STUDY ON VALUE ADDITION OF SELECTED SNACKS BY INCORPORATING MUSHROOM

BY

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CANDIDATE'S DECLARATION

I, hereby declare that the dissertation or part thereof
has not been submitted by me to any
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Parbhani

Date 26/06/2002

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CERTIFICATE-I

This is to certify that Ms. **Jaybhaye Savita Dnyanoba** has satisfactorily prosecuted her course of research for a period of not less than four semesters and that the dissertation entitled "***Study On Value Addition Of Selected Snacks By Incorporating Mushroom***" submitted by her is the result of original research work and is of sufficiently high standard to warrant it's presentation to the examination. I also certify that, the dissertation or part thereof has not been previously submitted by her for the award of a degree of any university.

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CERTIFICATE-II

This is to certify that the dissertation entitled "***Study On Value Addition Of Selected Snacks By Incorporating Mushroom***" submitted by Ms. **Jaybhaye Savita Dnyanoba** to the Marathwada Agricultural University in partial fulfilment of the requirements for the degree of **Master of Science (Home Science)** in the subject of Foods and Nutrition has been approved by the student's Advisory Committee after oral examination in collaboration with the external member.

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PARBHANI

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Chapter 1

INTRODUCTION

Good health is the prerequisite of good "quality of life" and adequate nutrition is an indispensable component of healthy life. Nutrition is the focal point for health and well being. There are innumerable factors intricately of an individual (Subbulakshmi and Naik, 1999).

India is the seventh largest and the second populous country in the world. A vast gap still exists between the population and food production. Especially there has always been a lack of harmony between the rapidly growing world population and the adequate supply of protein rich foods in the human diets. The scientists and other workers in the field of nutrition from different countries are involved in order to minimize the severity of the problem. This has posed a challenge to agricultural scientists and nutritionists to investigate the new and alternate sources of food (Haque, 1989).

Among the many alternate or novel sources of protein to bridge the protein gap, mushroom offer themselves as potential sources. They have got capacity to convert nutritionally valueless substances into high fat and protein food. The edible mushrooms attract the lovers of mushrooms hunters due to their flavour, palatability and nutritive value (Kannaiyan and Ramasamy, 1980).

Mushroom is thought to be derived from the French Word 'Mousseron', 'Mouse' or 'Moss', (Anon, 1994) while in India its known as 'Ksumpa' in Sanskrit and 'Khumbi' or 'Kukurmutta' in Hindi. Mushroom comprises a large heterogenous group with different shape, size, colour and edibility. Of the 2000 known edible species, only 20 are commercially cultivated. Some important mushrooms grown in India such as, Button / European / Temperate mushroom, Button / Edulis / Hot weather mushroom, Oyster mushroom, Paddy straw / Chinese / Tropical mushroom / Black ear mushroom, White milky mushroom, Brown cap / Giant mushroom and Shiitake mushroom (Pathak *et al.*, 2000).

Taking into account the different nutritional indices the food value of mushroom lies between meat and vegetable thus is regarded that as "vegetable's meat" (Crisian and Sands, 1978). The protein conversion efficiency of mushrooms is remarkable being about 50 times more as compared to even animal source of protein such as milk, egg and meat per unit land and time (Pathak *et al.*, 2000).

Mushroom has a good medicinal value. Because of the low starch content in mushroom, these can also be recommended to diabetic and obese patients. Moreover, mushrooms contain calvacin, which acts as antitumour agent for treating of tumours. Besides all these they can also be used for lowering down of the cholesterol level, rapid coagulation of blood and can

also be recommended for patient suffering from diseases of the breast and lungs, skin, gouts, jaundice. In mushrooms, Potassium Sodium ratio is very high which is ideal for patients of hypertension. Mushrooms contain folic acid, which is blood building vitamin and counteracts the pernicious anemia. They serve as a possible source of antibiotics and anti-cancer agents (Raza 2001). In mushrooms, potassium sodium ratio is very high which is ideal for patients of hypertension (Pathak *et al.*, 2000).

Mushrooms are rich sources of protein of high biological value. This is very pertinant in respect of providing sufficient quantities of proteins for human consumption mainly those whcse staple diets are included more cereals (Haque, 1989). The protein contains nearly all essential amino acids which in some species lies between 21 to 49 per cent (dry weight basis), which is higher as compare to vegetables (Alan and Padam, 1990). Mushrooms are rich in lysine and tryptophan, the two essential amino acids that are deficient in cereals. (Pathak *et al.*, 2000). The mushroom protein digestibility ranges between 71 and 91 per cent (Maw and Flegg, 1975).

Mushrooms are also an excellent source of vitamins such as ascorbic acid, pantothenic acid and folic acid (Haque and Chakrabarti, 1982). They contain good amount of vitamin C and B complex such as thiamine, riboflavin and niacin. (Pathak *et al.*, 2000). It contains minerals like calcium, phosphorus and an appreciable amount of iron (Haque and Chakrabarti, 1982).

The edible mushroom mycelium (10-20%) may be put in different products like sausages, minced meat and vegetables, soups, pastes and bakery products and many other dietary menus (Raza, 2001).

In view of the existing rate of protein deficiency mushroom a novel source of protein can be used for incorporation in selected food products. These products can be utilized to serve as a medium to supply more proteins. It is a well known fact, that the popularity of snacks for consumption is increasing among all age groups. Hence incorporation of mushrooms in snacks can serve as ideal source to provide more proteins.

The earlier studies conducted in the department of Foods and Nutrition have revealed that *Sev, Chakli, Khari bundi, Shankarpale* and B*esan wadi* are some of the traditional, popular and commonly consumed food products as snacks by the people of Marathwada region. Hence, five commonly consumed snacks of this region are selected, for determining the extent of incorporation of mushroom in percentage with an optimum level of acceptability.

Very few studies have been conducted on the value addition of snacks with incorporation of mushrooms. Hence present investigation will be undertaken with the following objectives.

1. To find out the effect of incorporation of different levels of mushroom on the acceptability of selected snacks.
2. To estimate the protein and protein digestibility of the selected snacks having the best/ well accepted level of incorporation of mushroom.

3. To determine the keeping quality of well accepted snacks with incorporation of mushroom.
4. To calculate the nutrient benefit ratio of well accepted snacks with incorporating mushroom.

Review of Literature

Chapter 2

REVIEW OF LITERATURE

Mushroom is being relished throughout the world as food and medicine. Mushroom provides a rich addition to the diet in the form of protein, valuable salt and vitamins. As food the nutritional value of mushroom lies between meat and vegetables. Being a good source of vitamin B and C; and minerals. Hence, the mushroom are giving importance because of their protein content and they have used in the preparation like soup, pastes, pickle, sausages, bakery products and many other dietary menus at varying levels for value addition of product in terms of nutritional quality.

The studies which have been reported in the literature on study of value addition of selected snacks by incorporating mushroom are review here under various heads.

2.1 Studies on processing of mushroom and use of mushroom in the food products.

2.2 Studies on nutritional composition of mushroom.

2.1 Studies on processing of mushroom and use of mushroom in the food products

Singh *et al.* (1977) studied the stability of *Pleurotus* for pickle preparation. The main principle here is that storage life is extended after partial removal of water from the fresh fruit bodies and with a combination of spices and salt. Since *Pleurotus* is a non-acid food unlike raw mango or lime, vinegar was also added; served for both increasing the taste and protection from microbial attack.

Rai and Sexena (1987) studied pickling of white button mushroom and reported that keeping quality and organoleptic tests were very good except few report that mushroom were more sour than the spice part.

Standardization of a method for the preparation of sweet chutney from edible mushrooms *Agaricus bisporus* (L) was studied by Joshi *et al.* (1991). Different recipes prepared such as high sugar with mushroom shreds, chutney with low sugar and with shreds, medium sugar and acid and with shreds, mushroom chutney without shreds but with high sugar content. Results showed that chutney with low sugar and high acid had better sensory qualities and good shelf-life than other product prepared from edible mushrooms.

Singh *et al.* (1994) conducted study on button mushrooms candy and pickle. The results obtained with the Hedonic Rating Test indicated that mushrooms candy and sweet pickle were most acceptable to all the respondent. Hence, mushroom can be prepared / cooked and stored in the form of candies and sweet pickles which have given delicious taste and flavour to the diet.

Anon (1994) conducted study on Hi-Tech mushroom paste export. Properties of mushroom paste and its uses in foods were outlined. At a concentrated of 1-3 per cent the paste had rich intense mushroom flavour; at concentration < 1 per cent paste acid as flavour enhancer. It also acts as a flavour potentiator by increasing the mushroom character of a mushroom ingredient. The paste also provides a slight, natural, sweetens and enhances salt flavours. The paste improves the eating qualities of food by increasing

viscosity and giving a richer mouth feel. The mushroom paste has been used experimentally in bakery product where it improved the yeast flavour of bread and reduced moisture evaporation loss.

Some industries reported to be using mushrooms to extract mushroom flavours, extraction of some medicinal compounds, preparation of tonics, cosmetic products and health drinks (Chang and Miles, 1993).

Utilization of whey for the manufacture of ready-to-serve mushroom soup was studied by Ghosh and Singh (1995). Cheese whey was utilized for the development of a whey based mushroom soup which was prepared with 4 per cent mushroom, 2.5 per cent corn flour and 90 per cent whey and found to be most acceptable. The total solid fat protein and viscosity values for the acceptable concoction were 13.01 per cent, 2.56 per cent, 2.65 per cent and 56 cp, respectively.

A study on production, processing and consumption pattern of mushroom was carried out by Singh *et al.* (1995). They reported that the world mushroom production had increased by seven fold. However, mushroom production does not demand land, but helps in the bioconversion of potential pollutants like agro-wastes to useful essential to developing country like India. Fresh mushrooms contain virtually no fat and cholesterol and hence they can be consumed by patients suffering from atherosclerosis. Mushroom foods can serve to improve the nutritional status of Indians and help in alleviating protein deficiency in children.

A study conducted on effect of whey concentration on the quality of whey based mushroom soup powder by Singh (1996) revealed that vacuum concentrated of whey (45 per cent total solids) can be utilized in the production of nutritious and ready to reconstitute mushroom soup powder. The soup powder is produced with cooking of 4 per cent mushroom slices (100 C for 10 min in concentrated whey) and properly blending mushrooms followed by addition of 2.5 per cent corn flour and subsequently spray drying under controlled conditions. The powder (100 g) was reconstituted well in boiled water (900 ml) with constant stirring.

Studies on storage stability land processing aspects of oyster mushroom was carried out by Kamble (1997). The fresh oyster mushrooms were utilized for the preparation of pickle using standard recipes and it was evaluated for their oraganoleptic qualities by expert panelist using a nine point hedonic scale. The mushroom pickle prepared by using 4 per cent salt concentration and 2 per cent chilli powder concentration with other constant ingredients was found to be most acceptable organoleptically.

Studies on dehydration and consumption pattern of oyster mushroom was conducted by Hashmi (1997). The fresh mushrooms were utilized for preparation of various products like mushroom pakoda, mushroom pulao and mushroom omlette using standard recipe. These products were evaluated for their organoleptic qualities by expert panelist using nine point hedonic scale. Among the products prepared, the mushroom omlette was very much liked by the panelist because this product secured maximum sensory score for colour, appearance, flavour, texture and overall acceptability. Further, the effect of

various levels of fresh oyster mushroom and organoleptic quality of a mushroom omlette was studied. It is revealed from the result that 15 per cent fresh oyster mushroom per egg was found to be the best.

Kaushal and Rawat (1998) presented survey report on oyster mushroom. In India, report of market survey indicated that oyster mushroom was far less popular than the button mushroom. While 75 per cent of the subjects were aware of button mushroom, only 5 per cent has a chance to come across oyster mushroom. However, the responses indicated that oyster mushroom has a good future market. Its acceptability level was good because of its taste, texture, aroma and ruffage etc.

A study *Pleurotus* mushroom: It's composition, preservation and role as human food conducted by Hussain (1998) revealed that *Pleurotus spp.* of mushroom had better nutritional and medicinal values. *Pleurotus spp.* of mushroom can be utilized in routes such as incorporation in preparation of low calorie diet and analog to animal and meat protein.

Bhosle (2000) conducted study on changes in chemical composition during harvesting stages of mushroom species (*Pleurotus flabellatus* and P*leurtous florida*) and preparation of mushroom powder. He found that protein content of mushroom was ranging from (20.06 to 24.87 %), fibre (7.50 to 9.50 %) and also rich in minerals like calcium, iron sodium, potassium, phosphorus. It was reported that, mineral and protein content of *Pleurotus flabellatus* was more than that of *Pleurotus florida.* Mushroom soup prepared by using 2.5 per cent corn flour and 4 per cent mushroom had maximum flavour and overall acceptability.

