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Tarun Kumar
Department of Agricultural Engineering, Sardar Vallabhbhai Patel University of Agriculture & Technology, Meerut, Uttar Pradesh, India

Samsher
Department of Agricultural Engineering, Sardar Vallabhbhai Patel University of Agriculture & Technology, Meerut, Uttar Pradesh, India

Suresh Chandra
Department of Agricultural Engineering, Sardar Vallabhbhai Patel University of Agriculture & Technology, Meerut, Uttar Pradesh, India

Neelesh Chauhan
Department of Agricultural Engineering, Sardar Vallabhbhai Patel University of Agriculture & Technology, Meerut, Uttar Pradesh, India

Gopal Singh
Department of Plant pathology, Sardar Vallabhbhai Patel University of Agriculture & Technology, Meerut, Uttar Pradesh, India

Vaishali
Department of Agricultural Biotechnology, Sardar Vallabhbhai Patel University of Agriculture & Technology, Meerut, Uttar Pradesh, India

Corresponding Author:
Tarun Kumar
Department of Agricultural Engineering, Sardar Vallabhbhai Patel University of Agriculture & Technology, Meerut, Uttar Pradesh, India

Nutritional content of different pretreated ready-to-make mushroom (*Pleurotus florida*) soup powders

Tarun Kumar, Samsher, Suresh Chandra, Neelesh Chauhan, Gopal Singh and Vaishali

Abstract
Soups are commonly used as appetizers but also as main course by the diet-conscious. Good quality ready-to-make mushroom soup powder of three formulations (labeled as M_{40}, M_{50} and M_{60}) were prepared during this experiment using fresh mushroom powder produced from oyster mushroom dried in the hot air oven. Products were kept in pet jar during storage. Physico-chemical parameters like moisture, ash, fat, protein, crude fibre, sugar, carbohydrates, energy, fatty acids, minerals, vitamins etc. were evaluated using chemical methods as well as modern highly sophisticated machines like GC-FID, ICP-MS, LCMS/MS, UPLC-DAD and UPLC-FLD. Investigation for organoleptic evaluation of the products was also performed during storage. On the basis of the experimental data it may be concluded that M_{60} sample shows better nutritional as well as overall acceptability score as compare to M_{40} and M_{50} sample. This is due to addition of more percentage of mushroom powder increases its nutritional quality of the soup samples. All the data were analyzed using CRD design of ANOVA and were found to be significant at $p<0.05$ level of significance.

Keywords: Mushroom soup powder, nutritional content, GC-FID, UPLC-DAD, sensory

Introduction
Mushrooms also called white vegetables or boneless vegetarian meat that can provide balance diet in sufficient quantities for human nutrition and contain various potent pharma-nutritional compounds. The cultivation, production and application of mushrooms are tremendously increasing very fast throughout the world, mainly due to their nutritional properties and medicinal attributes and their unique flavour and texture (Ares, 2007) [1]. Hence, the uniqueness of promising food ingredients and flavour together with enhanced health promoting properties in mushrooms is at present one of the key global market trends (Netzel *et al.*, 2007) [2]. Mushrooms are a good source of vitamins and minerals. Recently, the issues regarding the human nutrition are always being important and the outbreak of food related to animal meat sources has becomes the issues to be more complicated. According to Chandra and Samsher (2006) [3], fresh mushrooms have a short shelf life. Therefore, it is necessary that they are either marketed soon after harvesting or preserved with special care using processes such as drying and storing in cold or controlled environmental storage. In the peak period of production due to the glut in the market and owing to highly perishable nature, its preservation into more value added stable products is of great importance.

Materials and methods
Fresh mushrooms (*Pleurotus Florida*) were procured from the Mushroom Production Unit and experiment was conducted at Food Analysis Laboratory of Sardar Vallabhbhai Patel University of Agriculture and Technology, Modipuram, Meerut.

