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Formulation and quality evaluation of mushroom powder incorporated noodles

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Abstract
Mushroom is one of the most popular and widely cultivated fungi. Mushroom is an excellent source of protein, vitamins (B_1, B_2, niacin, vitamin C, folic acid, pro-vitamin D ergo sterol), minerals (P, K, Na, Ca and Fe), dietary fibers and is low in fat and also rich source of vitamin B_{12}, which is rarely found in plant diets, making them a great choice for vegetarians. In the present research efforts were being made to formulate the process for preparation of value-added product that is mushroom powder incorporated noodles. Five treatments were been made with the substitution of wheat flour with mushroom powder. Further, the best accepted formulation was assessed for nutritional composition. From the sensory evaluation it was evident that 5% formulation found optimum as per hedonic rating test, and the nutritional profile of mushroom powder incorporated noodles was found rich in protein, CHO, total minerals i.e., ash, energy and low in fat.

Keywords: mushroom incorporated noodles, sensory evaluation, nutritional profile

Introduction
The Indian diet is mostly made up of protein deficient cereals (wheat, rice and maize). The addition of mushroom recipes to the Indian diet will help to fill the protein gap and improve the general health and socio-economic conditions of backward communities. Digestible carbohydrate profile of mushrooms includes starches, pentose, hexoses, amino sugars, sugar alcohols, disaccharides and sugar acids. Since, the Neolithic and Palaeolithic ages, they have been employed in medicine (Samorini, 2001) [21]. Mushrooms are regarded to be a whole and safe food for people of all ages. This nutrient dense adaptable food can be taken as a substitute of meat, fish, fruits and vegetables (Kakon *et al*., 2012) [11]. Mushroom is an excellent source of protein, vitamins (B_1, B_2, niacin, vitamin C, folic acid, provitamin D ergo sterol), minerals (P, K, Na, Ca and Fe), dietary fibers and is low in fat (Kurtzman, 2005 [13]; Moharram *et al*., 2008) [15]. Mushrooms are an excellent source of vitamin B_{12}, which is rarely found in plant diets, making them a great choice for vegetarians (Koyyalamudi, 2009) [12].
Noodles are one of the most popular instant foods in many Asian countries. Instant noodles have become a most popular snack all around the world and their popularity is growing. Many researchers are investigating, if fortifying noodle could be used as a public health intervention to increase nutritional qualities. Taste, nutrition, ease, protection, a longer shelf life, and a reasonable price have all contributed to the success of this product (Pakhare *et al*., 2018) [17] Color, flavour, and texture as well as cooking quality are all important quality characteristics for instant noodles. Uniformity, rehydration rates during final preparation, and the presence or absence of rancid taste after prolonged storage (Gulia *et al*., 2014) [10]. Therefore, considering the above characteristics, of mushroom in human health an attempt was made to formulate and quality evaluation of mushroom noodles prepared from mushroom powder.

Materials and Methods
Present study entitled with formulation and development of mushroom powder incorporated noodles was carried out in the department of Food and Nutrition, Collage of community science at Post Graduate and Research center, Hyderabad, Rajendranagar, Telangana during the academic year of 2020 – 2021.

1. Raw materials
For the present study fresh oyster mushrooms were procured from the mushroom center (Department of Plant Pathology, PJTSAU), Rajendranagar. Commercially available wheat flour, maize flour, jowar flour, roasted bengal gram dhal, rice flour (RNR 15048), baking powder and additives required for product development were procured from local market of Hyderabad.

2. Preparation of mushroom powder
Fresh oyster mushroom, immediately after harvesting was collected, then cleaned to remove dirt, pieces of straw, etc. Oyster mushroom were chopped into small pieces with knife and blanched in hot water at 100°C for 3 minutes. Then water was drained and oyster mushrooms were spread in trays and kept in a hot air oven at 50°C. The time required for drying was 48 hours after which the dehydrated mushrooms ground to prepare powder. The powder was then sieved through 400-micron sieve. The prepared mushroom powder was stored at room temperature, by

keeping the mushroom powder moisture level 9% and kept for further preparation of mushroom-based value-added products.