A study on trends in processing of mushroom and processed mushroom foods carried out by Dhamale (2000) revealed that shelf-life of mushroom can be increased by using suitable preservation methods viz. dehydration, freezing, canning, pickling etc. mushroom processed foods such as mushroom soup, mushroom soup powder, mushroom chutney can be prepared successfully.

Proximate composition of mushroom species and preparation of pickle from dehydrated mushroom was studied by Vishnupurikar (2000). Results indicated that protein content of mushroom ranged between 20 and 24 per cent, carbohydrate content from 52 to 55 per cent and mineral content varied from 6.00 to 6.25 per cent. The result obtained clearly indicated that the protein content and mineral content of *Pleurotus sajor-caju* was more than that of *Pelurotus sapidus*. In nutshell, finiding inferred that mushroom provides a rich addition to the human diet in the form of protein, valuable minerals and fibre. The mushroom pickle was prepared from dehydrated mushroom by using standard procedure. On the whole, mushroom pickle found to have better acceptability due to its good organoleptic properties.

2.2 Studies on nutritional composition of mushroom

Essential amino acid composition of the protein of a mushroom (*Volvariella diplasia*) was determined by Bano *et al.* (1971). The content of protein. calcium and iron in the fresh mushroom were found to be 3.90 mg, 5.60 mg and 1.70 mg respectively. Majority of the amino acids content in the protein was in adequate quantities, but for leucine (3.5 g/ 16 gN) and methionine (0.9 g/ 16 gN).

The digestibility of mushroom protein is an important factor in determining its dietary value. Numerous feeding studies using rats and human subjects have indicated a digestibility of between 71 and 90 per cent and in vitro digestibility of protein falls between 63 and 89 per cent for the mushroom protein (Flegg and Maw, 1976).

Purkayastha and Chandra (1976) conducted study on amino acid composition of the protein of some edible mushrooms (viz. *Agaricus campestris, Lentinus subnudus, Calocybe indica, Volvariella volvacea* and *Termitomyces eurhizus*) were estimated after growing them in a liquid culture medium. The protein content varied from 14 to 27 per cent on dry weight basis. Chromatographic analyses of acid hydrolysates of mycelial proteins indicated that most of common amino acids were present in selected varieties of mushrooms. Among the amino acids, leucine, threonine, tryosine and alanine were found to predominant in *A. campestris, L. subnudus, C. indica* and *V. volvacea* respectively.

Biochemistry of higher fungi-II. Submerged growth of a few mushrooms in synthetic media studied by Ghosh and Sengupta (1978) revealed that protein content of strains of three varieties of wild mushrooms namely *T.clypeatus, P. papillionaceus* and *G.chrysimyces* were ranged from 27.23 to 31.76, fat; 1.0 to 5.15 ; carbohydrate; 34.7 to 52 ; fibre, 10.5 to 24.25 and ash. 0.5 to 5 per cent (dry weight basis).

Crisian and Sands (1978) reported that mushrooms contain more protein than most of the other vegetables. They also reported that protein content of fresh mushrooms can be easily digested upto 70 to 90 per cent.

Mushrooms have a low carbohydrate content, no cholesterol and almost fat free (0.2 g / 100 g). Therefore, they form an important constituent for a balanced food.

Bano and Rajarathnam (1979) revealed that *P.flabellatus* grown on rice straw supplemented with groundnut cake, sesame cake, cotton seed powder and yeast cake after spawn run found to have an increased protein content fruit bodies produced merely on a substrate of rice straw. Also there was a two fold increase in the protein content of fruit bodies grown on cotton seed supplemented straw substrate.

Stapper (1979) reported that Indian varieties of oyster mushroom contains 91 per cent moisture. Other nutritional components were crude protein 21.6 per cent, fat 7.2 per cent, carbohydrates 60.5 per cent, and 48.6 per cent (N-free), crude fibre 11.9 per cent and ash 10.7 per cent on dry weight basis.

Zadrazil (1980) observed a increase in the protein content of the fruit bodies of *P.sajor-caju* when the substrate was supplemented with alfa alfa and soybean meal.

Bano *et al.* (1981) estimated mineral and heavy metal contents in four species of *Pleurotus* grown on rice straw. They found that potassium and phosphorus were the main constituents of ash of *Pleurotus species*, as in *Agaricus* and other mushrooms, while magnesium represents the third major mineral. On the other hand, calcium and iron were present in low concentrations in all the species.

Khanna and Garcha (1981) determined the fat content of fruit bodies of *P.florida*. The fruit bodies were found to contain 6 per cent of total lipids on dry weight basis.

Delcaire (1981) stated that soya protein will represent about 80 per cent of novel proteins for human consumption by the year 2000. The remainder coming mostly from krill and single cell protein and that mushrooms would represent only 3 per cent of the novel proteins.

The availability of iron in the fruit bodies of *P.flabellatus* and *P. sajor-caju* was studied by Haque and Chakrabarti (1982). Thirty two mice were reduced to a practically uniform state of anemia by injection with phenyl hydrazine HCL (8 mg/100 g body weight). They were divided into four groups. The control group was kept on copper supplemented milk throughout the experimental period in order to maintain anemic condition, as milk is deficient in iron. The two experimental groups of mice were fed with the two *Pleurotus species* separately (2.5 kg) supplemented with copper milk (Cu to milk in 0.8 mg : 100 ml). After 28 days of feeding, hemoglobin concentration and iron stored in liver were estimated. Mushroom supplemented groups showed a significant increase compared to control. Evidently, these results indicated that iron present in the *Pleurotus species* in available form and helped in its utilization by the presence of other enhancing factors like protein and ascorbic acid.

Studies on effect of maturity and heat treatments on the nutritional quality of paddy straw mushroom *Volvariella volvacea* conducted by Shobha *et al.* (1983). The spawn of *V.volvacea* mushroom was prepared. Both the

buttons were analysed for proximate principles, mineral and vitamin composition. It was found that the protein content in these mushroom was similar to most of other vegetables. Results showed that other nutrients were high in immature button than, mature button. Also stem contained comparatively more nutrients than the cap.

Verma *et al.* (1987) evaluated three types of edible mushrooms namely *Agaricus bisporus, Pleurotus sajor-caju* and *Volvariella volvacea* for their mineral content. Results indicated that *A. bisporus* was found to be superior to others in content of phosphorus, calcium, magnesium, potassium, copper and manganese whereas *Pleurotus sajor-caju* was found to be superior to other in sulphur, sodium and zinc content. It was also noticed that *V.volvacea* was superior to other in the iron content. The data showed that the cap had higher mineral content than stipe.

Rai and Soni (1987) reported that *Pleurotus sajor-caju* contains moisture 90.2 g, protein 2.59 g, fat 0.29 g, carbohydrates 5.2 g, fibre 1.3 g and ash 0.6 g per cent on weight basis (100 gm of fresh mushroom with the calorific value of 35).

Twenty spp. of edible mushrooms were analysed for total lipid and fatty acid profiles of spores, pilei and stipes by Hiroi and Tsuyuk (1988). They found that total lipid concentration in pilei and stipe were 3.2 – 15.5 per cent (DM basis) and 2.0 – 6.8 per cent respectively.

Comparison of lipids in fresh and dried *Aragekikurage* mushroom, *Auricularia polytrica* was studied by Takenaga *et al.* (1988). Total lipid

contents of fresh and dried mushrooms were 0.2 and 1.47 per cent. Saturated fatty acid concentration in total lipid of fresh and dried mushrooms were 18.6 and 20.8 per cent respectively.

Alan and Padam (1990) reported that the protein content of different mushroom species lies between 21 and 49 per cent (Dry weight basis) which is higher as compared to vegetables.

A study on nutritional and toxicological evaluation of *Pleurotus spp.* was conducted by Singh and Verma (1991). Two wild mushrooms viz. *Pleurotus djamor* and *P. platypus* collected from North Eastern Hill regions (NEH) of India and cultivated on Paddy straw, were analysed for their proximate composition and tested for edibility. The sporophores of *P.diamor* and *P.platypus* contained 14.10 and 16.86 per cent crude protein and 2.75 and 2.59 per cent crude fat, 91.70 and 92.69 per cent moisture respectively.

Bansundhara and Shantibala (1992) reported that nutrients such as proteins, amino acids, sugar, vitamins and fat were estimated during the peak-growing season from June to August in *Clitocybe multiceps*. There was a significant difference in nutrient contents of pileus and stipes and that the content of proteins, amino acids, fat, thiamine and ascorbic acid were higher in pileus than that of stipes while reducing and non reducing sugars were found higher in stipes than pileus.

Bano *et al.* (1992) investigated several mushroom species for the make up of the carbohydrate and protein. According to them these species contains good amount of protein ranging from 17.5 to 28.5 on dry weight basis. Also carbohydrate content ranged 57.40 to 59.90 on dry weight basis.

Phosphorus content of edible wild mushrooms of Hungary was studied by Vetter (1994) revealed that average phosphorus concentration was relatively high (8.21 g/kg dry basis).

Nutritional evaluation of *Pleurotus florida* was carried out by Bajai *et al.* (1996). They found that estimated mushroom rich in protein (24.76 - 28.94 %); soluble sugar (11.02- 22.05 %) and mineral (8.4 -12.43 %) content whereas the fat content was low (4.91-6.82 %). Though fat represented a minor component of *P.florida*, but it was rich in poiyunsaturated fatty acid (86 %), linoleic acid being the most predominant one.

Dhanda *et al.* (1996) studied four *Pleurtous species*, namely *P. fabellatus*, *P.florida*, *P.sajor-caju* and *P.ostreatus* were found to have high protein content (26.9 and 27.4 per cent dry weight) respectively and low carbohydrates content (40.75 to 0.25 dry weight) and lipid value between (6.4 and 5.4 per cent dry weight).

Proximate analysis of Iraqui truffles *Terfezia claveryi* (Black) and *Terfezia lafizi* (White) was studied by Kaisey *et al.* (1996). Results of chemical composition of the black and white tryffles indicated that 17.6 and 19.2 per cent protein, 3.9 and 3.7 per cent fat, 5.8 and 6.9 per cent ash and 5.5 per cent crude fibre and 66.7 and 64.7 per cent total carbohydrates (including dietary fibre) on dry weight basis for *T. Claveryi* and *Te.hafizi* respectively. Both the varieties contained palmitic, stearic acid and oleic acid as free fatty acids.

Proximate and mineral composition of four cultivars of *Pleurotus* mushroom was evaluated by Shah *et al.* (1997). Protein content of *Pleurotus* mushroom was found to be higher than cereals (wheat and maize) and comparable to that of legumes (peal and lentils).

Two Iraqui Truffles, Terfezia claveryi (Black) and Terfezia hafizi (white) were analyzed for their mineral contents by Kaisey *et al.* (1998). It was reported that the most abundant inorganic elements in *T. Claveryi* and *T.hafizi* were Potassium (1903 and 1940 mg/ 100 g), Phosphorus (850 and 793 mg/100 g.) and Silicon (2.3 and 2.9 mg/100 g) were comparatively in low quantities. Potassium contributed 65.8 to 67.7 per cent of the total mineral contents of the two truffles. Therefore, it can be utilized beneficially in the diets of people who take diuretics to control hypertension. Magnesium and Phosphorus were the other two main constituents of the ash of the two truflles. Iron and copper were present in appreciable amounts in the tested truffles as compared to other items.

Singh *et al.* (1999) studied physico-chemical changes in white button mushroom (*Agaricus bisporus*) at different drying temperatures. White button mushroom (containing 90.10 per cent moisture, 3.79 per cent protein, crude fibre 0.52 per cent, fat 0.32 per cent. Total ash 0.68 per cent and ascorbic acid 7.77 mg / 100 gm) was dried at 50, 60, 70, 80, 90, 100 and 110^0c respectively by hot air oven method. Minimum changes in the quality of mushrooms were noted at 60^oc. dehydration and redehydration ratios were found to be 15:2:1.and 1:2 :65 respectively at 60^0c. Drying rate pattern was also studied at this temperature and the critical moisture content was found to be 43.4 per cent.

Upadhyay and Rai (1999) observed cultivation and nutritive value of *Lentins squarrosulus* mushrooms were cultivated on wheat straw and paddy straw. Mushroom yield was better (48-52 per cent BE) on paddy straw than on wheat straw (31-36 per cent BE). Fruit bodies were found to contain 89.2 per cent moisture, 2.45 per cent protein, 5.6 per cent carbohydrate, 0.16 per cent fat, 0.79 per cent ash and 1.2 per cent fiber on fresh weight basis. Other important constituents per 100 g fresh weight were 827 mg soluble protein, 4.1 mg free amino acids, 420 mg free soluble sugar and 4.32 mg ascorbic acid.