Sample Preparation: Mushroom soup powder were developed by mixing the mushroom powder with other ingredients like corn flour, milk powder, salt, cumin powder, black pepper and sugar etc. in the 3 ratios as follow-

Table 1: Ingredients for mushroom soup powder samples

Ingredients (g)	Sample code		
	M_{40}	M_{50}	M_{60}
Mushroom Powder	40	50	60
Corn Flour	15	15	15
Milk Powder	135	125	115
Salt	25	25	25
Cumin Powder	5	5	5
Black Pepper	5	5	5
Sugar	25	25	25
Total	250	250	250

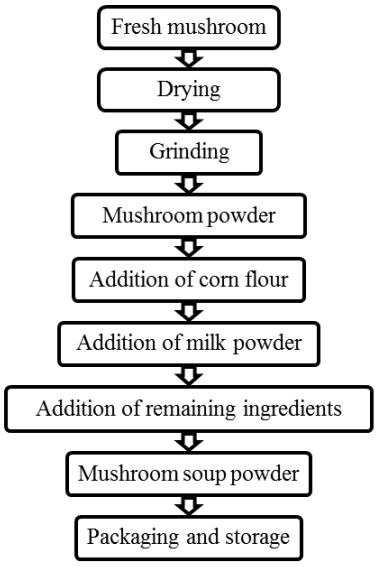

Fig 1: Process flowchart for preparation of mushroom soup powder

Nutritional Analyses: Proximate composition analyses for moisture, ash, protein, fat, crude fiber, sugar and carbohydrate were conducted using chemical methods given by AOAC (1990) [4]

Energy Content: (kcal) of the sample was obtained by calculation as following formula:

$$\text{Energy} = 4 \times [\text{Protein (\%)} + \text{Carbohydrate (\%)}] + [9 \times \text{Fat (\%)}]$$

Fat Content: Various fatty acids like SFA, PUFA and MUFA were estimated by GC-FID.

Mineral Content: Inductively coupled plasma-mass spectrometry (ICP-MS) was used for determination of total element concentration (mass fraction) in powder samples.

Vitamins: Determination of various types of vitamin B was done by LCMS/MS, vitamin A, vitamin C and vitamin D was done by UPLC-DAD and UPLC-FLD is used for determination of vitamin D.

Sensory Evaluation: Food products should have a typical taste, flavor, and texture. To test these organoleptic characteristics, sensory evaluation was done on the basis of 9 points hedonic scale. The sensory evaluation was carried out for color, aroma, texture, taste and overall acceptability.

Results and discussion

The proximate compositions of mushroom soup powder samples are presented in Table 2. Moisture (%) of samples was ranged from 3.68% to 3.70% depending upon the treatments; highest value was observed for M_{50} samples followed by M_{60} samples and lowest for M_{40} samples. Ash ranged from 15.57 % to 16.67 % among the samples and highest value was observed M_{60} samples while lowest for M_{40} samples. Farzana *et al.*, (2016) [5] reported 16.05±0.03 (%) of ash in soup powder enriched with mushroom-moringa leaf and our results resemblance with her findings. Other physico-chemical parameters like fat, protein, crude fiber, sugar and carbohydrate percentage was observed higher in case of M_{60} samples. Main reason behind this was the composition of the ingredients used in sample. Energy (kcal) ranged from 423.66 to 453.00 among samples. Since energy content was calculated with the help of formula based on protein, carbohydrate and fat content it was found highest in M_{60} samples followed by M_{50} samples and lowest for M_{40} samples. Highest saturated fatty acid (SFA) content was found 9.21% which was observed in M_{40} samples and similar value was observed in M_{60} samples also; M_{50} samples shows 9.15% of SFA. Values of PUFA, MUFA, mineral content (*viz*. copper, iron, zinc) and vitamins was found higher in case of M_{60} samples as compare to M_{50} and M_{40} samples.

Table 2: Proximate composition of mushroom soup powder samples (*n=3*)

