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RESEARCH ARTICLE

QUALITIES AND MICROBIAL PROPERTIES OF CULTURED OYSTER PICKLED MUSHROOM (*PLEUROTUSOSTREATUS*)

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ABSTRACT

The present study aimed at the formulation of oyster mushroom pickled product, as influenced by its qualities and physico-chemical properties. There were three formulated techniques prepared with three replications for each treatment. The formulations were T-1 (sour), T-2 (sweet) and T-3 (sweet and sour). The products have been evaluated of the effects of sugar concentration to its color, odor, texture, and taste. The salient findings of the study were: T-2 (sweet) contained the highest crude protein value of 2.30% and less acidic treatment with pH value of 4.01. T-1 (sour) exhibited the lowest value of crude protein of 1.81% and highest in moisture value of 88.8%. For T-3 (sweet and sour) the results showed high content for total sugar (as sucrose) with 8.35% and lowest value of 77.1% moisture. Storage studies demonstrated that pickles stored successfully for 90 days at ambient temperature (26±4C) without any significant change in the quality attributes of the mushroom pickle. Furthermore, microbiological analysis demonstrated the absence of bacteria in pickled products.

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INTRODUCTION

Filipinos had been cultivating and eating mushrooms long before its technology for growing was introduced. This was as early as the start of the 20th century. Based on beliefs that mushrooms are flowers of thunderbolts and lightning, plots or beds of rice straw substrates were prepared without having done spawn inoculation, expecting inoculation to occur when thunder and lightning strike. *Pleurotusostreatus* or oyster mushroom is most popular in the Philippines especially in rural areas where they grow naturally and abundantly on composting rice straw or banana trunks. They can be grown on beds made up of bundles of dried straw, water hyacinth or banana leaves. Within two (2) weeks, fresh mushrooms can be harvested from these beds. A one-meter bed can yield one kilo mushrooms within one month of maintaining the beds under plastic cover sheets. The method appears very simple but the main problem is the source of spawn or planting materials which usually should be supplied or sold by private spawn makers. Mushrooms are consumed for various reasons. Apart from their delicious taste, most people in are becoming aware of their medicinal properties. Indeed most mushrooms, including Pleorotus spp. are known to possess medicinal properties. Pleurotus spp. Has been proven to have anticholesterolemic and antioxidant properties (Anandhi *et al.,* 2013), blood lipid lowering effects (Hu *et al.,* 2006), antihepatoma and antisarcoma activities (Wang and Gao, Mycosphere 4 (5): 960–967 (2013). *Pleurotusostreatus* are cultured mushrooms produced by small scale growers of Department of Agriculture in Brgy. Turno, Dipolog City. With the training courses for producing oyster mushroom now in prosper, spawn makers have increased subsequently increasing mushroom growers and mushroom production. *Pleurotusostreatus* is a mushroom of pleasant flavour and possesses several proteins, minerals (Ca, P, Fe, Mg), and low carbohydrate quantities and fat, constituting excellent dietary food (Tulek, 2011). There is a pressing need to produce more food for the growing population of the world. In third world countries protein deficiency is a common nutrition problem. The establishment and expansion of mushroom industry could help solve this problem because nutritive value of mushrooms is high. The protein content is about 30-50% (dry weight) and 3-4% (fresh weight basis). Cultured mushrooms are highly perishable. They can be kept in prime condition for only one day at 50°F (10°C), 2 days at 40°F (4.4°C) or 5 days at 32°F (0°C) (Grill et.al 1999). The obvious undesirable changes are the opening of the cap, elongation of the stem, darkening and shriveling. Such changes make mushrooms unattractive to the costumer hence reducing their economic value. Pickling is one of the possible methods of preservation, which can be used by mushroom growers for wider and greater distribution of their produce.

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Objectives of the Study

Specifically, it aims to:

1. Determine the physico-chemical properties of mushroom in terms of
   - moisture
   - Total fat
   - pH
   - lead
   - Crude proteinand
   - Total sugar (as sucrose) ;
2. Determine the effects of sugar concentration on the quality of the product in terms of:
   - Color
   - Odor
   - Texture
   - Taste
3. Determine the microbial content of the three treatments and
4. Develop standard formulation for processing oyster mushroom into pickled product.

MATERIALS AND METHODS

Locale of the Study: The experiment was conducted at the HRM laboratory center, JRMSU DipologCampus. The data gathering startedfrom November 2017 to April 2018. Cultured oyster mushroom was obtained from Department of Agriculture Dipolog City. *Analysis for moisture, total fat, pH, crude protein, and total sugar titrable* was conducted at Department of Science and Technology,Cebu City. *Microbial content* was also determined of the pickled mushroom.

