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Development and Evaluation of Shiitake Mushroom (*Lentinus edodus*) Instant Soup Mixes

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A B S T R A C T

The instant soup mixes were prepared from treated and untreated mushroom pieces. Shiitake *(Lentinus Edodus)* mushroom was solar dried following citric acid treatment. The untreated mushroom was sun dried. The developed instant soup mixes were evaluated for sensory and nutritional attributes and were stored for one month at room temperature. The stored soup mixes were evaluated for sensory qualities and total bacterial count. The developed soup mixes were acceptable to judges and had a good nutritional profile with a protein content 13.96±0.14 to 14.52±7.21 g/100g, total carbohydrate 76.27±2.35 to 76.28±2.29 g/100g, total fibre 16.61±0.65 to 16.81±2.84 g/100g, soluble fibre 5.45±0.16 to 5.88±0.10 g/100g, phosphorus content 842.27±1.76 to 854.00±1.73 and iron content 7.60±0.31 to 8.62±0.47 mg/100g. The total bacterial count of curries varied from 0 to 4×10^2 cfu/g of product during 0 to 30th day of storage.

Introduction

Lentinus edodes, the Shiitake mushroom, is one of the most widely cultivated mushrooms worldwide. The interest in shiitake cultivation is increasing because of its high nutritional value and medicinal properties, which have been acknowledged by oriental cultures, especially in China and Japan (Hassegawa *et al*., 2005; Bisen *et al*., 2010). Interest in numerous biologically active compounds produced by this mushroom is also increasing.

Shiitake mushrooms have been attributed with many medicinal properties by both eastern and western medicine. They range from reducing cholesterol, lowering blood pressure, strengthening the immune system against diseases including viral ones, fighting tumors, and improving liver function (Finimundy *et al*., 2014). Many of the shiitake health benefits come from chemical compounds these mushrooms produce, these include: lentinan, eritadenine, L-ergothioneine. Lentinan has shown some effect on bowel cancer, liver cancer, stomach cancer, ovarian cancer, lung cancer and AIDS (Okamoto *et al*., 2004; Enman *et al*., 2007).

Mushrooms are rapidly perishable commodities, and they start deteriorating immediately within a day after harvest. In view of their highly perishable nature, the fresh mushrooms have to be processed to

extend their shelf life for off-season use. Drying is a comparatively cheap method and dried mushrooms, packed in airtight containers can have a shelf life of above one year. Pretreatments of mushrooms before drying in one form or other viz, washing in water, potassium metabisulphite (KMS), sugar, salt either alone or in combination are known to help in checking enzymatic browning, stabilizing colour, enhancing flavour retention and maintaining textural (Izli and Isik, 2014; Jiang *et al*., 2015).

Present article summarizes the development of instant soup mixes from treated and untreated dehydrated Shiitake mushroom and its nutritional, sensory and microbial attributes.

Materials and Methods

All the ingredients were procured from open market in a single lot, cleaned and stored in air tight food grade container. Mushrooms were washed in running tap water and sliced before treatment. Mushrooms were divided into two lots. One lot was given pre drying treatment by dipping for 15 min in a solution containing 5 g/L Citric acid. The treated mushrooms were solar dried after that. Second lot was not given any pre drying treatment and was dried under open sun.

Development of soup mixes

The ingredient were carefully and accurately weighted (Mushroom (pieces) 20 g, Skim milk powder 40 g, Onion (Blanched and oven dried) 10 g, Salt 5g, Black pepper powder 3g, Corn flour 5 g, Refined oil 10 g, Ajinomoto 1g). All ingredients were mixed together and filled in the retort pouch. It was sterilized at 121^0C for 43 min and cooled rapidly. Soup mix I contained untreated mushrooms while Soup mix II contained treated mushrooms. For preparation of soup, 100 ml of water was added to 10 g of soup mix and boiled while stirring for 5 min.

