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PRELIMINARY STUDIES ON THE EFFECT OF SELECTED SPICES ON CHEMICAL, SENSORY AND PRESERVATIVE PROPERTIES OF POWDERED MUSHROOM SOUP

B A. Akinwande*, B.I.O. Ade-Omowaye, O.O. Fapojuwo and A.T. Olorunyomi

Food Science and Engineering Department
Ladoke Akintola University of Technology, Ogbomoso, Oyo State, Nigeria.

*** Corresponding author**

ABSTRACT

Powdered mushroom soup was developed using three different spices, which were evaluated for their use as flavour enhancer and preservative. Different combinations of nutmeg, ginger and garlic were mixed with other spices and seasoning and added to mushroom powder to produce powdered mushroom soup. Samples were analysed for their proximate composition and sensory properties. Total plate count of samples kept in glass and plastic containers were also evaluated for three weeks on a weekly basis. The samples containing garlic, especially the one with three spice combination, had higher protein, fat and ash contents but lower crude fibre content, with significant difference ($p<0.05$). Also, odour and taste of the sample with three spice combination were better rated. A gradual decrease in the microbial load was observed in all the samples as the storage period progressed with the intensity of decrease being more in samples containing garlic. Samples in glass bottles kept better than those in plastic bottles at the end of the storage period.

Key words: Mushroom, spices, soup, packaging material, preservation

INTRODUCTION

Mushrooms are the name given to popular larger fleshy fungi, mostly of the class Basidiomycetes. They are widely distributed in nature and occur in a variety of habitats. They can be appropriately processed and prepared to be consumed as food stuffs or delicacies. Edible mushroom are the fruiting bodies of a specific plant group called fungi. They grow wild and are sometimes cultivated after which they are appropriately processed to be consumed as food stuffs or delicacies.

Mushroom contains digestible crude protein, all essential amino acids, vitamins and minerals (Bani and Rajarathnam, 1982). In a developing country like Nigeria, protein intake of the populations is low due to high cost of procurement of protein-rich foods. Greater emphasis has, therefore, been placed on the need for consumption of large quantities of plant protein and less expensive proteinaceous food in developing countries. Mushroom could serve as a replacement for other types of protein, especially from animal sources. Due to the structure and chemical composition of these edible fungi, they are generally very perishable within a short time of harvesting. Hence, they are marketed fresh or must be delivered to the consumer within a short time of picking (FAO/WHO, 2005).

Chemical preservatives are used to inhibit spoilage agents and to complement other food preservation techniques (Paine and Paine, 1983). The preservatives serve as either antimicrobials or antioxidants or both. As antimicrobials they prevent the growth of molds, yeasts and bacteria while as antioxidants, they keep foods from becoming rancid, or developing off colours.

Scientific experiments since the late 19th century have demonstrated the antimicrobial properties of some spices, herbs and their components (Shelef, 1983). There has been an increasing interest in the discovery of new natural antimicrobials due to side and residual effects of antibiotics. Spice can be defined as a flavouring made from seeds or leaves of plants, such as black pepper, chilli pepper, cinnamon, garlic, ginger, onion, nutmeg, clove, e.t.c. Spices can improve the palatability and the appeal of dull diets. Spices and herbs have been used for centuries by many cultures to enhance the flavour and aroma of foods. Early cultures also recognised the value of using spices and herbs in preserving foods and for their medicinal value. Certain spices and essential oils have been reported to prolong the storage life of foods by their antimicrobial activity. They appeal to consumers who tend to question the safety of synthetic additives because they are natural foodstuffs (Farag *et al.*, 1989).

In this study, ginger, garlic and nutmeg were examined for their potential in imparting flavour and as preservative in powdered mushroom soup using two different packaging materials.

MATERIALS AND METHODS

The mushroom sample (*Pleurotus pulmonarius*), commonly known as oyster mushroom, was obtained from a commercial mushroom grower in Ibadan. Fresh ginger (*Zingiber officinale*), garlic (*Allium sativum*), nutmeg (*Myristica fragrans*), and onion (*Allium cepa*), together with salt and seasoning, were obtained from local market in Ogbomoso. Plastic and glass containers were used as packaging materials and were purchased from Bode-gold investments in Ogbomoso and a commercial dealer in Lagos State, respectively. Food grade thickener in dry form was obtained from a food industry.