3. Preparation of mushroom powder incorporated noodles

Fig 1: Flow chart for preparation of mushroom noodles

4. Nutritional profile of mushroom powder incorporated noodles

4.1 Determination of moisture

About 5.0g of coarsely powdered sample was weighed into the petridish and spread evenly for uniform drying at 105°C in hot air oven for 2 hours with open lid. After that the petridish was transferred to a desiccator for cooling. Then the weight of the petridish with sample was noted carefully until a constant weight was attained AOAC (2005) [5]. The moisture content of the samples was calculated by,

$$\text{Moisture (\%)} = \frac{\text{Initial weight - Final weight}}{\text{Total weight of the sample}} \text{X } 100$$

4.2 Determination of Protein

The crude protein content was estimated as per Kjeldahl method (AOAC, 2005) [7] and was calculated as percentage nitrogen of product and multiplied with 6.25 to obtain the protein content. This is based on the fact that organic components are oxidised and nitrogen is transformed to ammonium sulphate during digestion with concentrated sulphuric acid and catalysts. Ammonia is liberated when the reaction mixture is made alkaline, removed by steam distillation, collected, and titrated

Procedure

Powdered sample of 0.5 g was weighed into digestion tubes and digestion mixture along with 10.0 ml of concentrated H_2SO_4 for 1½ hr. at 375°C till the content of digestion flask get transparent colour. After the samples were allowed to cool and then diluted with distilled water. The ammonia from the samples was liberated through distillation after adding 40% NaOH and 4.0% of boric acid collected in conical flask using two drops of mixed indicator (1.0 ml of 0.2% bromocresol green + 3.0 ml of 0.2% methyl red). The contents were blue in colour after distillation. The titration was done adding indicator with standard 0.1 N HCl till the contents of the flask turned to pink colour. A blank was run simultaneously. The crude protein percentage was calculated by using the formula,

$$\text{Protien (\%)} = \frac{\text{(Sample TV-blank TV) x 0.014 x 0.1N of HCl x100 x 6.25}}{\text{Weight of the sample (g)}} \text{ X } 100$$

Total crude protein = % Nitrogen × 6.25

2.3 Determination of fat

Fat was estimated as crude ether extract of the dry material using automatic Soxtherm extraction unit by the method (AOAC, 1997) [5]. Dried 2.0 g of powdered sample remained after moisture content was taken in a thimble and placed in tube of Soxtherm extraction apparatus. About 100.0 ml of petroleum ether (40-60°C B.P.) solvent was added and were kept into the Soxtherm apparatus. The fat was extracted by running petroleum ether over the sample at the rate of 3-4 drops per sec for about 5hrs. Petroleum ether was evaporated in the apparatus and the flasks were dried with the residue in the hot air oven at 100ºC for 1 hr. and then cooled in desiccator and weighed. Fat percentage was calculated according to the following formula,

$$\text{Fat content (\%)} = \frac{\text{Final weight of extraction beaker - empty weight of extraction beaker}}{\text{Sample weight}} \text{ X } 100$$

2.4 Determination of ash

Crucibles used for ash content was weighted and dried in hot air woven for 110°C to a constant weight. 5.0 g of powdered sample was weighed and placed into the crucible and weight of crucible was taken. The sample was kept on flame for charring to remove the organic matter and then incinerated at 600°C for 3 hrs. in muffle furnace. The weight of crucible with its ash content was noted and the ash content was calculated and expressed as percentage of original sample (AOAC, 2005) [6].

$$\text{Ash (\%)} = \frac{\text{Weight of crucible with ash- weight of empty crucible}}{\text{Weight of the sample (g)}} \text{ X } 100$$