Sensory, nutritional and shelf life evaluation

Sensory evaluation of developed products was carried out according to 9 points hedonic scale (Ranganna, 1986) by a panel of ten semi trained judges. The developed soup mixes were analysed for Proximate composition (AOAC, 2000), dietary fibre constituents (Furda, 1981), total carbohydrate (by addition method), total soluble sugars (Yemm and Willis, 1954), reducing sugars (Somogyi, 1945), non –reducing sugars (by difference) and starch (Clegg, 1956). *In vitro* protein digestibility was also determined (Mertz *et al*. 1983). Total iron, zinc, calcium and phosphorus in acid digested samples were determined by the atomic absorption spectrophotometer (Lindsey and Norwell, 1969). Mineral HCl extractability (Peterson, *et al*., 1943) and polyphenols (Singh and Jambunathan, 1981) were also studied. Ready to use soup mixes were stored at room temperature (30 ± 2°C) in for one month and subjected to sensory analysis at intervals of 15 and 30 days of storage. The fat acidity was determined by the standard method of analysis (AOAC, 2000). The stored soup mixes were also studied for microbial growth (using PCA media) at storage intervals of 15 and 30 days.

Statistical analysis

Suitable standard statistical methods were used for analysis of data (Sheoran and Pannu, 1999).

Results and Discussion

Moisture content was 83.69 and 84.04 per cent in soup I and soup II. Crude protein and crude fat in soup I were 14.52 and 5.80 per

cent. Total ash was 2.38 and 2.37 per cent in soup I and II. Crude fibre was 1.02 per cent in soup I and 1.62 per cent in soup II. Crude protein content of soup I was significantly (P≤0.05) higher than soup II (Table 1). Total carbohydrates in soup I and soup II were 76.28 and 76.27 per cent respectively. Total soluble sugar was 20.47 per cent in soup I and 20.42 per cent in soup II. Reducing and non reducing sugars were 1.51 and 18.95 (soup I), 1.67 and 18.74 (soup II), respectively. Starch content of soup I (29.92%) was significantly (P≤0.05) higher than of soup II (27.63 %).Total fibre, soluble and insoluble fibre in soup I were 16.81, 5.45 and 11.35g/100g and these were to 16.61, 5.88 and 10.01 g/100g in soup II. The insoluble fibre of soup II was significantly (P≤0.05) lower than soup I. Polyphenol content in soup I was 169.81 mg/100g which was significantly (P≤0.05) lower in soup II i.e. 162.70 mg/100g. *In vitro* protein digestibility of soup I was 60.97 per cent and that was significantly (P≤0.05) higher in soup II (75.27%) (Table 1). Total iron, zinc, phosphorus and calcium were 7.60, 8.14, 842.27 and 38.81 respectively in soup I. These were 8.62, 8.26, 854.00 and 39.75 mg/100g in soup II with no significant (P≤0.05) differences observed among the two soups. HCl extractability of iron, zinc, phosphorus and calcium were 63.39, 92.95, 47.42 and 58.97 per cent respectively in soup I. HCl extractability of all the minerals were significantly (P≤0.05) higher in soup II (70.60, 96.39, 57.75 and 67.57 % for iron, zinc, phosphorus and calcium respectively) (Table 2).

Table.1 Nutritive value of ripe mango per 100g

Component	**Content**		
	Soup I	**Soup II**	**'t' value**
Proximate composition (%)			
Moisture	83.69±0.40	84.04±0.74	0.71
Crude protein	14.52±7.21	13.96±0.14	3.49*
Crude Fat	5.80±0.24	5.78±0.14	3.38
Total Ash	2.38±0.96	2.37±0.27	3.50
Crude Fibre	1.02±2.19	1.62±0.17	1.65
Carbohydrate composition (%)			
Total Carbohydrate	76.28±2.29	76.27±2.35	0.63
Total Soluble sugars	20.47±0.30	20.42±0.30	0.12
Reducing sugar	1.51±0.21	1.67±0.22	0.51
Non-Reducing Sugars	18.95±0.11	18.74±0.13	1.21
Starch	29.92±1.01	27.63±0.57	3.08*
Dietary fibre constituents(g/100g)			
Total fibre	16.81±2.84	16.61±0.65	0.29
Soluble fibre	5.45±0.16	5.88±0.10	2.14
Insoluble fibre	11.35±0.18	10.01±5.77	6.97*
Antinutritional factor and *In vitro* protein digestibility			
Polyphenol(mg/100g)	169.81 ±2.12	162.70±0.92	3.06*
In vitro protein digestibility (%)	60.97±2.21	75.27±1.96	8.37*

Values are mean ± SE of three independent determinations
Soup I: Untreated mushroom, Soup II: Treated mushroom
't' value with *denotes significant (p≤0.05) difference in the given row

Table.2 Mineral composition and their HCl extractability in Shiitake mushroom Instant Soup mixes