A study on importance of mushroom was conducted by Raza (2001) revealed that mushrooms are rich in food values being food sources and out of 100 g it contains protein (3.6 g), fat (0.3 g), carbohydrates (1.5 g), dietary fibers (2.5 g) and ash (5.0 g) and the vitamin contains were exceptionally high. The protein contents were significantly higher than those provided by the food stuffs like dates, potatoes, lettuce, carrots and dried mushrooms containing more protein than beet.

Materials and Methods

Chapter 3

MATERIAL AND METHODS

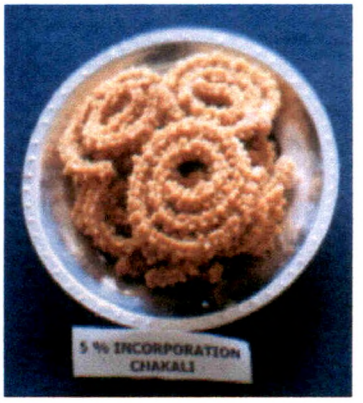
The present study was undertaken to find out the effect of incorporation of varying levels of mushroom in the commonly consumed selected snacks by the people of Marathwada region on the acceptability and protein content and digestibility of protein. The organoleptic characteristics of snacks prepared by incorporating different levels of mushroom were evaluated to determine the most suitable and most accepted level for the incorporation. Total protein content and digestibility of proteins were estimated in the snacks of most accepted level of incorporation and without incorporation of mushroom. Keeping quality of snacks was studied and nutrient benefit ratio was calculated.

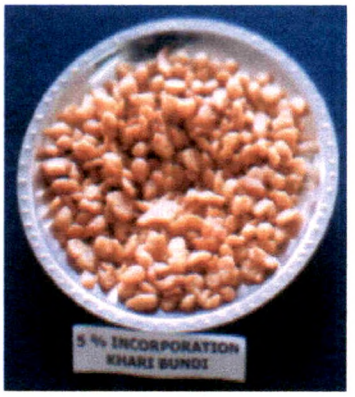
3.1 Selection of snacks preparation

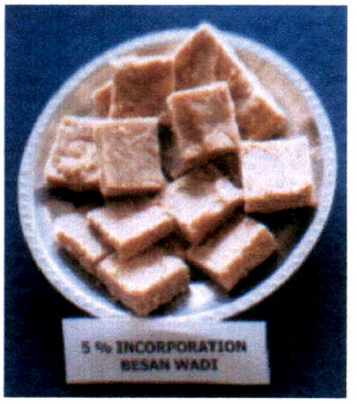
Sev, Chakli, Khari bundi, Shankarpale, Besan wadi; were the five snacks preparation selected for the incorporation of different levels of mushroom, as they were known to be the most commonly consumed snacks preparation among the diet of population in the Marathwada region of Maharashtra State.

3.2 Collection of materials

Dried mushrooms (*Pleurotus sajor-caju*) were procured from Shilpa Mushroom Training Center, Parbhani. Mushroom







Snacks Prepared with 5% Level of
Incorporation of Mushroom Powder

was cleaned and made free from foreign materials. Then they were stored in air tight containers at room temperature to last till the end of the experiment.

3.3 Preparation of Mushroom Powder

Dry mushrooms were cleaned and ground to a fine powder in a mixer in the laboratory to obtain mushroom powder.

The various steps followed while preparing mushroom powder from dry mushroom are given in flow chart (Fig. 1). Then the mushroom powder obtained was stored in air tight container and kept in room temperature to last till end of the experiment.

3.4 Incorporation of mushroom powder in the selected snacks

Mushroom powder was incorporated at different levels in the preparation of each of the selected snacks. The levels of mushroom powder incorporated were 5, 10, 15 and 20 per cent. The major ingredients replaced by the mushroom powder were bengal gram flour in the preparations of *Sev, Chakli, Khari bundi,* and *Besan wadi* whereas maida in *Shankarpale.*

3.5 Evaluation of acceptability of the selected snacks prepared by the incorporation of different levels of Mushroom powder

All the selected five snacks were prepared with different levels of incorporation of mushroom powder and also without the incorporation to serve as a control. These snacks were prepared by following the prevailing traditional methods of preparation in the Marathwada region of Maharashtra State (Joshi *et al.*, 1998).

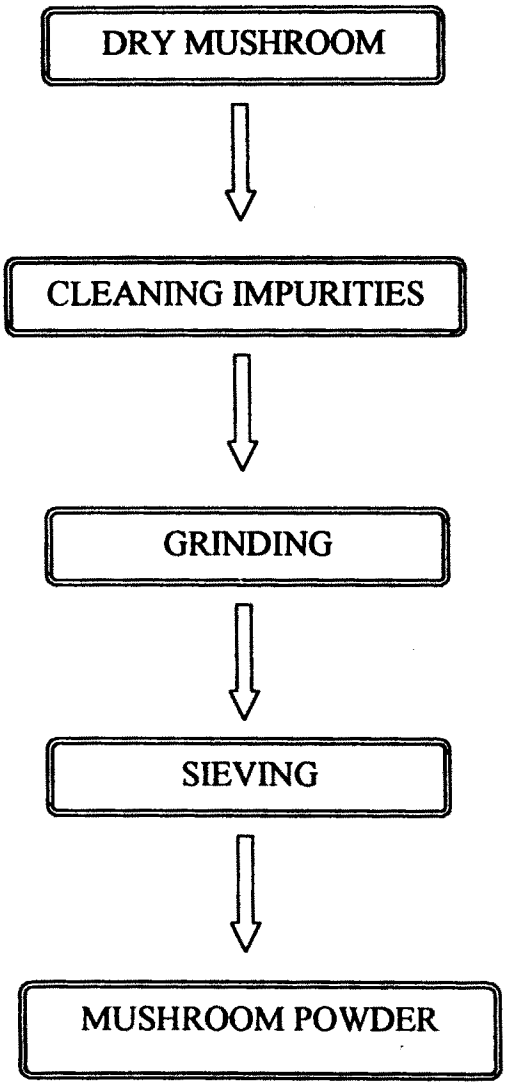


Fig. 1 Flow chart of preparation of mushroom powder.

Different Forms of Mushroom

The sample of all variations for each one of the selected snacks, were served freshly to 10 trained panelist, for the evaluation of organoleptic characteristics like colour, texture, taste, flavour and overall acceptability. A nine point hedonic scale was used for the evaluation of selected snacks (Swaminathan, 1987).

3.6 Estimation of total protein content and digestibility of proteins of selected snacks prepared with and without incorporation of mushroom powder

Protein content and digestibility of proteins in the snacks preparation of most accepted level of incorporation of mushroom was estimated.

The estimation of protein content was carried out by A.O.A.C. (1975) and in vitro digestibility of proteins was carried out by using standard method.

3.6.1 Determination of total protein content in the selected snacks

Total protein content was calculated by multiplying the estimated total nitrogen content with a factor 6.25.

3.6.1.1 Preparation of the reagents

3.6.1.1.1 Catalyst Mixture

It was prepared by grinding together in a mortar and pestle to a fine powder using 98 parts of potassium sulphate (K_2SO_4) and two parts of copper sulphate ($CuSO_4$).

3.6.1.1.2 Forty per cent Sodium Hydroxide Solution

A weighed amount of 40 g of sodium hydroxide pellets was dissolved in distilled water and diluted to 100ml.

3.6.1.1.3 Methyl red Indicator

3.6.1.1.4 Two per cent boric acid solution

Exactly 2.0 g of boric acid was dissolved in distilled water and the volume was made upto 100 ml.

3.6.1.1.5 0.1N Sulphuric acid

Exactly 27.8 ml of concentrated sulphuric acid was dissolved in distilled water and the volume was then made upto 1000 ml. This solution was 1N sulphuric acid. Then 100 ml of 1N sulphuric acid was diluted to 1000 ml with distilled water.

3.6.1.2 Procedure

One g. of defatted powdered sample of the selected snack was weighed in a butter paper and placed in 500 ml Kjeldhal flask, in triplicate. An amount of 5.0 g of catalyst mixture, 20 ml of concentrated sulphuric acid and 2-3 glass beads were added into each flask. Similarly, blank was also prepared by using same reagents. The contents in the flask were digested by heating for about eight hours until the digested material was clear. Then the contents were allowed to cool and diluted by rinsing down the neck of the flask with distilled water. The contents were then transferred to a 100 ml volumetric flask and the volume was made upto the mark with distilled water.

Ten ml. of boric acid solution was delivered in to 100 ml conical flask and 2.0 drops of Methyl red indicator were added and mixed. The flask was then placed under the condenser with the tip of condenser extending below the surface of boric acid solution. Five ml of digested sample was delivered into the distillation apparatus. Then 10 ml of 40 per cent sodium hydroxide solution was added and the funnel was washed with 2-3 ml of distilled water. Steam distillation was commenced and it was continued for 7 minutes, until about 40 ml distillate had been collected in the boric acid solution which had turned to light brown colour. Then, the tip of the condenser was washed with distilled water and removed. The distillation was then terminated and the apparatus was washed with distilled water.

The ammonia collected in boric acid was titrated against the standard 0.1 N sulphuric acid. The end point of the titration was noted when one drop of 0.1 N sulphuric acid produced a light pink colour. Then, the volume of 0.1 N sulphuric acid required to neutralize the collected sample was noted. The per cent of nitrogen present in the sample was then calculated by using the formula.

$$\text{Nitrogen (\%)} = \frac{\text{(Titrate value of sample - Titrate value of blank) X Normality of } H_2SO_4 \text{ X 14 X 100 X Dilution factor}}{\text{Weight of Sample (mg)}}$$

3.6.2 Determination of In vitro digestibility of proteins of the selected Snacks

3.6.2.1 Preparation of reagents

3.6.2.1.1 Pepsin in 0.1 N Hydrochloric acid

Dissolved 1.5 mg of Pepsin in 15 ml of 0.1 N Hydrochloric acid.

3.6.2.1.2 0.2 N Sodium Hydroxide solution

Eighty g. of sodium hydroxide pellets of reagent grade was dissolved in 1000 ml of distilled water. Ten ml. of which was made upto 100 ml in volumetric flask.

3.6.2.1.3 Pancreatic solution in phosphate buffer (pH 8.0)

Four mg. of pancreatin was dissolved in 7.5 ml of phosphate buffer solution. Phosphate buffer solution of pH 8.0 was prepared by dissolved 8.6467 g of Na_2Hpo_4 $2H_2o$ (Sodium phosphate dibasic) and 0.2215 g of $NaH_2po_42H_2o$ (Sodium dihydrogen orthophosphate monobasic) in 500 ml of distilled water.

3.6.2.1.4 30 per cent of Trichloroacetic acid solution

Thirty g. of Trichloroacetic acid was dissolved in 100 ml of distilled water.

3.6.2.1.5 0.1 N Hydrochloric acid

100 ml. of 1 N Hydrochloric acid was dissolved in water and the volume was made upto 1000 ml. (For 1N hydrocholric acid, 90 ml of conc. Hydrochloric acid was dissolved in water and the volume was made upto 1000 ml).

3.6.2.2 Procedure

An amount of 488 mg of defatted sample was taken in 250 ml glass stoppered conical flask, in triplicate. Then 15 ml of pepsin enzyme solution was added into each of the flasks. The contents of each flask were then incubated for 3 hours at 37^0C with intermittent shaking. At the end of three hours enzyme action in each flask was neutralized with 7.5 ml of 0.2N sodium hydroxide solution. Then 7.5 ml of pancreatic solution was added into each flask and the contents were incubated again for 24 hours at 37^0C with intermittent shaking. Two to three drops of toluene were added into each flask to avoid microbial growth. At the end of 24 hours, enzyme action was arrested by adding 4.0 ml of 30 per cent Trichloroacetic acid. The mixture was then centrifuged and filtered. Then nitrogen content in the supernatant was determined by micro-Kjekdhal method as described earlier.

3.7 Keeping quality of snacks with incorporation of mushroom powder

The snacks of most accepted level of incorporated mushroom were tested for keeping quality. To know the keeping quality, one sample was kept in controlled condition i.e. refrigerator and another was kept at room temperature for three weeks period.

They were evaluated for overall acceptability at initial, one week, two week and three week with the help of panel members.