2.5 Crude fiber

Crude fiber was determined by following the method as described in (AOAC, 1990) [3]. About 1g of moisture and fat free powdered sample was weighed and placed in the fiber bags. The glass spacer was placed into the bags and were loaded to the sample carousel. The sample carousel was kept into glass container carefully, added with 500.0 ml of

1.25% dilute H_2SO_4 and glass container axial was heated for 30 min. After completion of time, the bags were washed by boiling with 500.0 ml distilled water for 30 min and followed by heating with 500.0 ml of 1.25% NaOH was added and left for another 30 min. Later again 500.0 ml distilled water was added and boiled for further 30 min. The residue was transferred to empty crucible and weighed then dried at 100°C for 4 hours in hot air oven, cooled in desiccator and weighed. The crucible was incinerated in a muffle furnace at 600°C for 3 hrs. Then crucible was cooled in desiccator and weighed. The crude fiber percentage was calculated by using the following formula,

$$\text{Crude fiber (\%)} = \frac{\text{Weight of residue - weight of ash}}{\text{Weight of the sample (g)}} \text{ X } 100$$

2.6 Determination of carbohydrates: Carbohydrate content was calculated by difference method i.e., subtracting the total of moisture, ash, protein, fat and crude fiber from 100 (AOAC, 1980) [2].

Carbohydrate (g) = 100 – (moisture + ash + protein + fat + crude fiber)

2.7 Determination of energy: Energy content was calculated by multiplying protein, fat and carbohydrate values obtained from analysis by 4, 9 and 4 respectively and expressed as kcal / 100 g (AOAC, 1980) [2].

Energy (kcal/100 g) = (Protein × 4) + (Fat × 9) + (Carbohydrates × 4)

2.8 Determination Total Dietary fiber (TDF): Total dietary fiber of the samples was analysed by the standard procedure of AOAC, (1995) [4].

5. Sensory evaluation

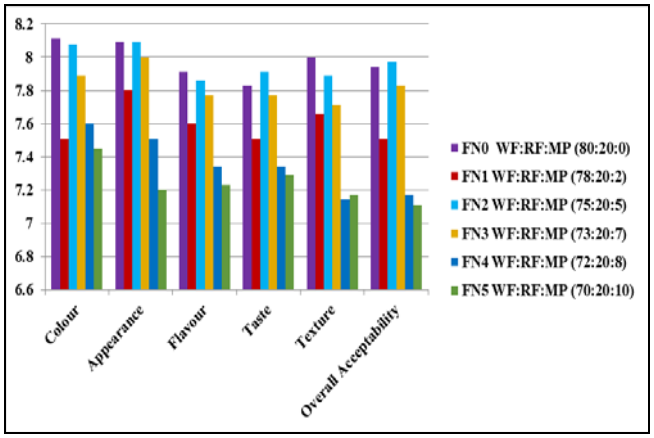
Sensory evaluation was conducted with the help of trained and semi-trained panel of 35 members from Post Graduate and Research Centre and AICRP-H.SC, Rajendranagar, Hyderabad by using 9-point hedonic scale. Mushroom products were scored for color, appearance, taste, flavor, after taste, consistency and overall acceptability. Scores were based on a hedonic scale of 1 to 9 where 1= dislike extremely; 2 = dislike very much; 3 = dislike moderately; 4 = dislike slightly; 5 = neither like nor dislike; 6 = like slightly; 7 = like moderately; 8 = Like very much; 9 = like extremely (Amerine *et al*., 1965) [1].

Results and Discussion

1. Sensory evaluation of mushroom noodles

Sensory evaluation is an important tool for new food product development and consumer responses are used to modify the product and play a fundamental role in the management of product quality in food industry. Sensory evaluation measures the reaction to stimuli resulting from consumption of a food or food product (Mihafu *et al*., 2020) [14]. The sensory evaluation scores of five mushroom powder incorporated noodles formulated with different proportions of oyster mushroom powder is given in Figure 2.