Sample preparation: The mushroom sample was cleaned and dried in tray drier at 60 °C for 48 h. The dried sample was milled into powder using a cleaned moulinex blender for 2 min. Except nutmeg that was grated before sieving (600 μm), the spices were processed into dry form by oven drying cleaned and cut slices of 2 mm thickness at 50 °C for 48 h. Samples were later milled with domestic blender and sieved to pass through a mesh size of 600 μm size.

The recipes were mixed according to predetermined proportions. Soup mix one (SP1) had combination of nutmeg and ginger, soup mix two (SP2) had combination of nutmeg and garlic while soup mix three (SP3) contained combination of the three spices. Combination of each of the spice mixtures was done at equal proportions while its ratio in the overall soup mix was the same. The plastic bottle and glass containers were thoroughly washed in warm soapy water, rinsed under running water, dried and sterilized in oven at 65 °C and 105 °C, respectively for each, for 1 h before being cooled in desiccators. Each sample was put in the two different packaging materials, labelled accordingly and kept on the shelf for three weeks.

Chemical analysis: The samples were analysed for their proximate composition according to standard methods (AOAC, 2000).

Sensory evaluation: Each of the formulations was reconstituted by addition of 250 ml portable water to 9.0 g sample, heated up and allowed to boil for 25 min. The cooked soup was served warm to 15 semi-trained panellists to assess the quality attributes using descriptive terms (Watts *et al.*, 1989). Portable water was provided to rinse their mouth after each sample tasting/evaluation.

Storage studies: Total plate count was evaluated for three weeks on weekly basis according to standard methods (AOAC, 2000). Identification of the isolates was done after examination of the cultural, morphological, biochemical and physiological characteristics (including microscopic and macroscopic examination of the isolates).

Statistical analysis: Each analysis was done in three replicates using randomized complete block design (RCBD). Statistically significant differences ($p<0.05$) in the means were determined by Analysis of Variance (ANOVA) while Least Significant Difference (LSD) was used to separate the means using Statistical Analysis Systems (SAS) package (version 8.2 of SAS Institute Inc, 1999).

RESULTS AND DISCUSSION

Chemical composition of the formulated soup mixes

The result of the proximate composition of the samples is presented in Table 1. Average crude protein content was 33.75%. Mushroom was reported to have protein content of 4.81 – 43.02% on dry weight, depending on the specie (Kurtzman, 1975; Ogbonda, 1997). Fat content had mean value of 117%, which is close to the range (1.6%-1.9%) observed in the same specie of mushroom when analysed under different drying temperatures by Okeke *et al.* (2003). High crude fibre and ash contents (average of 6.95% and 5.36%, respectively) indicate that mushroom is high in crude fibre and mineral contents. The values are also close to range of 7.5%-7.9% and 7.4%-8.0% (for crude fibre and ash contents, respectively) reported by Okeke *et al.* (2003). Mean moisture content value of 10.17% was recorded. The value was higher than moisture content of 5% recommended for storage stability of mushroom powder (Krugliakova, 1990; Oei, 1996). Range of values of 40.90%-44.26% was recorded for carbohydrate. These values agree with average value of 42.90% reported by Ogbonda (1997) for different species. There was variation in all the proximate components, with significant difference ($p<0.05$), among the three samples evaluated. SP3 had highest protein, fat and ash contents while least values were recorded for SP1. On the other hand, SP1 had the highest values for crude fibre, moisture and carbohydrate contents with SP3 having the least values.

Sensory properties of the soup mixes

Results of the sensory quality attributes of the three samples are indicated in Table 2. The colour of the samples was reported to be in the range of light brown. The same specie of mushroom that was dried at 60 °C was indicated to be slightly brownish when observed with lovibond Tintometer (Okeke *et al.*, 2003). The odour and taste were better rated in the sample containing the three spice combination when compared to the other two.

