenticated by mycologist, Associate Professor Dr. Fagbohun, E.D of the Department of Microbiology, Ekiti State University, Ado Ekiti. Further identification of the mushroom species was done based on the guide book by [10]. The species was identified as *Pleurotus ostreatus*.

### Sample preparation and pre-treatment

The modification of the method of [11], was used for the sample preparation and pretreatment. Oyster Mushroom fruit bodies were divided into three (3) equal parts; the first part serves as the control and did not undergo any treatment while each of the other two parts were subjected to one of the following treatment; (a) Control (untreated) (b) Steeping in citric acid (0.5%) at room temperature (at ratio of 250ml solution/50g sample) for 10min (c) Steeping in sodium metabisulphite (SMS) (0.5%) at room temperature (at ratio of 250ml solution/50g sample) for 10min.

### Drying of the prepared samples

After subjecting the samples to pretreatments, each treated samples were further divided into two (2) equal parts and subjected to drying. Two different drying methods was used; Sun-drying and cabinet drying until reaching constant weight.

### Proximate composition

The pretreated and dried mushroom samples were subjected to proximate analysis (crude fibre, protein, ash, fat and moisture) using the method of [12].

### Microbiological analyses

Microbiological analyses were performed on dried mushroom samples following the procedures of the International Commission for Specification for Food (ICMSF, 1978). A tenfold serial dilutions up to  $10^{-3}$  for each sample were prepared in 0.1% peptone water and subsequently plated onto standard Plate Count Agar (PCA), MacConkey Agar (MA) Potato Dextrose Agar (PDA) with chloramphenicol (250 mg/100 ml) to count total aerobic, coliform bacteria and total mould/yeast respectively. PCA plates were incubated for  $48 \pm 2$  h at  $32 \pm 1^\circ\text{C}$ . MA plates for coliforms were incubated for  $24 \pm 2$  h at  $37 \pm 1^\circ\text{C}$  while the PDA plates were incubated for  $102 \pm 2$  h at  $28 \pm 1^\circ\text{C}$ . The colony forming units (cfu) and the most probable number were employed to count total bacteria and coliforms, respectively.

### Mineral analysis

The mineral contents of the samples were determined after acid digestion of the ashed samples as follows: 2 ml of aqua regia (mixture of HCl and HNO<sub>3</sub> in ratio 3:1) was added to each ashed sample in a 100 ml flask and made up to the mark with distilled water. The solution was then filtered through N0.4 Whatman filter paper and the clear solution was kept in a plastic bottle with lid. Calcium and magnesium were determined using Atomic Absorption Spectrophotometer while sodium and potassium were determined using flame photometer [12].

### Results and Discussion

Table 1 showed the proximate composition of pre-treated and dried mushroom samples of *Pleurotus ostreatus* by steeping in citric acid and sodium metabisulphite as well as the control sample (untreated) prior to drying by sun and cabinet. The crude protein was found to be highest in the untreated sundried sample (28.6%) while the least in cabinet dried samples treated with 0.5% citric acid (24.3%). The untreated sundried sample had the highest ash content (8.5%) and the cabinet dried samples treated with 0.5% sodium metabisulphite had the lowest value of 7.7%. The moisture content was found to be high in sundried pretreated sample in citric acid (8.8%) and lowest in cabinet dried untreated sample (7.6%). The fibre content of untreated sundried sample had the highest value (4.3%) and lowest value was found in pretreated (citric acid) cabinet dried sample (3.2%). The fat content was highest in untreated cabinet dried sample (1.42%) and lowest in pretreated (sodium metabisulphite)sun dried sample (1.27%). The calculated carbohydrate was highest in pretreated (citric acid) cabinet dried sample (56.1%) and lowest in untreated sundried sample (48.85%). According to [13], in their study, *Pleurotus sp.* contained lower protein content (23.9%), higher fat (2.16%) and carbohydrate (61.1%) when compared to this study. However, they

**Table 1:** Proximate composition of pre- treated and dried wild oyster mushroom.

| <i>(Pleurotus ostreatus)</i>                      |                |                |     |          |       |      |              |
|---|----------------|----------------|-----|----------|-------|------|--------------|
| Samples   | Drying Methods | Parameters (%) |     |          |       |      |              |
|   |                | Protein        | Ash | Moisture | Fibre | Fat  | Carbohydrate |
| Untreated blanched mushroom                       | Sun drying     | 28.6           | 8.5 | 8.4      | 4.3   | 1.35 | 48.85        |
|   | Cabinet drying | 27.4           | 8.0 | 7.6      | 3.7   | 1.42 | 51.88        |
| Pre-treated mushroom (0.5% citric acid)           | Sun drying     | 25.5           | 8.2 | 9.8      | 3.5   | 1.28 | 51.72        |
|   | Cabinet drying | 24.3           | 7.8 | 7.3      | 3.2   | 1.30 | 56.1         |
| Pre-treated mushroom (0.5% sodium metabisulphite) | Sun drying     | 27.8           | 7.9 | 8.6      | 3.8   | 1.27 | 50.63        |
|   | Cabinet drying | 26.5           | 7.7 | 7.7      | 3.6   | 1.28 | 53.22        |

reported 7.5% ash which was higher than what was found in this work. Fat values in the present study are about the same as reported by [14]. They found that fat content in *Pleurotus sp.* (1.3-1.6%) are lower compared with other mushroom. [6], also reported higher protein (29.63%) and fat content (4.41%) in the mushroom sample soaked in sodium metabisulphite with lower fibre (2.87%) and carbohydrate (39.82%) when compared with this study. They reported ash value as 8.28% in *Pleurotus sp.* which is within the range of this work (7.7-8.5%).