Five formulations of mushroom powder incorporated noodles (FN1 to FN5, 78:20:2; 75:20:5; 73:20:7; 72:20:8; 70:20:10) was prepared and evaluated for sensory attributes *viz*. Colour, appearance, flavour, taste, texture and overall acceptability. Among all 5 formulations the formulation FN2 (75:20:5) was found to be superior and scored higher sensory attributes with respect to colour (8.08), appearance (8.09), flavor (7.86), texture (7.91), taste (7.89) and overall acceptability (7.97). The sensory attributes of per cent of mushroom powder incorporated noodles acceptability in the sequence of 5% >7% > 2% > 8% and >10%. Hence, FN2 (75:20:5) formulation was selected as the best accepted product and subjected for further analytical analysis.



WF: Wheat flour; RF: Rice flour (RNR 150+48); MP: Mushroom powder

Fig 2: Sensory evaluation of prepared product

Parvin *et al*. (2020) [18] developed fortified noodles by incorporating various proportions of mushroom powder. The sensory score of overall acceptability of the noodles was found maximum in 5% mushroom incorporation noodles rather than the 8%, 10%; and also observed good taste without any odd flavours. Wahyono *et al*. (2018) [23] also developed noodles by incorporating various proportions of mushroom powder i.e. 2.5%, 5%, 7.5%, 10%, 12.5% and 15%. It was observed that the colour, taste, aroma and texture of the noodles were better accepted in 5% mushroom powder incorporated noodles compared to all other proportions.

2. Nutritional profile of mushroom powder incorporated noodles

2.1 Moisture

The moisture content of mushroom powder incorporated noodles was 4.86%. Arora *et al*. (2018) [8] reported that the moisture content of the developed mushroom powder incorporated noodles has lower moisture content (3.78%) compared to control noodles (4.3%) and it was observed that with increase in addition of mushroom powder the moisture content of noodles decreased from 4.3% to 3.78%. Parvin *et al*. (2020) [18] also reported that the moisture content of the developed noodles using mushroom powder was decreased from 7.90 % to 7.40 %. Further, Puwani *et al*. (2006) [20] explained about, the moisture content of noodles ranged from 6.32 % to 10.86 % would enhance the shelf-life stability of the food products by inhibiting the microbial activities and chemical reactions on storage.

2.2 Protein

The main objective of adding the mushroom powder was to increase the protein content in noodles. The protein content of mushroom powder incorporated noodles was 13.93g/100g. Parvin *et al*. (2020) [18] reported that the protein content of 5% mushroom powder incorporated noodles was (14.40 ± 0.08%); which was higher than the

control noodles (12.75 ± 0.06%) and same results was also observed a study conducted by Arora *et al*., (2018) where the protein content of developed mushroom noodles was (12.26%) higher than the control (9.65%). Thus, the results of the present investigation were in accordance with the results reported in the above findings. Prodhan *et al*. (2015) [19] developed mushroom incorporated biscuits in the range of 5%, 10% and 15% and found that, the protein content was increased from 12.80% to 13.45% with proportional increase in mushroom powder incorporation by replacement of wheat flour in biscuits formulations.

Okafor *et al*. (2012) [16] observed that wheat bread made with oyster mushroom powder had higher protein content with increase in mushroom powder incorporation from 5% to 25% and observed 83.65% of protein content with 25% addition of mushroom powder. Sheikh *et al*. (2013) [22] reported that 15% mushroom powder incorporation in cake had showed increase in protein content from 8.70% to 13.36%.

2.3 Fat

Fat plays a significant role in determining the shelf of food. A high fat content could increase the deterioration process causing rancidity, which may result in off-flavours and odours. Further, a high-fat diet entitles the consumer to various illnesses such as obesity, heart disease, and so on (Bello *et al*., 2017) [9]. The fat content of mushroom powder incorporated noodles was 0.77g/100 g respectively. A study conducted by (Bello *et al*., 2017) [9] mushroom powder incorporated biscuits, where the fat content was decreased from 21.71% to 19.05%.