Parameters	Sample codes					
	M_{40}		M_{50}		M_{60}	
Moisture (%)	3.68	±0.15	3.70	±0.15	3.69	±0.15
Ash (%)	15.57	±0.62	16.33	±0.65	16.67	±0.67
Fat (%)	18.28	±0.73	19.05	±0.76	19.88	±0.80
Protein (%)	18.54	±0.74	19.66	±0.79	20.45	±0.82
Crude fibre (%)	4.52	±0.18	5.33	±0.21	6.05	±0.24
Sugar (%)	31.85	±1.27	32.45	±1.30	33.15	±1.33
Carbohydrates (%)	46.24	±1.85	47.33	±1.89	48.07	±1.92
Energy (kcal)	423.66	±16.95	439.41	±17.58	453.00	±18.12
SFA (%)	9.21	±0.35	9.20	±0.37	9.21	±0.36
PUFA (%)	4.69	±0.19	4.98	±0.20	5.00	±0.20
MUFA (%)	2.72	±0.11	3.05	±0.12	3.18	±0.13
Copper(mg/kg)	3.87	±0.15	3.98	±0.16	4.15	±0.17
Iron(mg/kg)	45.37	±1.81	46.50	±1.86	47.33	±1.89
Zinc(mg/kg)	30.40	±1.22	31.33	±1.25	32.15	±1.29
Vitamin A(IU/kg)	148.89	±5.96	149.05	±5.90	149.16	±5.97
Vitamin B1(mg/kg)	3.87	±0.15	3.98	±0.16	4.26	±0.17
Vitamin B2(mg/kg)	10.88	±0.44	11.15	±0.45	11.67	±0.47
Vitamin B3(mg/kg)	81.67	±3.27	82.05	±3.28	82.89	±3.32
Vitamin B5(mg/kg)	30.77	±1.23	31.33	±1.25	32.00	±1.28
Vitamin B6(mg/kg)	3.09	±0.12	3.67	±0.15	4.05	±0.16
Vitamin C(mg/kg)	1.70	±0.07	1.85	±0.07	1.99	±0.08
Vitamin D(mg/kg)	10.00	±0.40	11.15	±0.45	12.05	±0.48
Vitamin E(mg/kg)	6.56	±0.26	7.05	±0.28	7.83	±0.31

Microbial load study of different mushroom soup powder was done during storage and result is represented in Fig. 2. Study revealed that total plate count (TPC) in different mushroom soup powder was ranged from 0.062 to 0.341 (× 10^3 CFU/g). Highest TPC was detected in M_{60} sample while lowest was found in M_{40} sample during the storage duration of 0 to 120 days.

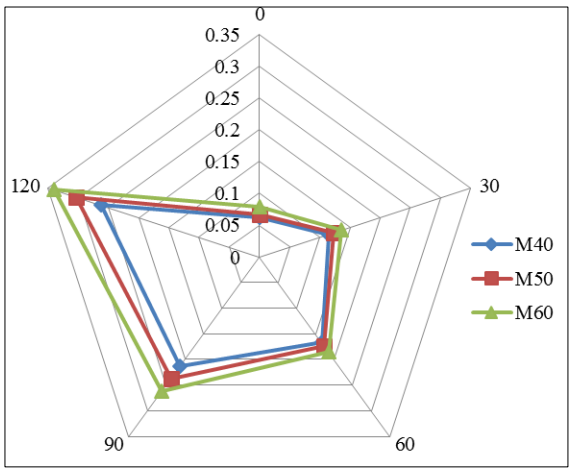

Fig 2: Changes in total plate count (CFU × 10^3/g) of mushroom soup powder during storage

The organoleptic properties of different mushroom soup powders were also analyzed during the storage period and presented as follow.

Colour: The sensory data for change in colour score of mushroom soup powders are presented in and Fig. 3 revealed that the highest score for colour was awarded to M_{60} and M_{50} samples (8.11, like very much), and minimum to M_{40} sample (8.08, like very much). Decrement was observed in the colour scores for all samples during storage and after 120 days of storage maximum score was found for M_{50} sample followed by M_{60} and then M_{40} sample.