3.8 Nutrient benefit ratio of selected snacks with incorporation of mushroom powder

Nutrient benefit ratio was calculated in terms of value addition of selected snacks with incorporated mushroom powder. Nutrient benefit ratio of the selected snacks prepared with the highly accepted level of incorporation of mushroom powder and the control snacks for nutrient (protein / digestibility of proteins) was calculated by using the following formula.

$$\text{Nutrient benefit ratio} = \frac{\text{Amount of nutrient in the mushroom incorporated snack}}{\text{Amount of nutrient in the control snack}}$$

3.9 Statistical analysis

Results of the acceptability of selected snacks were statistically analyzed by analysis of variance and critical difference test to find out the significant difference among the snacks prepared with varying level of incorporation of mushroom powder. The difference with regard to nutrient content between snacks prepared with and without incorporation of mushroom powder and keeping quality were tested by applying 't' test (Panse and Sukhatme, 1985).

Results and Discussion

Chapter 4

RESULTS AND DISCUSSION

The present study was undertaken on the value addition of selected snacks namely *Sev, Chakli, Kahri bundi, Shankarpale* and *Besan wadi* by incorporating mushroom powder at different levels in the place of major ingredient, bengal gram dhal / maida, in each of the selected snacks. Mushroom powder was incorporated in selected snacks at varying levels were 0, 5, 10, 15 and 20 per cent. The selected snacks were evaluated for the acceptability in terms of organoleptic characteristics following nine point hedonic scale (Swaminathan, 1987). Most accepted level of incorporation of mushroom powder in each snacks were analyzed for protein, protein digestibility and keeping quality.

4.1 Organoleptic characteristics of *Sev* prepared with different levels of incorporated mushroom powder

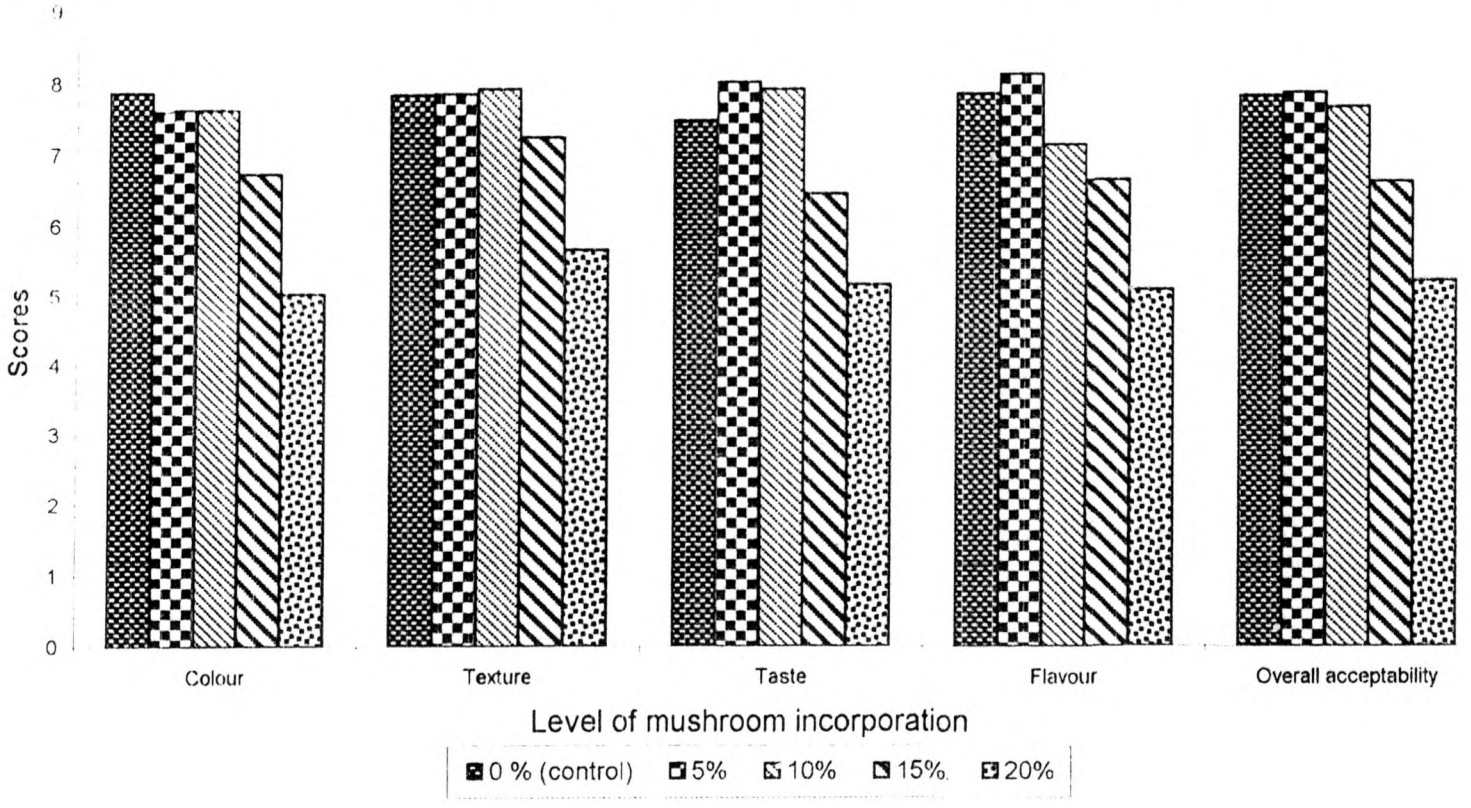
The mean scores for organoleptic characteristics of *Sev* prepared with different levels of mushroom powder are presented in Table 1 and illustrated in Figure 2.

The scores for colour of *Sev* prepared with 0, 5, 10, 15 and 20 per cent levels of incorporated mushroom powder were varied from 7.90 to 5.04. The maximum score for colour was recorded by the *Sev* (7.9) prepared without incorporation of mushroom powder, while the minimum score 5.04 was recorded by that with 20 per cent level of incorporation. Similar score was recorded for colour at 5 per cent and 10 per cent level of incorporation of mushroom powder. Whereas, the scores obtain for the colour of *Sev* at 15 per cent and 20 per cent

Table 1 : **Mean values of organoleptic scores for the acceptability of *Sev* prepared with and without incorporation of different levels of mushroom powder**

Level of Mushroom incorporation	Organoleptic scores of *Sev*				
	Colour	Texture	Taste	Flavour	Overall acceptability
0 % (control)	7.90	7.85	7.50	7.89	7.86
5 %	7.63	7.86	8.03	8.16	7.91
10 %	7.63	7.93	7.93	7.17	7.70
15 %	6.74	7.26	6.47	6.67	6.65
20 %	5.04	5.67	5.18	5.11	5.25
SE±	0.26	0.25	0.29	0.33	0.23
CD at 5 %	0.73	0.70	0.81	0.92	0.66

Fig. 2. Mean values of organoleptic scores for the acceptibility of *Sev* prepared with and without incorporation of different levels of mushroom powder



levels of incorporation of mushroom powder were found to be significantly lower than other that of score at 0, 5 and 10 per cent level of incorporation. Statistical analysis showed that the scores obtained for colour of *Sev* prepared with 10, 15 and 20 levels of incorporation of mushroom powder, differed significantly.

From the findings, it can be said that 5 and 10 per cent levels of incorporation of mushroom powder was found to be the most accepted level of incorporation in the preparation of *Sev*.

The scores of texture of *Sev* prepared with different levels of incorporated mushroom powder were ranging from 7.93 to 5.67. The maximum score was recorded by the 5 per cent level of incorporation of mushroom powder and the minimum score was recorded by the 20 per cent level of incorporation of mushroom powder. The scores for texture of *Sev* prepared with 0, 5 and 10 per cent levels of incorporated mushroom powder did not differ significantly. But the scores for 20 per cent level incorporation was significantly lower than other per cent level of incorporation. On the whole, it was found that the texture of *Sev* prepared with 10 per cent level of incorporation of mushroom powder was higher than other.

The scores obtained for the taste of *Sev* prepared with 0, 5, 10, 15 and 20 per cent levels of incorporation of mushroom powder were 7.50, 8.03, 7.93, 6.47 and 5.18 respectively. The maximum score was obtained by that with 5 per cent level of incorporation of mushroom powder which was comparatively higher than control.

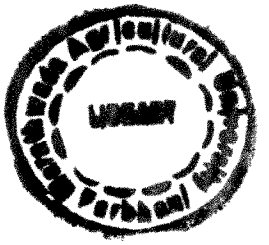
Statistical analysis indicated that, from 10, 15 and 20 per cent level of incorporation of mushroom powder in the *Sev* were differed significantly it, was found that, as the per cent level of incorporation of mushroom powder was increased, the taste of the product was found to be significantly decreased.

The score obtained for flavour by the *Sev* with 0, 5, 10, 15 and 20 per cent level of incorporation of mushroom powder were 7.89, 8.16, 7.17, 6.67 and 5.11 respectively. The maximum score of flavour was obtained by the 5 per cent level of incorporation of mushroom powder whereas, minimum for 20 per cent level of incorporation. The scores obtained for the falvour of *Sev* with 20 per cent level of incorporation of mushroom powder was significantly low.

In conclusion, it can be said that 5 per cent level of incorporation of mushroom powder was found to be the most accepted level of incorporation in the preparation of *Sev*.

The mean scores for overall acceptability of *Sev* prepared with 0, 5, 10, 15 and 20 per cent level of incorporated mushroom powder were found to be 7.86, 7.91, 7.70, 6.65 and 5.25 respectively. Statistical analysis revealed that the scores obtained for overall acceptability of *Sev* prepared with 15 and 20 per cent level of incorporation of mushroom powder found to differ significantly.

Maximum score for overall acceptability was recorded by *Sev* with 5 per cent level of incorporated mushroom powder, which was comparatively higher than control, that was consider as most accepted level of incorporation of mushroom powder.



From the result, it can be said that 5 per cent level of incorporation of mushroom powder was found to be the most accepted level of incorporation in the preparation of *Sev*.

These results are in agreement with the findings of Singh (1996) and Bhosle (2000) in mushroom soup. They reported that 4 per cent level of incorporation of mushroom was found to be most acceptable for incorporation. Similar results were recorded in the present study that 5 per cent level of incorporation of mushroom powder was found to be most acceptable level for the replacement of besan in *Sev*.

4.2 Organoleptic characteristics of *Chakli* prepared with different levels of incorporated mushroom powder

The mean values for organoleptic scores for the acceptability of *Chakli* prepared with and without incorporation of different levels of mushroom powder are given in Table 2 and depicted in Figure 3.