2.4 Ash

The ash content of mushroom powder incorporated noodles was 3.06g/100g. The presence of high ash content in the noodles might be attributed to the fact that mushroom has been reported to the good source of minerals. The ash content present in the food material could be used as an index of minerals constituents as food (Bello *et al*., 2017) [9]. Parvin *et al*. (2020) [18] reported that, the ash content of mushroom noodles increased from 1.70 ± 0.05 to 2.40 ± 0.09 by 0 to 10% of mushroom powder incorporation.

2.5 Crude fiber

The fiber content of mushroom powder incorporated noodles was 2.03g/100g. Parvin *et al*. (2020) [18] conducted a study on mushroom powder incorporated noodles and stated that increase in mushroom incorporation from 0 to 10% in noodles would increase in fiber content from 0.12 ± 0.05 g/100 g to 1.43 ± 0.04 g/100 g. Bello *et al*. (2017) [9] reported that an increase in mushroom powder incorporation in biscuits from 5% to 30% resulted in an increase of crude fiber content (2.10 to 2.93%) in the samples. The increase in crude fiber content in mushroom incorporated noodles was found when compared to control. This can be due to the presence of fiber in the mushroom powder.

2.6 Carbohydrate

The carbohydrate content was found in the mushroom incorporated noodles was 74.39g/100g. The decrease in carbohydrate could be substituting the refined wheat flours with mushroom powder. Parvin *et al*. (2020) [18] reported that, the carbohydrate content of mushroom powder incorporated noodles lowered from 76.55 ± 0.22 to 70.56 ± 0.29g/100g by addition of 10% of mushroom powder. Sheikh *et al*. (2013) [22] also reported that, the incorporation of mushroom powder in cake from 0 to 15% had resulted in reduction of CHO content (57.09 to 46.81 g/100 g).

2.7 Energy

The energy content of mushroom powder incorporated noodles (364.63 kcal/100 g). Parvin *et al*. (2020) [18] conducted a study on mushroom incorporated noodles (0 to 10%) and observed increased energy value in mushroom incorporated noodles 367.46 ± 0.13 kcal/100g compare to control noodles 366.02 ± 0.25 kcal/100g and found no significant difference. This might be due to the fat content in oyster mushroom powder.

2.8 Total Dietary Fiber

The dietary content of mushroom powder incorporated noodles was 15.31g/100g. Arora *et al*., 2018) [8] reported that, 0 to 10% of mushroom powder in corporation in 100g of noodles has increased the dietary fibre from 1.8 to 2.18%.

Table 2: Nutritional profiling of mushroom powder incorporated noodles

Sr. No	Nutrients	Values (per cent)
1	Moisture (%)	4.86
2	Protein (%)	13.93
3	Fat (%)	0.77
4	Ash (%)	3.06
5	Crude Fiber (%)	2.03
6	Dietary Fiber (%)	15.31
7	Carbohydrate (%)	74.39
8	Energy (kcal)	364.63

Conclusion

It can be concluded that good quality noodles can be prepared from mushroom powder by adding mushroom powder upto 5%. The prepared mushroom powder incorporated noodles were accepted with good sensory scores and desirable nutritional qualities. Hence this developed technology of noodles supplemented with mushroom powder opens new avenue to the noodle's tenderer along with the health benefits. The developed technology was modest economy and can be commercially explored for noodles with mushroom powder incorporation along with health benefits to consumers.

Reference

1. Amerine MA, Pangborn RM and Roseller EB. Principles of sensory evaluation of food. Academic Press. London. 5, 1965.
2. AOAC. Official Methods for computation of carbohydrates and energy. Associatio of Official Analytical Chemists. 14th Edition. Washington, D.C. USA, 1980.
3. AOAC. Official Methods of Analysis for crude fiber. Association of Official Analytical Chemists. 15th Edition. Washington, D.C. USA, 1990.
4. AOAC. Official Methods of Analysis for fiber. Association of Official Analytical Chemists.14th Edition. Washington, DC. USA, 1995.
5. AOAC. Official Methods of Analysis for fat (crude) or ether extract in flour. Association of Official Analytical Chemists. 16th Edition. Washington, DC. USA, 1997.
6. AOAC. Official Methods of Analysis for ash, moisture