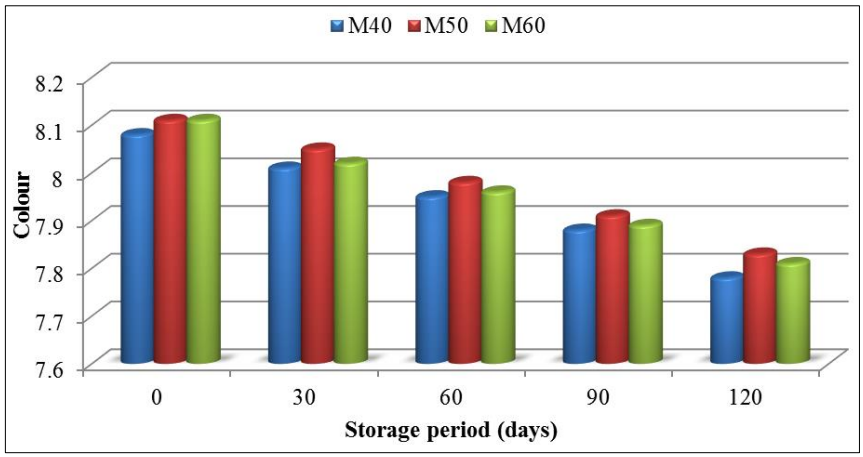

Fig 3: Changes in colour values of mushroom soup powder during storage

Texture: The sensory data for change in texture score of mushroom soup powders are presented in Fig. 4 revealed that the highest score for texture were awarded to M_{60} sample (7.93, like very much) then M_{50} sample (7.76, like very much), and minimum texture score were awarded to M_{40} sample (7.66, like very much). Some decrement was observed in the texture scores for all soup powders samples during storage and after 120 days of storage maximum score was found for M_{60} sample followed by M_{50} and then M_{40} sample.

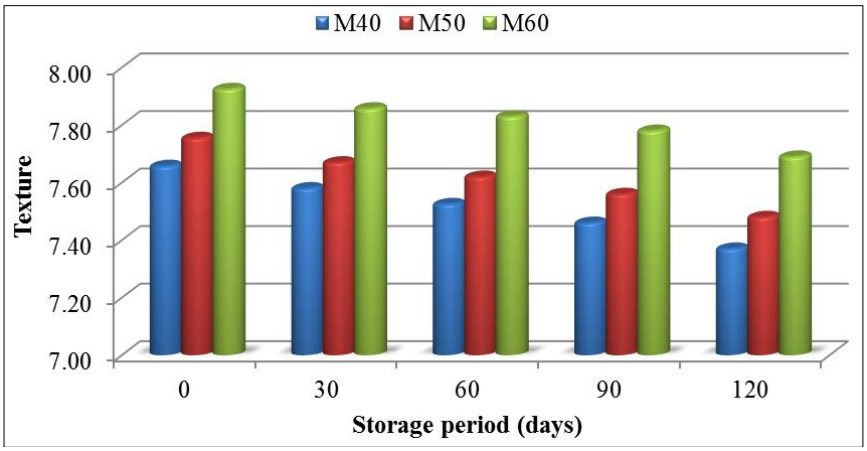

Fig 4: Changes in texture values of mushroom soup powder during storage

Aroma: The sensory data for change in aroma score of mushroom soup powders are presented in Fig. 5 revealed that the highest score for aroma were awarded to M_{60} sample (8.59, like extremely) then M_{50} sample (8.58, like extremely), and minimum aroma score were awarded to M_{40} sample (8.52, like extremely). Some decrement was observed in the aroma scores for all soup powders samples during storage and after 120 days of storage maximum score was found for M_{60} sample followed by M_{50} and then M_{40} sample.

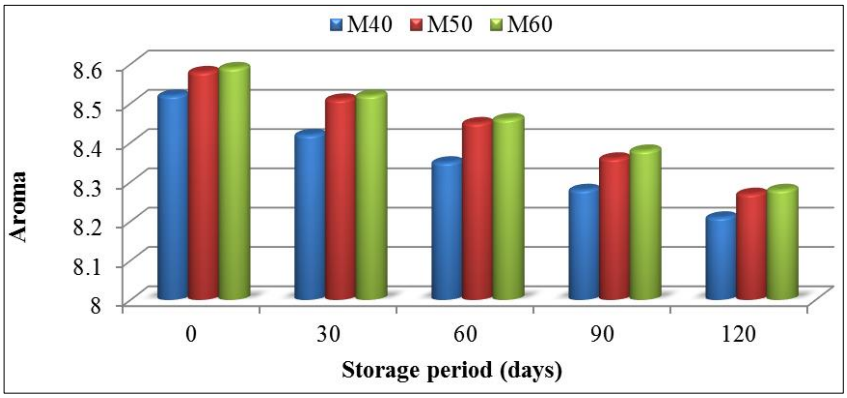

Fig 5: Changes in aroma values of mushroom soup powder during storage

Taste: The sensory data for change in taste score of mushroom soup powders are presented in Fig. 6 revealed that the highest score for taste were awarded to M_{60} sample (8.24, like very much) then M_{50} sample (8.22, like very much), and minimum taste score were awarded to M_{40} sample (8.21, like very much). Some decrement was observed in the taste scores for all soup powders samples during storage and after 120 days of storage maximum score was found for M_{60} sample followed by M_{50} and then M_{40} sample.