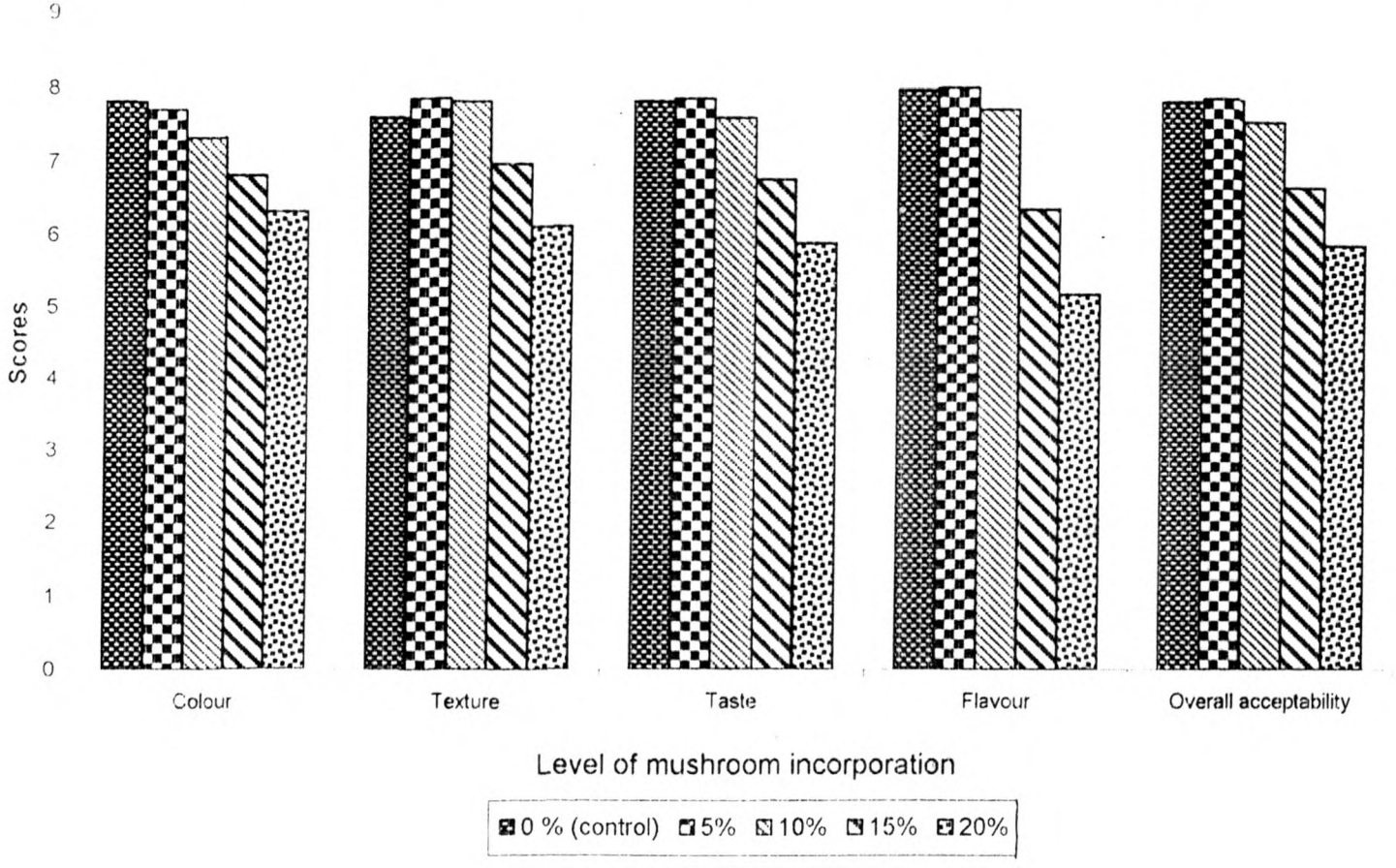
The maximum score of 7.8 for colour was recorded by *Chakli* prepared without the incorporation of mushroom powder, while minimum score of 6.32 was obtained by 20 per cent level of incorporation of mushroom powder. The scores of 5 and 10 per cent levels of incorporation of mushroom powder were found to be not significant. However, significantly low score was noticed for colour of *Chakli* prepared by 20 per cent level of incorporation of mushroom powder than that of 5 and 10 per cent levels of incorporation.

On the whole, it can be inferred from the findings that among the varying level of incorporation of mushroom powder, *Chakli* with 5 per cent level of

Table 2 : Mean values of organoleptic scores for the acceptability of *Chakli* prepared with and without incorporation of different levels of mushroom powder

Level of mushroom incorporation	Organoleptic scores of *Chakli*				
	Colour	Texture	Taste	Flavour	Overall acceptability
0 % (control)	7.80	7.61	7.83	7.99	7.83
5 %	7.69	7.87	7.86	8.02	7.87
10 %	7.31	7.83	7.60	7.73	7.57
15 %	6.80	6.98	6.77	6.37	6.67
20 %	6.32	6.13	5.90	5.20	5.88
SE±	0.23	0.16	0.21	0.28	0.17
CD at 5 %	0.63	0.45	0.58	0.78	0.48

Fig. 3. Mean values of organoleptic scores for the acceptibility of *Chakli* prepared with and without incorporation of different levels of mushroom powder



incorporation of mushroom powder was more accepted, as it recorded more score for colour.

Chakli prepared with 5 and 10 per cent levels of incorporation of mushroom powder secured almost the same score for texture (7.87 and 7.83). While the score of texture of *Chakli* with 10, 15 and 20 per cent levels of incorporation of mushroom powder were found to be differed significantly.

The scores recorded for taste of *Chakli* preparation without incorporation of mushroom powder was 7.83. The maximum score of 7.86 for taste was recorded by *Chakli* prepared with 5 per cent level of incorporation of mushroom powder and the minimum score of 5.9 was recorded by 20 per cent level of incorporation of mushroom powder in the preparation of *Chakli*. The scores obtained for *Chakli* prepared with 10, 15 and 20 per cent levels of incorporated mushroom powder, differed significantly.

On the whole, it was found that 5 per cent level of incorporation of mushroom powder in *Chakli* was considered as the most suitable and accepted level, as it secured higher rating with that of the control for taste.

The scores for flavour of *Chakli* prepared with 0, 5, 10, 15 and 20 per cent levels of incorporated mushroom powder were found to be 7.99, 8.02, 7.73, 6.37 and 5.20 respectively. The maximum score of 8.02 for flavour was secured by *Chakli* prepared with 5 per cent level of incorporation of mushroom powder, which was found to be more than that of the *Chakli* prepared without incorporation of mushroom powder, whereas the minimum score of 5.2 was recorded by *Chakli* prepared with 20 per cent level of incorporation.

It was found that the score registered for flavour of *Chakli* prepared with 10, 15 and 20 per cent levels of incorporated mushroom powder were significantly low than those prepared with (5 %) and without incorporation of mushroom powder.

The mean scores secured for overall acceptability was recorded by *Chakli* prepared with 0, 5, 10, 15 and 20 per cent levels of incorporated mushroom powder were 7.83, 7.87, 7.57, 6.67 and 5.88 respectively. The highest score of 7.87 for overall acceptability was recorded by the *Chakli* prepared with 5 per cent level of incorporation of mushroom powder, while the lowest score of 5.88 was recorded by *Chakli* prepared with 20 per cent level of incorporation. The recorded score for overall acceptability of *Chakli* with 5 and 10 per cent level of incorporated mushroom powder was found to be higher than the scores of *Chakli* with 15 and 20 per cent level of incorporation of mushroom powder. The score obtained for the overall acceptability of *Chakli* with 5 per cent level of incorporation of mushroom powder was significantly higher than that of *Chakli* with 15 and 20 per cent level of incorporation of mushroom powder.

On the whole, it was inferred from the results that 5 per cent level of incorporation of mushroom powder in *Chakli* was considered as the most accepted level, as it secured highest score than other.

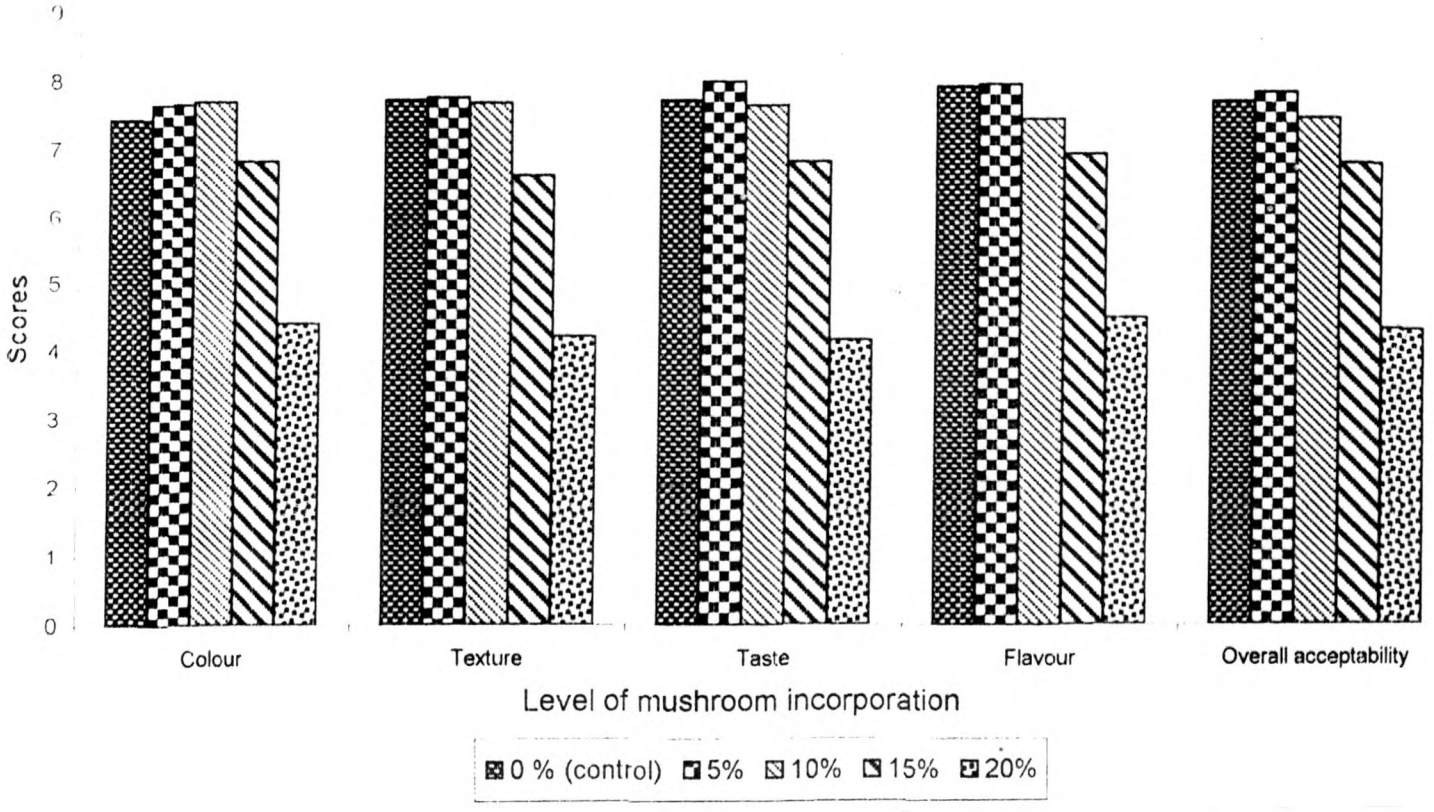
4.3 Oraganoleptic characteristics of *Khari bundi* prepared with different levels of incorporated mushroom powder

The mean scores for organoleptic characteristics of *Khari bundi* with different levels of incorporation of mushroom powder are given in Table 3 and presented in Figure 4.

Table 3 : Mean values of organoleptic scores for the acceptability of *Khari bundi* prepared with and without incorporation of different levels of mushroom powder

Level of mushroom incorporation	Organoleptic scores of *Khari bundi*				
	Colour	Texture	Taste	Flavour	Overall acceptability
0 % (control)	7.44	7.73	7.74	7.94	7.72
5 %	7.65	7.77	8.01	7.97	7.85
10 %	7.70	7.69	7.66	7.46	7.47
15 %	6.82	6.62	6.82	6.94	6.80
20 %	4.39	4.20	4.16	4.49	4.32
SE±	0.26	0.26	0.27	0.24	0.22
CD at 5 %	0.73	0.72	0.76	0.67	0.62

Fig. 4. Mean values of organoleptic scores for the acceptibility of *Khari bundi* prepared with and without incorporation of different levels of mushroom powder



The highest value was secured for the colour of *Khari bundi* prepared with 10 per cent level (7.70) and the lowest value (4.39) was obtained for colour of *Khari bundi* with 20 per cent level of incorporation of mushroom powder.

Statistical analysis indicated that the scores obtained for colour of *Khari bundi* prepared with 10, 15 and 20 per cent levels of incorporation of mushroom powder differed significantly from one another, but for significant difference was not noticed in colour of *Khari bundi* for 0, 5 and 10 per cent levels of incorporation of mushroom powder.

On the whole, *Khari bundi* with 10 per cent level of incorporation of mushroom powder was more acceptable followed by 5 per cent level of incorporation of mushroom powder.

Wide variations were noticed in the scores of texture of all the preparation of *Khari bundi.* The maximum score (7.77) was obtained by the *Khari bundi* prepared with 5 per cent level of incorporation of mushroom powder, whereas the minimum score (4.20) recorded by the *Khari bundi* prepared with the incorporation of 20 per cent level of mushroom powder. The mean scores for incorporated with mushroom powder at 0, 10 and 15 per cent levels were 7.73, 7.69 and 6.62 respectively. Statistical analysis indicated that the scores of the *Khari bundi* prepared with 10, 15 and 20 per cent levels of incorporation of mushroom powder were differed significantly.

The results revealed that 5 per cent level of incorporation of mushroom powder in *Khari bundi* was the most acceptable for texture, as it secured the highest mean score of 7.77.

The mean scores of taste for *Khari bundi* incorporated with mushroom powder with 0, 5, 10, 15 and 20 per cent levels were 7.74, 8.01, 7.66, 6.82 and 4.16 respectively. The score of 8.01 recorded by the 5 per cent level of incorporation of mushroom powder was higher than all other per cent level of incorporation.

Results indicated that, the score for taste of *Khari bundi* prepared with 15 and 20 per cent levels of incorporation of mushroom powder found to be significantly less than that of 10 per cent level of incorporation of mushroom.