in flour. Association of Official Analytical Chemists. 18th Edition. Arlington VA 2209, USA. AOAC 929.09 & 03, chap 32, 2005, 1-2.
7. AOAC. Official Methods of Analysis for protein. Association of Official Analytical Chemists. 18th Edition. Arlington VA 2209, USA. AOAC 984.13, chapter,2005:04:31.
8. Arora B, Kamal S, Sharma VP. Nutritional and quality characteristics of instant noodles supplemented with oyster mushroom (P. ostreatus). Journal of Food Processing and Preservation,2018:42(2):1-8.
9. Bello M, Oluwamukomi MO, Enujiugha VN. Nutrient composition and sensory properties of biscuit from mushroom-wheat composite flours. Archives of Current Research International,2017:9(3):1-11.
10. Gulia N, Dhaka V, Khatkar BS. Instant Noodles: Processing, Quality, and Nutritional Aspects. Critical Reviews in Food Science and Nutrition, 2014:54(10):1386-1399.
11. Kakon AJ, Choudhury MBK, Saha S. Mushroom is an ideal food supplement. Journal of Dhaka National Medical College and Hospital,2012:18(1):58-62.
12. Koyyalamudi SR, Jeong SC, Cho KY, Pang G. Vitamin B12 is the active corrinoids produced in cultivated white button mushrooms (Agaricus bisporus). Journal of Agricultural and Food Chemistry,2009:(14):6327-6333.
13. Kurtzman RH. A review mushrooms: Sources for modern western medicine. Micologia Aplicada International,2005:17(2):21-33.
14. Mihafu, FD, Issa JY, Kamiyango MW. Implication of sensory evaluation and quality assessment in food product development: A Review. Current Research in Nutrition and Food Science Journal,2020:8(3):690-702.
15. Moharram HA, Salama MF, Hussien AA. Characterization of oyster mushroom mycelia as a food supplement. Australian Journal of Basic and Applied Sciences,2008:2:632-642.
16. Okafor JNC, Okafor GI, Ozumba AU, Elemo GN. Quality characteristics of bread made from wheat and Nigerian oyster mushroom (Pleurotus plumonarius) powder. Pakistan Journal of Nutrition,2012:11(1):5-10.
17. Pakhare KN, Dagadkhair AC, Udachan IS, Andhale RA. Studies on preparation and quality of nutritious noodles by incorporation of defatted rice bran and soy flour. Journal of Food Processing and Technology,2016:7(10):1-4.
18. Parvin R, Farzana T, Mohajan S, Rahman H, Rahman SS. Quality improvement of noodles with mushroom fortified and its comparison with local branded noodles. Journal of the Society of Nutrition and Food Science,2020:20:37-42.
19. Prodhan UK, Linkon KMMR, Al-Amin MF, Alam M. Development and quality evaluation of mushroom (Pleurotus sajor-caju) enriched biscuits. Emirates Journal of Food and Agriculture,2015:27(7):542-547.
20. Puwani EY, Widaningrum R, Thahir R, Muslich K. Effect of heat moisture treatment of sago starch on its noodle quality. International Journal of Agricultural Science,2006:7(1):8-14.
21. Samorini G. Fungi hallucinogeni. Studi etnomicologici. Telesterion, Dozza, Bolonga, Italy, 2001, 250.
22. Sheikh M, Kumar A, Islam M, Mahomud M. The Effects of Mushroom Powder on the Quality of Cake. Progressive Agriculture,2013:21:(1-2).
23. Wahyono A, Bakri A. Physicochemical and sensorial characteristics of noodle enriched with oyster mushroom (Pleorotus ostreatus) powder. Journal of Physics: Conference Series,2018:953(1):1-6.