Preparation of Bottled Pickled Mushroom: A total of six (6) kilograms of mushrooms and two (2) gallons of datuputi vinegar and the rest of the pickled ingredients will be bought at dipolog public market. Fresh, young and firm mushrooms will be selected, washed, cut in half, soaked in alum solution for 30 minutes and rewashed, drained and steamed-balanced for 5 minutes and arranged well in sterilized jars. Pickled solution, composing of vinegar, sugar, salt all spices, cinnamon and other spices were brought to boil for five minutes and poured while hot in sterilized jars then will be garnished and sealed at once. The bottled samples were labeled and sterilized according to the three formulation techniques studied, namely: Treatment 1 (sour pickle preparation) with 1tbsp sugar/6cups vinegar, Treatment 2 (sweet pickle preparation) with 1 ½ cups of sugar/6 cups vinegar and the Treatment 3 (sweet and sour pickle preparation) with 3 cups sugar/6 cups vinegar. At the end of 5 minute sterilization time, the bottles were cooled first before final labeling will be done.

Physico-Chemical Analysis and Microbial Determination of Pickled Mushroom: A volume of pickled mushroom samples were poured into sterilized beakers and glass bottles, labeled and brought to the laboratory of Department of Science and Technology (DOST) Cebu City for physico-chemical analysis and microbial determination respectively.

E.coli Count: Procedure Description: Prepare decimal dilutions of samples. Following Bacteriological Analytical Manual 8th ed., Online 1998 Rev, Chapter 4: *Escherichia coli*and the *Coliform Bacteria.*

Aerobic Plate Count: Decimal dilutions of 10^{-2},10^{-3},$10^{-4}$and others as appropriate, are prepared. Following Bacteriological Analytical Manual, 8thed.,Online January 2001, Chapter3: Aerobic Plate Count.

Mold and Yeast Count: Food homogenate is prepared and made appropriate dilutions. Following Bacteriological Analytical Manual 8th ed., Chapter 18; Yeasts, Molds &Mycotoxins.

Enumeration of S. aureus: Decimal dilutions are prepared. Following Bacteriological Analytical Manual Online, January 2001, Chapter 12: *Staphylococcus aureus.*

Salmonella Detection: 25g sample is weighed aseptically into a sterile container and added with 225 ml LB. Following Bacteriological Analysis Manual Online, april 2003 Chapter 5: *Salmonella.*

Moisture.Modified AOAC 934.01
Total Fat.CSOP-3-007
pH.Modified AOAC 945.10
Lead.CSOP-3-111
Crude protein.CSOP-3-009
Total Sugar.AOAC 923.09

RESULTS AND DISCUSSION

Chemical Analysis: *Moisture content* of mushroom pickle formulated ranged from 77.1% to 88.8% between all treatments investigated as shown in table depending upon the harvest time and environmental conditions; where the T-1 (sour) formulated contained higher moisture content followed by the T-2(sweet) 81.9% and T-3 (sweet & sour) with a moisture content of 77.1%. *pH* is an important factor for good production of Oyster mushroom. Most of the mushrooms grow and perform well at pH near to neutral or light basic. In the beginning pH was recorded 4.01 to 3.89.; pH value was dropped gradually most of the time during processing of pickle. The low pH for the period of storage may be due to the activity of certain types of the bacteria, which is producing acid. In addition to the findings of the study were: T-2 (sweet) contained the highest *crude protein* value of 2.30% and less acidic treatment with pH value of 4.01. T-1 (sour) exhibited the lowest value of crude protein of 1.81%. For T-3 (sweet and sour) the results showed high content for total sugar (as sucrose) with 8.35% and lowest value of 77.1% moisture. *Pb* finds its way into the environment as constituent of pesticides and industrial waste release into the environment, such as used car batteries, alloys, solder, broken ceramics and plastics. *Lead* has no benefit to human metabolism. Gradual accumulation can lead to lead poisoning. This may lead to high blood pressure, muscular weakness, and headaches among others. The ranges detected for lead fall within what is generally detected from mushrooms in the literature. These include Tuzen *et al.* (1998), who detected a range of 0.75–7.77 mg/kg; Svoboda *et al.,* 2000, who detected a range of 0.40–2.80 mg/kg. Moreover, lead (Pb) was not observed and detected in *Pleurotusostreatus* pickled mushroom and less than in concentration of 0.656mg/kg in (Table 1).

Table 1. Physico-chemical properties of cultured mushroom

Treatment	*Moisture*	*Total fat*	*pH* (10% aqueous)	*Lead*	*Crude protein*	*Total sugar* (as sucrose)
T-1 (Sour)	88.8%	0.53%	3.89	Not detected < 0.656	1.81%	4.59%
T-2 (sweet)	81.9%	0.51%	4.01	Not detected <0.656	2.30%	6.48%
T-3 (Sweet & Sour)	77.1%	0.51%	3.95	Not detected <0.656	2.14%	8.35%

Table 2. Microbial Analysis of Picked mushroom

Sample	Aerobic Plate Count	E.coli Count	Enumeration of S. aureus	Mold & Yeast Count	Salmonella Detection
T-1 sour	8.3 x10^5cfu/g	<1.0x10 cfu/g	<1.0x10cfu/g	<1.0x10 cfu/g	negative
T-2 sweet	<25x10^2eapc/g	<1.0x10 cfu/g	<1.0x10 cfu/g	<1.0x10 cfu/g	negative
T-3 sweet & sour	<25x10^2eapc/g	<1.0x10 cfu/g	<1.0x10 cfu/g	<1.0x10 cfu/g	negative