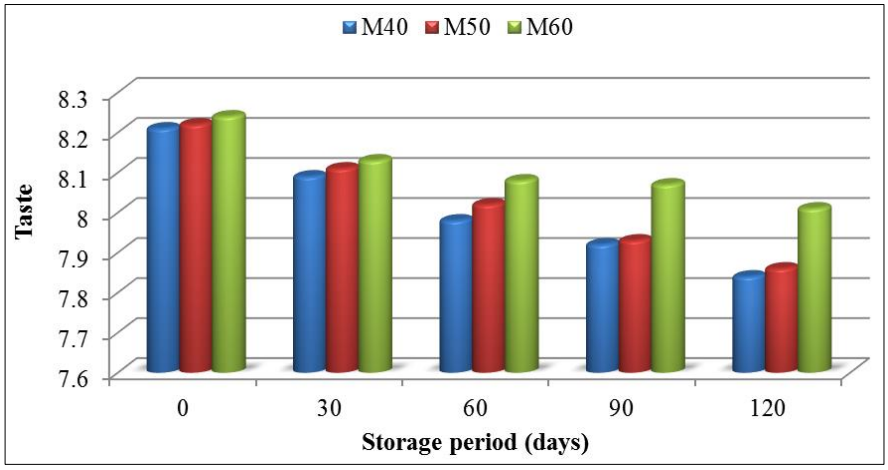

Fig 6: Changes in taste values of mushroom soup powder during storage

Overall acceptability: The sensory data for change in overall acceptability score of mushroom soup powders are presented in Fig. 7 revealed that the highest score for overall acceptability were awarded to M_{60} sample (8.22, like very much) then M_{50} sample (8.17, like very much), and minimum overall acceptability score were awarded to M_{40} sample (8.12, like very much). Some decrement was observed in the overall acceptability scores for all soup powders samples during storage and after 120 days of storage maximum score was found for M_{60} sample followed by M_{50} and then M_{40} sample.

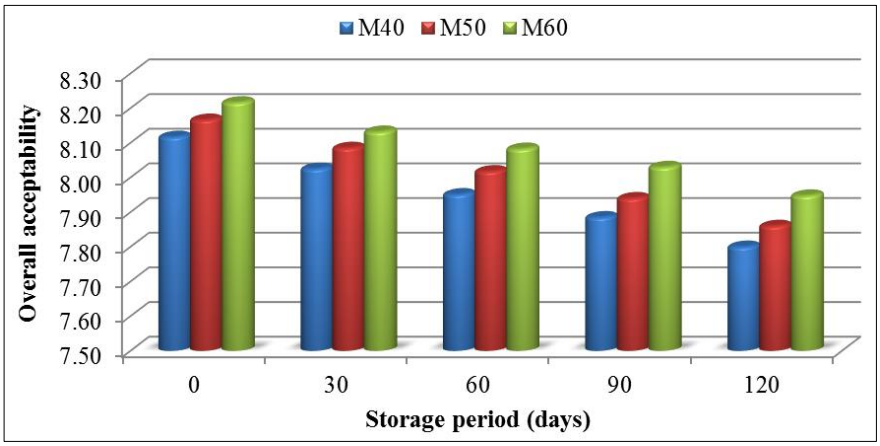

Fig 7: Changes in overall acceptability values of mushroom soup powder during storage.

Conclusions

Mushroom soup powder samples M_{50} (Mushroom powder 50gm + Other ingredients 200gm) got the highest moisture followed by M_{60} and M_{40} sample during storage duration. Mostly physiochemical parameters like ash, protein, fat, carbohydrates, sugar, energy and vitamins were found higher in M_{60} samples. Mineral content of mushroom soup powder samples remains intact during storage duration and no degradation in the values were seen. During organoleptic evaluations, M_{60} sample was found better over M_{50} and M_{40} samples; but highest TPC was also detected in M_{60} sample while lowest was found in M_{40} sample during storage. The data revealed that although there was a significant increase in total plate count of all mushroom soup samples during storage but was found below the hazardous level. All the data were analyzed using CRD design of ANOVA and all the parameters were found to be significant at $p<0.05$ level of significance.

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