Component	Content		
	Soup I	Soup II	't' value
Mineral content (mg/100g)			
Iron	7.60±0.31	8.62±0.47	1.78
Zinc	8.14±0.14	8.26±0.08	0.50
Phosphorus	842.27±1.76	854.00±1.73	15.96
Calcium	38.81±0.36	39.75±0.24	2.13
HCl extractability (%)			
Iron	63.39±1.75	70.60±0.36	4.02*
Zinc	92.95±0.80	96.39±1.76	0.38*
Phosphorus	47.42±0.01	57.75±0.68	0.83*
Calcium	58.97±3.75	67.57±0.93	2.22*

Values are mean ± SE of three independent determinations
Soup I = Untreated mushroom, Soup II = Treated mushroom
't' value with *denotes significant (p≤0.05) difference in the given row

Table.3 Sensory characteristics of Shiitake mushroom instant soup mixes after storage

Treatment	Storage period (days)			
	0	15	30	CD(P≤0.05)
Colour				
Soup I	8.00±0.14	7.92±0.10	7.72±0.11	NS
Soup II	8.25±0.17	8.15±0.15	8.15±0.13	NS
Appearance				
Soup I	8.10±0.18	7.80±0.15	7.85±0.13	NS
Soup II	8.25±0.17	8.15±0.13	8.15±0.16	NS
Aroma				
Soup I	7.95±0.21	7.80±0.15	7.80±0.50	NS
Soup II	7.95±0.20	7.75±0.12	7.75±0.21	NS
Texture				
Soup I	7.90±0.28	8.10±0.12	8.12±0.11	NS
Soup II	8.25±0.20	8.15±0.11	8.20±0.21	NS
Taste				
Soup I	7.60±0.20	7.60±0.17	7.52±0.15	NS
Soup II	8.00±0.21	7.85±0.13	7.80±0.10	NS
Overall Acceptability				
Soup I	7.91±0.08	7.84±0.24	7.70±0.26	NS
Soup II	8.14±0.06	7.82±0.13	7.90±0.17	NS

Values are mean ± SE of ten independent determinations
Soup I = Untreated mushroom, Soup II = Treated mushroom

Table.4 Effect of storage period on fat acidity (mg KOH/100gm) of Shiitake mushroom soup mixes (on dry weight basis)

Treatment	Storage (days)			
	0	15	30	CD(P≤0.05)
Soup I	2.39 ±0.38	2.64±0.28	2.97±0.29	0.66
Soup II	2.36±0.50	2.42±0.47	2.45±0.45	0.97

Values are mean ± SE of three independent determinations
Soup I = Untreated mushroom, Soup II = Treated mushroom

Table.5 Total bacterial count (cfu/g) of Shiitake instant soup mixes at different storage periods

Treatment	Storage period (days)		
	Total bacterial count (cfu/g)		
	0	15	30
Soup I	0	1×10^{1}	4×10^{2}
Soup II	0	0	2×10^{2}

Soup I = Untreated mushroom; Soup II = Treated mushroom

Plate.1 Soup I = Untreated mushroom soup; Soup II = Treated mushroom soup

Both soup mixes had acceptable mean scores on 0 day with no significant (P≤0.05) difference up to 30th day of storage (Table 3). The fat acidity of soup mixes exhibited non-significant (P≤0.05) changes during storage period (Table 4). The total bacterial count of soup I varied from 0 to 4×10^{2} (cfu/g) of instant soup mix during 30 days of storage. The total bacterial count of Type I soup and Type II ranged from 0 to 4×10^{2} and 0 to 2×10^{2} cfu/g of soup, respectively. These were within the acceptable range upto 30th days of storage (Table 5).

The Shiitake, is highly prized in Asia for its nutritional qualities such as high protein, dietary fibers and important mineral contents, vitamins B1, B2, B3 and B12 (in trace amounts), vitamin C, ergosterol and the provitamin D2 (Regula and Siwulski,2007; Ko *et al*.,2008). Shiitake is rich in several anti-oxidants (selenium, uric acid, vitamin A, E, C) as well as vitamin D (Kitzberger *et al*., 2007; Zembron *et al*., 2013). Similar work on product development from mushrooms, their evaluation and shelf life has been reported by various other authors (Bora and Kawatra, 2014 Singh and Sindhu, 2016; Singh *et al*., 2016a; Singh *et al*., 2016b).

In conclusion the developed products were organoleptically acceptable. The developed

products could be stored successfully upto 30 days. It can be concluded that the Shiitake mushroom has a potential for use in food processing industry.

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