In nutshell, it can be said that 5 per cent level of incorporation of mushroom powder in *Khari bundi* was most acceptable and suitable level for incorporation of mushroom powder in regard to taste.

Marked variations were noticed in the mean scores of flavour of the *Khari bundi* prepared with different levels of incorporated mushroom powder. The maximum score for flavour of 7.97 was recorded by the *Khari bundi* prepared with 5 per cent level of incorporation of mushroom powder, while the minimum score of 4.49 was recorded by that with 20 per cent level. Statistical analysis revealed the scored values of only preparations of *Khari bundi* with 15 and 20 per cent levels of incorporation of mushroom powder for flavour, differed significantly.

On the whole, it can be said that 5 per cent level of incorporation of mushroom powder in the preparation of *Khari bundi* recorded the high score than other levels of incorporation of mushroom powder. Hence 5 per cent level of incorporation can be considered better in terms of flavour of *Khari bundi*.

The mean value for overall acceptability of *Khari bundi* prepared with different levels of incorporated mushroom powder were ranging from 7.85 to 4.32. The scores obtained for overall acceptability of *Khari bundi* prepared with 0, 5, 10, 15 and 20 per cent levels of incorporation of mushroom powder were found to be 7.72, 7.85, 7.47, 6.80 and 4.32 respectively. The maximum score for overall acceptability was recorded by the 5 per cent and the minimum score was recorded by the 20 per cent level of incorporation of mushroom powder. Much difference was not noticed in the score for overall acceptability of *Khari bundi* prepared with 5 and 10 per cent level of incorporation of mushroom powder.

The score of *Khari bundi* obtained by 5 per cent level of incorporated mushroom powder was noticed to be greater than the scores of *Khari bundi* prepared with 10, 15 and 20 per cent levels of incorporation of mushroom powder. However, significant difference was not noticed between 5 and 10 per cent level of incorporation of mushroom powder.

It can be concluded from the result that highest scores for overall acceptability in the preparation of *Khari bundi* was noticed in 5 per cent level of incorporation of mushroom powder. Hence it was considered to be most acceptable level of incorporation.

Hashmi (1997) reported that fresh mushrooms were utilized for preparation of various products like mushroom pakoda, mushroom pulao and mushroom omlette. Among the products prepared the mushroom omlette with 15 per cent fresh oyster mushroom per egg was found to be the best as its secured maximum sensory score. Even in the presents study, more at organoleptic scores

was recorded by *Khari bundi* prepared with 5 per cent level of incorporation of mushroom powder.

4.4 Organoleptic characteristics of *Shankarpale* prepared with different levels of incorporated mushroom powder

The mean scores for organoleptic characteristics of *Shankarpale* with varying levels of incorporation of mushroom powder are presented in Table 4 with standard error and critical differences and illustrated in Figure 5.

The scores obtained for the colour of *Shanakarpale* prepared with 0, 5, 10, 15 and 20 per cent levels of incorporation of mushroom powder were 7.69, 7.48, 7.12, 7.01 and 5.56 respectively. The highest score of 7.69 was recorded by the control and the lowest score of 5.56 was recorded by the 20 per cent level of incorporation of mushroom powder in *Shankarpale* for the colour.

The scores obtained for colour of *Shankarpale* prepared with different per cent levels of incorporation of mushroom powder were differed from each other, but significant difference was noticed only in case of 15 and 20 per cent levels of incorporation.

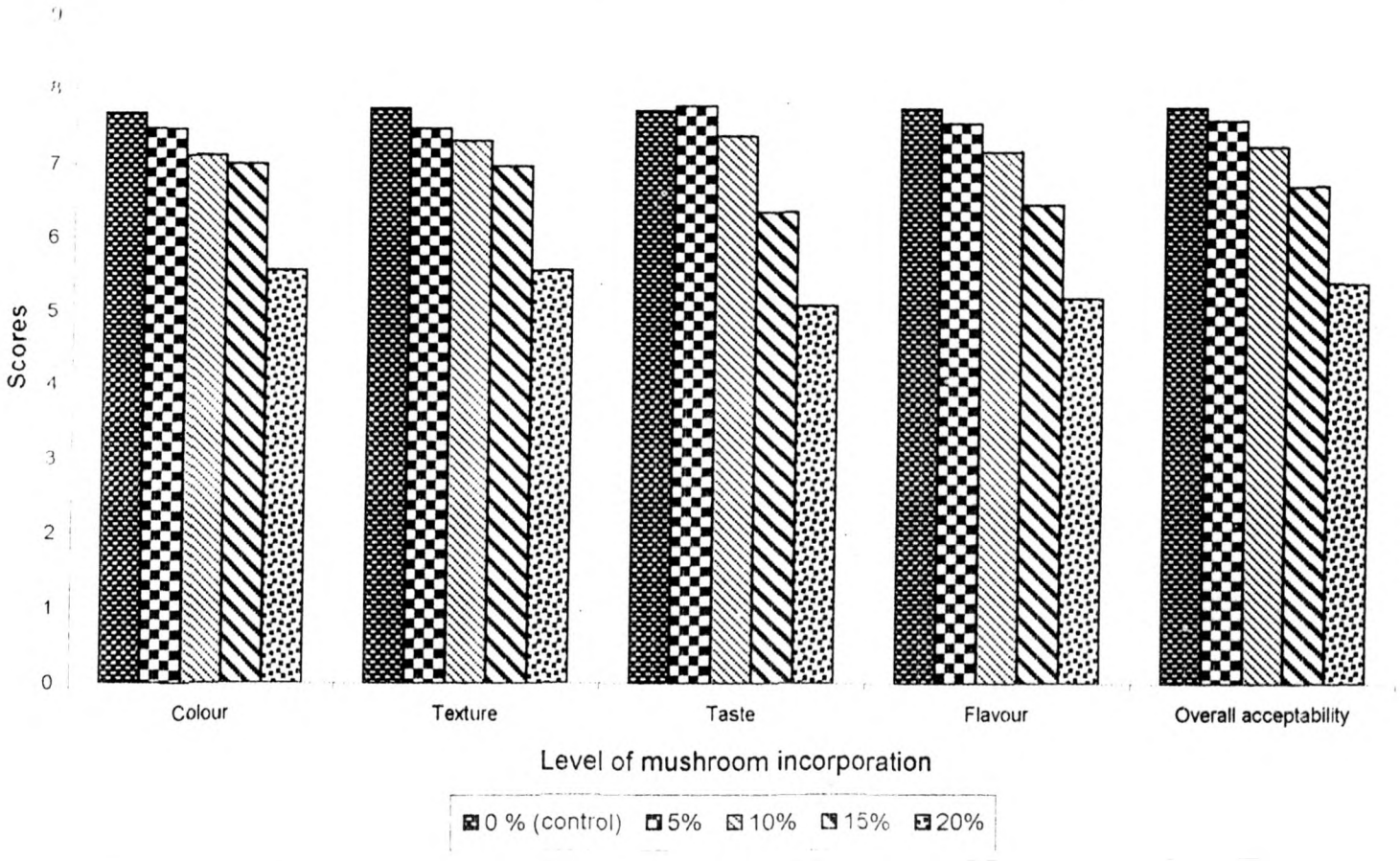
On the whole, from the result it can be said that in the preparation of *Shankarpale* with 5 per cent level of incorporation of mushroom powder were found to be most acceptable level for colour.

The mean score of texture of *Shankarpale* at 0, 5, 10, 15 and 20 per cent levels of incorporation of mushroom powder were 7.77, 7.50, 7.33, 6.99 and 5.57 respectively. The maximum score of 7.77 for the texture was recorded by the *Shankarpale* prepared without incorporation of mushroom powder, that is the control, while minimum score of 5.57 was recorded by the *Shankarpale* prepared

Table 4 : Mean values of organoleptic scores for the acceptability of *Shankarpale* prepared with and without incorporation of different levels of mushroom powder

Level of Mushroom incorporation	Organoleptic scores of *Shankarpale*				
	Colour	Texture	Taste	Flavour	Overall acceptability
0 % (control)	7.69	7.77	7.75	7.79	7.81
5 %	7.48	7.50	7.81	7.59	7.64
10 %	7.12	7.33	7.41	7.20	7.28
15 %	7.01	6.99	6.37	6.47	6.74
20 %	5.56	5.57	5.09	5.20	5.42
SE±	0.29	0.24	0.27	0.27	0.25
CD at 5 %	0.80	0.68	0.74	0.75	0.69

Fig. 5. Mean values of organoleptic scores for the acceptibility of *Shankarpale* prepared with and without incorporation of different levels of mushroom powder



with 20 per cent level of incorporation. The secured score by the *Shankarpale* with 5, 10, 15 and 20 per cent level of incorporation of mushroom powder were found to be not differed significantly from one another.

On the whole, results indicated that 5 per cent level of incorporation was most accepted level of incorporation, as it secured the higher score.

The scores of taste of the *Shankarpale* prepared with 0, 5, 10, 15 and 20 per cent levels of incorporation of mushroom powder were 7.75, 7.81, 7.41, 6.31 and 5.09 respectively. The maximum score of 7.81 for the taste was secured by the 5 per cent and the minimum score of 5.09 was recorded by the 20 per cent level of incorporation of mushroom powder in the preparation of *Shankarpale.* The scores obtained by 15 and 20 per cent level of incorporation of mushroom powder on the taste of *Shankarpale* were not found to be differed significantly.

From the result, it can be said that in the preparation of *Shankarpale*, the 5 per cent level of incorporation of mushroom powder was found to be the most acceptable level, as it recorded the highest score for taste of *Shankarpale*.

The mean scores of the flavour of the *Shankarpale* with 0, 5, 10, 15 and 20 per cent levels of incorporation of mushroom powder were 7.79, 7.59, 7.20, 6.47 and 5.20 respectively. Statistically, with 15 and 20 per cent level of incorporated mushroom powder was significantly lower than other.

In nutshell, it can be said that the highest score of 7.59 was obtained for flavour of *Shankarpale* with 5 per cent level of incorporation. Therefore, it can be considered as most accepted level of incorporation.

Wide variations were noticed in the mean scores of overall acceptability of *Shankarpale* prepared from varying level of incorporation of mushroom

powder. It was ranging from 7.81 to 5.42. The highest score was obtained by control *Shankarpale* without mushroom followed by 5 per cent level of incorporation, whereas the lowest score was secured by *Shankarpale* prepared with 20 per cent level of incorporation of mushroom powder.

Statistical results indicated that the scores obtained at 0, 5, 10 and 15 per cent levels of incorporation were found to be more than that of 20 per cent level, but significant difference was noticed only in between 15 and 20 per cent level of incorporation.

On the whole, among the varying level of incorporation of mushroom powder, 5 per cent level of incorporation of mushroom powder in *Shankarpale* was more accepted than other.

4.5 Organoleptic characteristics of *Besan wadi* prepared with different levels of incorporated mushroom powder

The mean values of organoleptic scores for the acceptability of *Besand wadi* prepared with and without incorporation of mushroom powder are given in Table 5 along with the values of standard error and critical differences and depicted in Figure 6.