Storage stability of the soup mixes

Micro-organisms were isolated at the beginning of the storage period (Table 3). This contamination could be from some of the ingredients used for the formulation as mushroom dried at 60 and 65 °C were reported to be free of mold and yeast (Okeke *et al.*, 2003). However, there was a decrease in microbial load in all the samples with increase in storage period, irrespective of the type of spice and

packaging material used. At the end of the third week of storage, the samples that contained garlic had lesser number of micro-organisms compared with the one without garlic. Samples kept in glass bottles kept better than those in plastic bottles at the end of the storage period.

Decrease in microbiological load with storage time confirms that the spices that were used have anti-microbial activity. Al-Turki (2007) reported that hydrosols from five different spices demonstrated antibacterial activities against *Bacillus subtilis* and *Salmonella enteritidis*. He also observed that combined extract of the spices had slightly higher antibacterial activity against the organisms when compared with single plant hydrosols. Garlic extract was confirmed by El Aslta (2004) to have high antibacterial efficacy against certain pathogenic bacteria. Sallam *et al.* (2004) also reported that garlic exhibited combined antioxidant and antimicrobial effect in raw chicken sausage at refrigerated condition for 21 days.

CONCLUSION

The sample with the three spice combination (SP3) had highest protein, fat and ash contents while least values were recorded for SP1. On the other hand, SP1 had the highest values for crude fibre, moisture and carbohydrate contents with SP3 having the least values. The odour and taste were better rated in the sample containing the three spice combination when compared to the other two. A gradual decrease in the microbial load was observed in all the samples as the storage period progressed with the intensity of decrease being more in samples containing garlic. Samples in glass bottles kept better than those in plastic bottles at the end of the storage period.

Table 1: Proximate composition (%) of powdered mushroom soup

Sample	Crude protein	Crude fat	Crude Fibre	Ash	Moisture	Carbohydrate
SP1	31.68c	1.07c	7.53a	5.24c	10.22a	44.26a
SP2	33.72b	1.18b	6.94b	5.37b	10.17b	42.62b
SP3	35.86a	1.25a	6.38c	5.48a	10.13c	40.90c
Mean	33.75	1.17	6.95	5.36	10.17	42.59

SP1 - combination of nutmeg and ginger; SP2 - combination of nutmeg and garlic
SP3 - combination of nutmeg, ginger and garlic
Means followed by the same letter down the coloumn are not significantly different ($p<0.05$) from one another

Table 2: Effect of spice mixtures on sensory quality attributes of powdered mushroom soup

Sample	*Quality attributes		
	Colour	Odour	Taste
SP1	2.23a	2.50a	1.30a
SP2	2.24a	2.59a	1.27a
SP3	1.93b	2.70a	1.37a

SP1 - combination of nutmeg and ginger; SP2 - combination of nutmeg and garlic
SP3 - combination of nutmeg, ginger and garlic
*Colour: 3 = Dark brown; 2 = Light brown; 1 = Cream
Odour: 3 = Pleasant; 2 = Bland; 1 = Repulsive
Taste: 3 = Very salty; 2 = Slightly salty; 1 = not salty
Means followed by the same letter down the coloumn are not significantly different ($p<0.05$) from one another

Table 3: Effect of spices and packaging materials on total plate count (cfu/ml) of powdered mushroom soup recipe

Storage time (wk)	Glass			Plastic		
	SP1	SP2	SP3	SP1	SP2	SP3
0	$3.0x10^3$	$3.0x10^3$	$3.0x10^3$	$3.0x10^3$	$3.0x10^3$	$3.0x10^3$
1	$2.7x10^3$	$2.7x10^3$	$2.6x10^3$	$2.9x10^3$	$2.9x10^3$	$2.9x10^3$
2	$2.3x10^3$	$2.2x10^3$	$2.3x10^3$	$2.4x10^3$	$2.4x10^3$	$2.4x10^3$
3	$2.1x10^3$	$1.7x10^3$	$1.7x10^3$	$2.3x10^3$	$1.9x10^3$	$1.8x10^3$

SP1 - combination of nutmeg and ginger; SP2 - combination of nutmeg and garlic
SP3 - combination of nutmeg, ginger and garlic

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