Table 2 showed the result of mineral composition of untreated and pretreated dried (sun and cabinet) wild oyster mushroom (*Pleurotus ostreatus*). The cabinet dried control sample had the highest calcium content (40.2mg/100g) and lowest in pretreated (sodium metabisulphite) cabinet dried (37.4%). The sun dried control sample had the highest sodium, magnesium and potassium content. Untreated sample (sun dried) had the highest sodium while sample treated in sodium metabisulphite (0.5%) using cabinet drying method had the lowest sodium content of 2.5mg/100g. The sample steeped in citric acid (0.5%) had the lowest potassium content (5.3mg/100g). Mushrooms are known to contain calcium, potassium, magnesium, phosphorus and sodium, these elements are very important in human nutrition. They are required in repairing worn-out cells, strong teeth, building blood cells and maintaining osmotic balance [15].

The mushroom samples are very rich in calcium and magnesium. This is in agreement with the report of analysis of cultivated mushroom as analysed by [16], *Pleurotus sp.* was observed to have low sodium and potassium content. Minerals in the diet are required for metabolic reactions transmission of nerve impulses, rigid bone among others. Sodium content of *Pleurotus pluminarius* moisture is relatively lower when compared to general vegetable [17].

Table 3 showed the microbial density of untreated and pretreated dried wild oyster mushroom (*Pleurotus ostreatus*) over a storage period of 15 days. The microbial density showed that total bacterial count ranged between 04–08×10<sup>3</sup>cfu/g. No

**Table 2:** Mineral composition of pre-treated and dried wild oyster mushroom.

| <i>(Pleurotus ostreatus)</i>                     |                |                            |        |           |           |
|--|----------------|----------------------------|--------|-----------|-----------|
| Samples  | Drying Methods | Mineral ((mg/100g) Calcium | Sodium | Magnesium | Potassium |
| Untreated mushroom                               | Sun drying     | 39.4                       | 3.5    | 20.7      | 6.5       |
|  | Cabinet drying | 40.2                       | 3.3    | 19.9      | 6.3       |
| Pretreated mushroom (0.5% Citric acid)           | Sun drying     | 37.6                       | 2.8    | 18.9      | 5.8       |
|  | Cabinet drying | 38.2                       | 2.5    | 18.2      | 5.3       |
| Pretreated mushroom (0.5% Sodium metabisulphite) | Sun drying     | 38.3                       | 2.7    | 18.6      | 6.2       |
|  | Cabinet drying | 37.4                       | 2.5    | 18.7      | 6.0       |

**Table 3:** Microbial density of pre-treated and dried wild mushroom.

| <i>(Pleurotus pluminarius)</i>                   |                |  |  |  |
|--|----------------|--|--|--|
| Samples  | Drying Methods | Total bacterial count(TBC) (10 <sup>3</sup> cfu/g) | Total coliforms count(TCC) (10 <sup>3</sup> cfu/g) | Total mould and yeast count (TMYC) (10 <sup>3</sup> sfu/g) |
| Untreated mushroom                               | Sun drying     | 08   | NILL   | 09   |
|  | Cabinet drying | 06   | NILL   | 07   |
| pretreated mushroom (0.5% citric acid)           | Sun drying     | 06   | 0.2  | 08   |
|  | Cabinet drying | 04   | NILL   | 07   |
| pretreated mushroom (0.5% sodium metabisulphite) | Sun drying     | 08   | NILL   | 08   |
|  | Cabinet drying | 06   | NILL   | 07   |



coliform was found in all samples except sundried sample pretreated with 0.5% citric ( $0.2 \times 10^3$  cfu/g). The total yeast/mould ranged between  $07-09 \times 10^3$  sfu/g. It is worthy to note that the total mould/yeast counts were higher than total bacterial count, and this could be attributed to the reduction in water activity of the samples after drying.

The drying process caused a dramatically decrease in total microbial load. Citric acid steeped samples shows the lowest total bacterial count, while the control sample were on the contrary. In this respect, [18], stated that, fresh mushroom of good quality have over one million bacteria cells. The objective of drying is to remove water to a level at which microbial spoilage and deterioration reactions are greatly minimized. Kulshreshtha et al. (2009) stated that, air drying is better as it gives dried product with higher rehydration ratio, lower shrinkage, reduced microbial activities to minimal and better colour. Drying of *Pleurotus ostreatus* using low heat air blow method can lengthen their shelf life and retain their properties plus quality as close to the original sample as possible as observed by [11,19] Reported that, sulphitation prior to drying is usually carried out to control non-enzymatic browning and microbial load in order to improve acceptability of the products.

## Conclusion

It is obvious from this work that the proximate composition of the untreated mushroom samples were the best while pretreated mushroom samples with 0.5% sodium metabisulphite was better than the other treatment (0.5% citric acid) and sun drying method better than cabinet drying method. The drying treatment methods used reduced microbial load in the samples which showed that they were adequate.

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