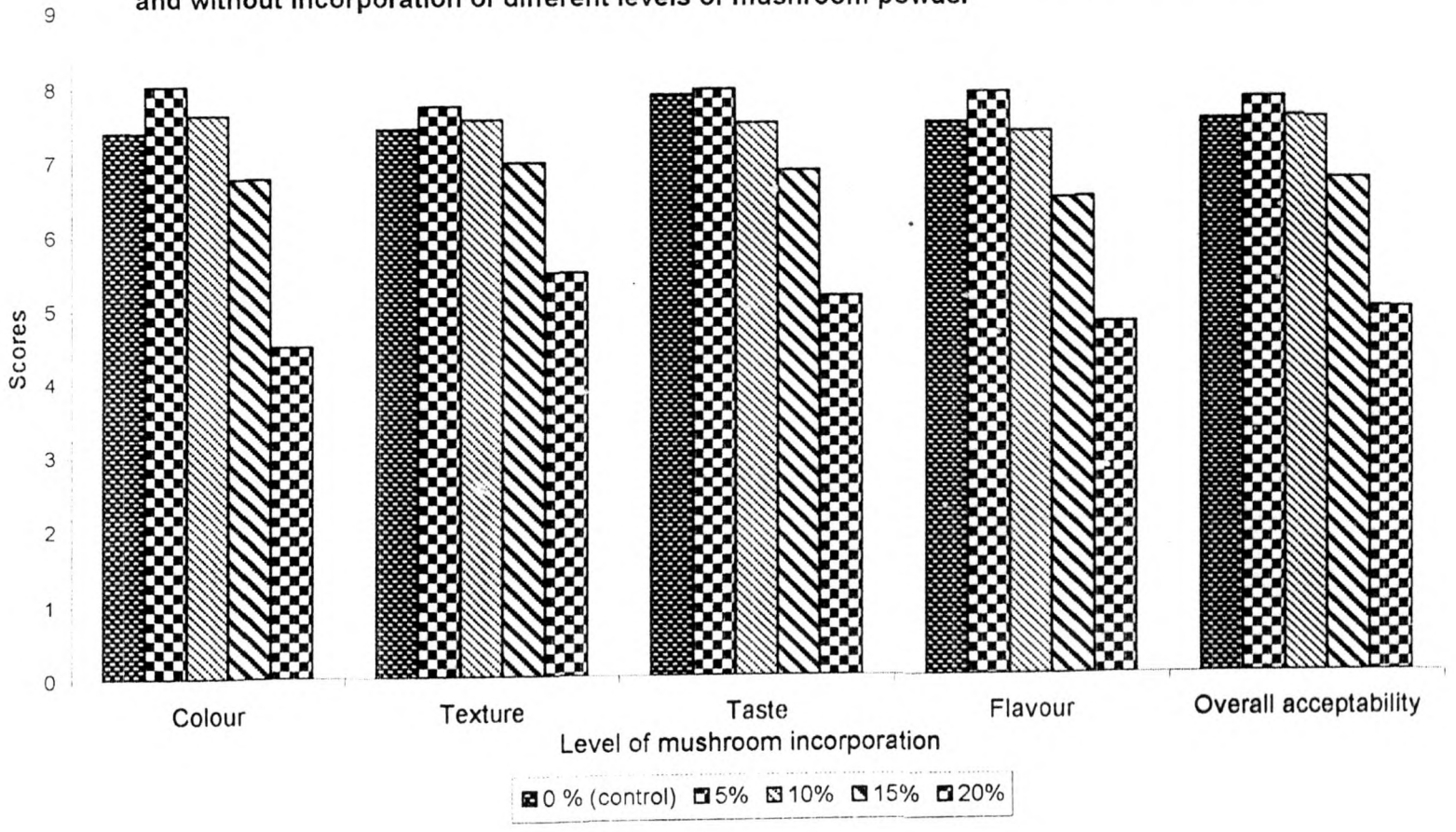
Marked variations were noticed for colour of *Besan wadi* prepared with incorporation of mushroom powder with at 0, 5, 10, 15 and 20 per cent levels. Maximum score (8.02) for colour of *Besan wadi* was obtained by 5 per cent level, whereas minimum score (4.48) was obtained by 20 per cent level of incorporation of mushroom powder.

The result of statistical analysis indicated that in the colour of *Besan wadi*, the significant difference was obtained between 10 and 15 per cent level; and 15

Table 5 : Mean values of organoleptic scores for the acceptability of *Besan wadi* prepared with and without incorporation of different levels of mushroom powder

Level of mushroom incorporation	Organoleptic scores of *Besan wadi*				
	Colour	Texture	Taste	Flavour	Overall acceptability
0 % (control)	7.39	7.43	7.87	7.49	7.51
5 %	8.02	7.73	7.94	7.90	7.80
10 %	7.62	7.55	7.48	7.36	7.54
15 %	6.76	6.96	6.84	6.46	6.71
20 %	4.48	5.47	5.14	4.77	4.94
SE±	0.24	0.20	0.22	0.25	0.18
CD at 5 %	0.68	0.56	0.61	0.70	0.50

Fig. 6. Mean values of organoleptic scores for the acceptibility of *Besan wadi* prepared with and without incorporation of different levels of mushroom powder



and 20 per cent level of incorporation of mushroom powder. However, the statistical difference between 0 and 5 per cent level; and 5 and 10 per cent level of incorporation of mushroom powder were not noticed.

From the result, it can be said that 5 and 10 per cent level of incorporation of mushroom powder in *Besan wadi* in terms of colour was found to be most accepted.

With 0, 5, 10, 15 and 20 per cent levels of incorporation of mushroom powder in *Besan wadi* had recorded the score of texture such as 7.43, 7.73, 7.55, 6.96 and 5.47 respectively. Among that, the highest score was recorded by 5 per cent level, whereas the lowest score was recorded by 20 per cent level of incorporation of mushroom powder for texture of *Besan wadi*. It was found that the texture of *Besan wadi* with 10, 15 and 20 per cent levels of incorporation of mushroom powder were differed significantly from each other. On the other hand, incorporation of mushroom powder with 0, 5 and 10 per cent levels in the *Besan wadi*, the texture did not differ significantly.

On the whole, it can be concluded from the result that 5 per cent level of incorporation of mushroom powder in the *Besan wadi* was secured more score for texture. Therefore, it is considered to be most accepted level of incorporation of mushroom powder in the *Besan wadi* preparation.

The highest score (7.94) of taste of *Besan wadi* with 5 per cent level of incorporation of mushroom powder was recorded, whereas the lowest score (5.14) by 20 per cent level of incorporation. The score of taste with 0, 10 and 15 per cent levels of incorporation of mushroom powder were 7.87, 7.48 and 6.84 respectively. The result of statistical analysis indicated that, statistical difference

was observed only between 10, 15 and 20 per cent levels of incorporation. But not at 0, 5 and 10 per cent levels of incorporation of mushroom powder.

In nutshell, it can be said that, 5 per cent level of incorporation of mushroom powder was found to be the most acceptable level in the preparation of *Besan wadi.*

The mean value of score of flavour of the *Besan wadi* prepared with varying level of incorporation of mushroom powder were ranging from 7.90 to 4.77. Maximum score for flavour was obtained by 5 per cent level of incorporation, followed by 10 per cent level of incorporation. While mean score was obtained by 20 per cent level of incorporation of mushroom powder. In the flavour of *Besan wadi* with 0, 5 and 10 per cent levels of incorporation of mushroom powder did not differ significantly. However, significant difference was observed between 10 and 15 per cent level; and 15 and 20 per cent level of incorporation of mushroom powder.

Results showed that 5 per cent level of incorporation of mushroom powder in *Besan wadi* resulted, most accepted level for flavour.

The mean score of overall acceptability of *Besan wadi* was obtained at 0, 5, 10, 15 and 20 per cent levels of incorporation of mushroom powder were 7.75, 7.80, 7.54, 6.71 and 4.94 respectively. Results of statistical analysis revealed that the scores of overall acceptability of *Besan wadi* 15 and 20 per cent level of mushroom powder were significantly low. Among the varying level of incorporation of mushroom powder in *Besan wadi*, the maximum score (7.80) for overall acceptability was recorded at 5 per cent level of incorporation.

On the whole, findings of present study indicated that the score of majority of organoleptic characteristics were found to be more at 5 per cent level of incorporation of mushroom powder. Hence it is considered to be most accepted level of incorporation.

4.6 Value addition of the five selected snacks prepared with most accepted level of the incorporation of mushroom powder and without incorporation in terms of protein and protein digestibility

Results of organoleptic evaluation of five selected snacks prepared with varying level of incorporation of mushroom powder indicated that 5 per cent level incorporation of mushroom powder in the snacks found to be most accepted level of incorporation. Therefore, value addition in terms of protein and protein digestibility was determined for most accepted (5 %) level of incorporation mushroom powder in the selected snacks.

The contents of moisture (g %), protein (g %) and digestibility of proteins (%) of *Sev* prepared with and without incorporation of mushroom powder is given in Table 6 and depicted in Figure 7.

Moisture content of *Sev* prepared with and without mushroom powder incorporation varied from 4.88 ± 0.084 to 5.06 ± 0.24. Moisture content of *Sev* without incorporation of mushroom powder was found to be more than that of *Sev* prepared with mushroom incorporation, but the difference was not statistically significant.

Protein content of *Sev* prepared with 5 per cent level of incorporation of mushroom powder found to be significantly more than that of protein content of

Table 6 : The contents of moisture, protein and per cent digestibility of proteins of *Sev* prepared with and without incorporation of mushroom powder

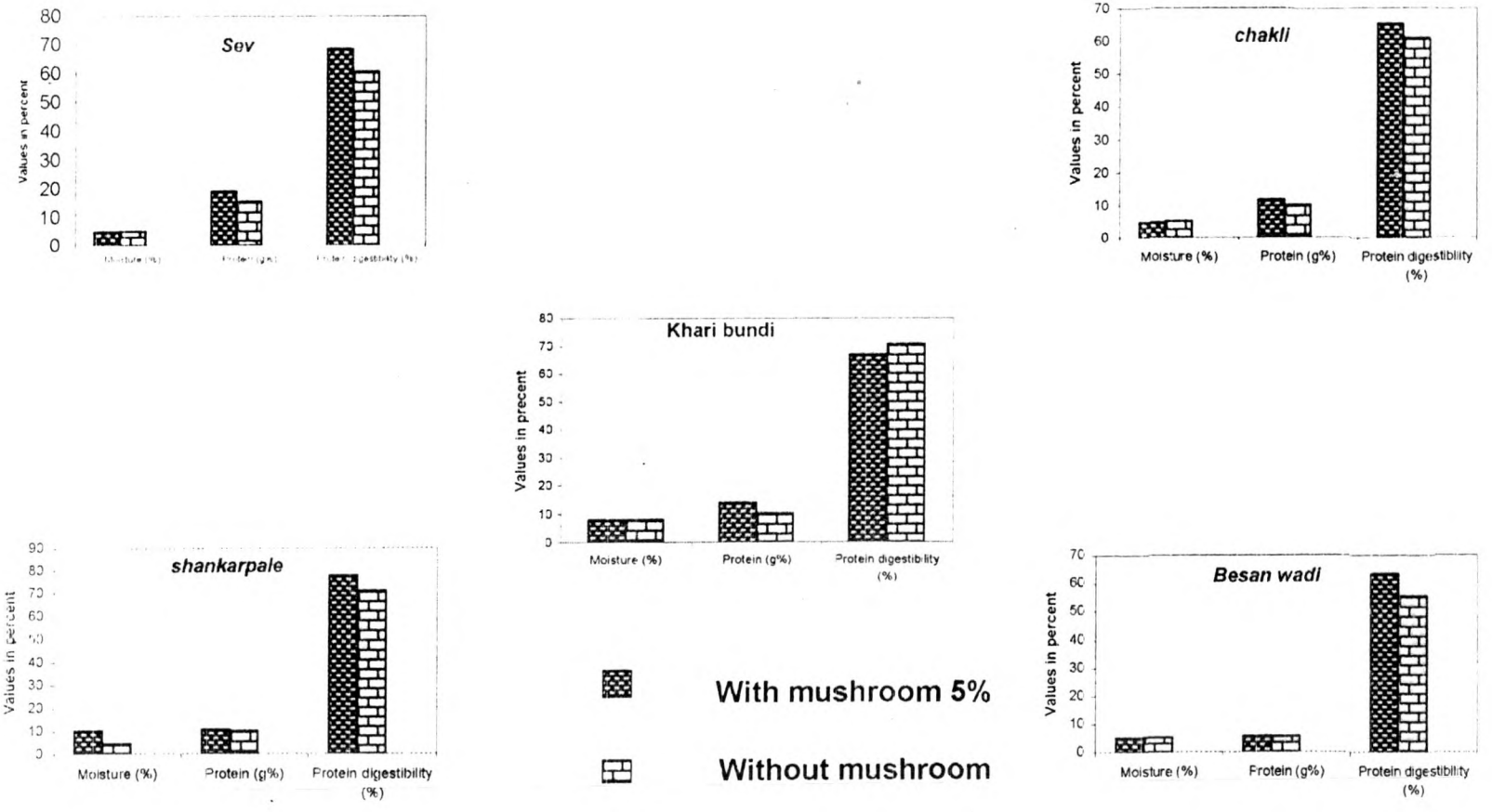
Parameters	*Sev* Preparation		't' value
	With mushroom (5%) Mean ± SD	Without mushroom Mean ± SD	
Moisture (g%)	4.88 ±0.084	5.06 ± 0.24	1.24NS
Protein (g%)	18.95 ± 0.41	15.46 ± 3.95	3.95**
Protein digestibility (%)	68.44 ± 4.39	60.40 ± 5.34	2.01*

* Significant at 5 per cent level

** Significant at 1 per cent level

NS Non significant

Fig. 7. The contents of moisture, protein and the percent digestibility of proteins of five selected snacks prepared with and without incorporation of mushroom



Sev prepared without incorporation of mushroom powder. Similar trend also were noticed in case of protein digestibility of *Sev*.