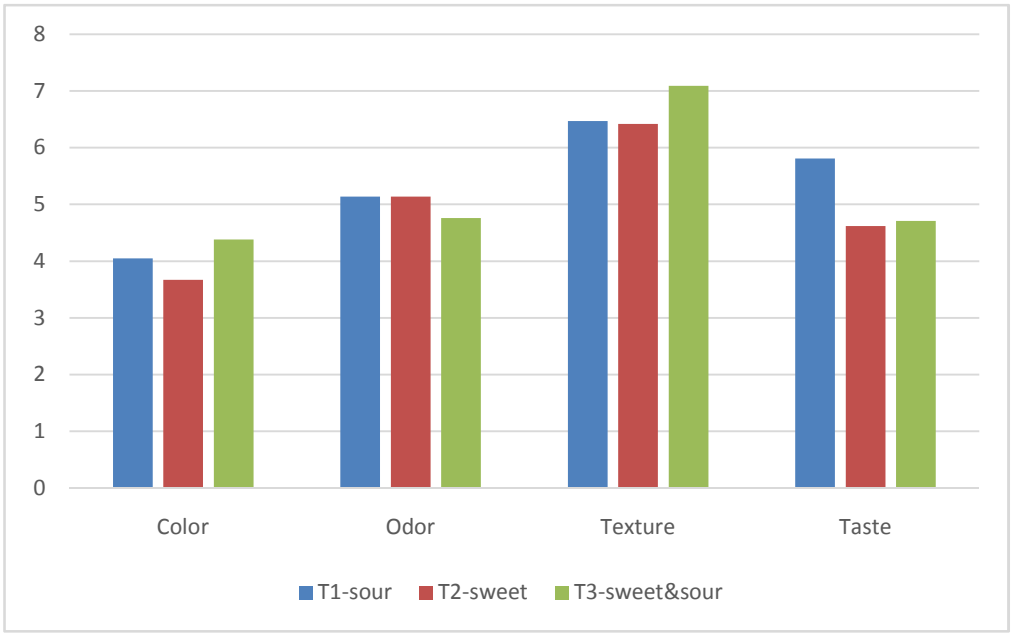

Figure 1.. Effects of sugar concentration on the quality of the product

Based on the research results, T-3 (sweet & sour) 8.35% showed the higher concentration of *sucrose* (*total sugar)* than T-2 (sweet) 6.48% and T-1 (sour) 4.59%. This was confirmed by Desrosier (1988) which revealed that the total sugar content determination is the determination of sugar before inversion or reducing sugar and glucose measurements after inversion (sucrose). During the boiling solution of sucrose in the presence of acid hydrolysis process will occur produce reducing sugars (dextrose and levulose). Sucrose is converted into reducing sugar and the result is known as invert sugar. Speed is affected by temperature inversions, heating time and pH value of the solution. During heating a solution of sucrose into glucose and fructose due to the influence of the effect of heat and acid will increase the solubility of sucrose. With the increased solubility of sucrose will increase the total sugar content. Analysis revealed that the three formulations did not differ significantly between and among treatments in the evaluation of the effects of sugar concentration specifically in color, odor and texture. However, in taste, T-1 (sour) was noted to be different among the treatments with the mean value of 5.8 as presented in the graph.

Microbial analysis

Bacterial numbers in foods are of great significance. Their identification and enumeration in pickled mushroom serve many purposes; detection of contamination with filth in groos contamination and violation of effective saniraty practices.

The microbial *Pleurotusestreatus* of pickles is shown in Table 2. The total no. of viable bacteria was calculated by multiplying the colony forming unit (cfu) by dilution number. The total bacterial count for pickles formulated were counted respectively. It is reported that the low acid meat pickle had a gradual increase in microbial count by increased time. It is reported that the three treatments was negative in Salmonella. While on the aerobic plate count, E.*coli* count, Enumeration of S. aureus and mold and yeast analysis, the results were on the standard range of Microbial Standard for fermented vegetables, ready to eat. Furthermore, reported that mushroom pickle products would deteriorate quickly, protection is required against the act of molds, which metabolize the acid developed and permit the proceed of other microorganisms. While in cold storage fermented and pickled foods could be expected to remain stable for several months.

Conclusion and Recommendations

Based on the results, it could be concluded that the mushroom can be developed into a quality pickled product. On the basis of the aforementioned findings, the following recommendations are made;

1. Conduct an intense study of developing mushrooms as a protein-rich ingredient for protein enrichment of food.
2. Need for continuous research program and experimental cookery on mushroom culinary arts to improve and

compare it to the commercial products for global competition.

3. Introduction of Mushroom products for commercial adoption and global competitiveness.

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