On the whole, it can be inferred from the findings that incorporation of mushroom powder with 5 per cent level in *Sev* preparation resulted, significantly increase in protein content and protein digestibility of *Sev*.

The contents of moisture (g %), protein (g %) and digestibility of proteins (%) of *Chakli* prepared with and without incorporation of mushroom powder are recorded in Table 7 and illustrated in Figure 7.

The content of moisture was high (4.80 ± 1.17) in *Chakli* prepared with 5 per cent level of incorporated mushroom powder, while it was low (4.6 ± 0.43) in *Chakli* preparation without incorporation.

Chakli prepared with incorporation of mushroom powder registered a relatively high value (11.66 ± 1.64) for protein content, while *Chakli* prepared without incorporation of mushroom powder was registered relatively lower value for protein content. Even protein digestibility of *Chakli* prepared with mushroom powder was more than that of *Chakli* prepared without mushroom powder. However, significant difference was not noticed in content of moisture, protein and protein digestibility of *Chakli* prepared with and without incorporation of mushroom powder.

In nutshell it can be said that incorporation of mushroom powder in *Chakli* preparation resulted in increase in protein and protein digestibility.

The contents of moisture (g %), protein (g %) and digestibility of proteins (%) of *Khari bundi* prepared with and without incorporation of mushroom powder are presented in Table 8 and shown in Figure 7.

Table 7 : **The contents of moisture, protein and per cent digestibility of proteins of *Chakli* prepared with and without incorporation of mushroom powder**

Parameters	*Chakli* Preparation		't' value
	With mushroom (5%) Mean ± SD	Without mushroom Mean ± SD	
Moisture (g%)	4.80 ±1.17	4.6 ± 0.43	0.29NS
Protein (g%)	11.66 ± 1.64	9.91 ± 0.82	1.66NS
Protein digestibility (%)	65.03 ± 7.07	60.81 ± 7.34	0.71NS

NS Non significant

Table 8 : The contents of moisture, protein and per cent digestibility of proteins of *Khari bundi* prepared with and without incorporation of mushroom powder

Parameters	*Khari bundi* Preparation		't' value
	With mushroom (5 %) Mean ± SD	Without mushroom Mean ± SD	
Moisture (g%)	7.73 ± 1.47	7.80 ± 0.58	0.1NS
Protein (g%)	13.70 ± 0.41	9.90 ± 0.42	11.45**
Protein digestibility (%)	66.66 ± 11.78	70.63 ± 14.41	0.37NS

** Significant at 1 per cent level.

NS Non significant

Results indicated that, much difference was not noticed in content of moisture in *Khari bundi* prepared with and without incorporation of mushroom powder. In case of protein content *Khari bundi* with incorporation of mushroom powder registered significantly high value (13.70 ± 0.41) than that of *Khari bundi* prepared without incorporation of mushroom powder (9.90 ± 0.42). On the other hand, protein digestibility of *Khari bundi* prepared without mushroom powder was reported to be more.

On the whole, it can be said that protein content of *Khari bundi* prepared with incorporation of mushroom powder was significantly more than that of *Khari bundi* prepared without incorporation of mushroom powder.

Flegg and Maw (1976) reported that the in vitro digestibility of mushroom proteins falls between 63 and 89 per cent. Similar findings were recorded in the present study that *Khari bundi* incorporated with 5 per cent mushroom powder found to have protein digestibility of 66.66 per cent.

The contents of moisture (g %), protein (g %) and digestibility of protein (%) of *Shankarpale* prepared with and without incorporation of mushroom powder are given in Table 9 and depicted in Figure 7.

Moisture (g %), protein (g %) and digestibility of proteins (%) of Shankarapale prepared with incorporation of mushroom powder were 3.93 ± 0.33, 10.49 ± 1.23 and 77.77 ± 7.85 respectively. The respective values for corresponding *Shankarpale* without incorporation of mushroom powder were 4.06 ± 0.52, 9.91 ± 1.48 and 71.03 ± 14.9. Though the protein content and protein digestibility were more in *Shankarpale* prepared with mushroom powder, but it was not significant statistically.

Table 9 : The contents of moisture, protein and per cent digestibility of proteins of *Shankarpale* prepared with and without incorporation of mushroom powder

Parameters	*Shankarpale* Preparation		't' value
	With mushroom (5%) Mean ± SD	Without mushroom Mean ± SD	
Moisture (g%)	3.93 ± 0.33	4.06 ± 0.52	0.37NS
Protein (g%)	10.49 ± 1.23	9.91 ± 1.48	0.52NS
Protein digestibility (%)	77.77 ± 7.85	71.03 ± 14.9	0.71NS

NS Non significant

Table 10 : The contents of moisture, protein and per cent digestibility of proteins of *Besan wadi* prepared with and without incorporation of mushroom powder

Parameters	*Besan wadi* Preparation		't' value
	With mushroom (5%) Mean ± SD	Without mushroom Mean ± SD	
Moisture (g%)	5.70 ± 0.18	5.40 ± 0.49	0.29NS
Protein (g%)	5.54 ± 1.48	5.24 ± 0.71	0.31NS
Protein digestibility (%)	63.17 ± 7.85	55.17 ± 14.9	0.84NS

NS Non significant

On the whole, it can be inferred from the findings that protein content and protein digestibility were not found to be increased significantly in *Shankarpale* with incorporation of mushroom powder.

Crisian and Sands (1978) revealed that protein content of fresh mushroom can easily digested upto 70 to 90 per cent. Thus, the result of present study are in conformity in the earlier study.

The contents of moisture (g %), protein (g %) and digestibility of protein (%) of *Besan wadi* prepared with and without incorporation of mushroom powder are presented in Table 10 and illustrated in Figure 7.

Moisture content was high (5.7 ± 0.18) in *Besan wadi* prepared with mushroom powder (5 %), while it was low (5.40± 0.29) in *Besan wadi* prepared without incorporation of mushroom powder. On the other hand, protein content and protein digestibility of *Besan wadi* prepared with mushroom powder were slightly more (5.54 ± 1.48 and 63.17 ± 7.85 respectively) than that of *Besan wadi* without incorporation of mushroom powder (5.24 ± 0.71 and 55.17 ± 14.9 respectively).

In nutshell, it can be said that much difference was not noticed in *Besan wadi* prepared with and without incorporation of mushroom powder with 5 per cent level in terms of protein content and protein digestibility.

4.7 Keeping quality of most accepted five snacks

Organoleptic evaluation was conducted to find out the keeping quality of five snacks namely *Sev*, *Chakli*, *Khari bundi*, *Shankarpale* and *Besan wadi*. For each snack one sample was stored in refrigerator and another in room

temperature. Organoleptic evaluation was carried out at initial, one weeks, two weeks and three week period of storage by the trained panelist.

Effect of storage condition and period of storage on keeping quality of snacks were studied by comparing the scores obtained for overall acceptability of the different samples by using 't' test.

The mean scores of overall acceptability of *Sev* stored in refrigerator and room temperature for varying period presented in Table 11.

Results indicated that there was no significant difference in the acceptability score of *Sev* stored in refrigerator and room temperature for the period of one week storage. On the other hand, significantly more score was obtained for acceptability of *Sev* stored for two and three weeks in refrigerator than that of stored in room temperature.

The *Sev* stored in refrigerator for two to three weeks found to have significantly low score in comparison with score obtained at initial stage, whereas significant difference was noticed in *Sev* stored for period of one, two and three weeks at room temperature.

On the whole, it was found that as the period of storage was increased in mean score of overall acceptability of both the samples there was decreased significantly.

These results are in agreement with the findings of Singh *et al.* (1994) in mushroom candy and sweet pickle, revealed that six month storage period of mushroom candy and sweet pickle showed no spoilage in this both recipes. Even in the present study *Sev* stored for three weeks were well accepted.

Table 11 : Mean score for overall acceptability of *Sev* stored in refrigerator and room temperature on varying period

Sr. no	Parameter	Overall acceptability score for *sev*		't' values
		Refrigerator Mean ± SD	Room temperature Mean ± SD	
I	Initial	8.17±0.57	8.17±0.57	NS
II	One week	7.47±0.32	7.15±0.50	1.70NS
III	Two week	7.40±0.73	6.47±0.80	2.13*
IV	Three week	6.47±0.28	4.55±0.68	8.26**

't' values for refrigerator		't' values for room temperature	
I Vs II	3.38**	I Vs II	4.25**
II Vs III	0.27NS	II Vs III	2.27*
III Vs IV	3.76**	III Vs IV	5.78**
IV Vs I	8.46**	IV Vs I	11.72**

* Significant at 1 per cent level

** Significant at 5 per cent level

NS Non significant

The mean scores of overall acceptability of *Chakli* prepared with incorporation of mushroom powder, stored in refrigerator and room temperature for varying periods are given in Table 12.

The mean scores of overall acceptability of *Chakli* kept in refrigerator at initial, one, two and three weeks period of storage were 8.15 ± 0.40, 7.92 ± 0.31, 6.90 ± 0.42 and 6.02 ± 0.42 respectively. The corresponding values for the *Chakli* kept in room temperature were 8.15 ± 0.40, 7.20 ± 0.44, 5.90 ± 1.0 and 3.47 ± 1.12 respectively. It was found that scores were low for the *Chakli* kept at room temperature than that of refrigerator. Significant difference was noticed only between *Chakli* stored for the period of two and three weeks.

The result of statistical analysis indicated that the overall acceptability scores obtained for varying period of storage of *Chakli* stored in refrigerator and room temperature differed significantly. Except, *Chakli* kept in refrigerator at initial stage and one week period.

In nutshell, it can be inferred from the findings that the effect of storage was noticed on overall acceptability of *Chakli* kept in refrigerator as well as room temperature. On the whole, it can be said that *Chakli* kept in room temperature was well accepted upto storage period of two weeks which was extended upto three weeks for the *Chakli* kept in refrigerator.

Rai and Sexena (1987) for mushroom pickle and Joshi *et al.*(1991) for mushroom chutney reported good keeping quality and organoleptic scores. Similar findings were recorded in present study that *Chakli* prepared with mushroom stored in refrigerator of three weeks period found to have good keeping quality and overall acceptablility.

Table 12 : Mean score for overall acceptability of *Chakli* stored in refrigerator and room temperature on varying period

Sr. no	Parameter	Overall acceptability score for *Chakli*		't' values
		Refrigerator Mean ± SD	Room temperature Mean ± SD	
I	Initial	8.15±0.40	8.15±0.40	NS
II	One week	7.92±0.31	7.20±0.44	0.53NS
III	Two week	6.90±0.42	5.90±1.0	2.92**
IV	Three week	6.02±0.42	3.47±1.12	6.74**

't' values for refrigerator		't' values for room temperature	
I Vs II	1.45NS	I Vs II	5.07**
II Vs III	6.2**	II Vs III	11.91**
III Vs IV	4.70**	III Vs IV	5.18**
IV Vs I	11.72**	IV Vs I	12.50**

** Significant at 5 per cent level

NS Non significant

The mean scores of overall acceptability of *Khari bundi* prepared with incorporation of mushroom powder, stored in refrigerator and room temperature for varying periods are given in Table 13.

Wide variations were noticed in acceptability scores obtained for *Kahri bundi* at initial to three weeks period of storage. It was found that the acceptability scores were significantly low from initial to one week, one week to two weeks and two weeks to three weeks period of storage It was also observed that significantly high score was secured by the *Khari bundi* stored in refrigerator than that of *Khari bundi* kept at room temperature from initial to three weeks period of storage.

In conclusion, it can be said that, the *Khari bundi* kept in refrigerator was having better keeping quality as compared to room temperature. Also it was found that as the period of storage was increased, there was a decrease in the score of overall acceptability of *Khari bundi* kept at refrigerator and room temperature.

The mean scores of overall acceptability of *Shankarpale* stored in refrigerator and room temperature for varying periods presented in Table 14.

Results indicated that maximum (7.75 ± 0.35) score was recorded for *Shankarpale* at initial stage, while minimum score was recorded at three weeks period of storage by the *Shankarpale* kept at refrigerator (4.95 ± 0.60) and room temperature (2.65 ± 1.09).

Statistical analysis indicated that scores of overall acceptability of *Shankarpale* were significantly low from one to three weeks period for both the samples. It was found that the scores recorded by the sample stored in room

Table 13 : Mean score for overall acceptability of *Khari bundi* stored in refrigerator and room temperature on varying period

Sr. no	Parameter	Overall acceptability score for *Khari bundi*		't' values
		Refrigerator Mean ± SD	Room temperature Mean ± SD	
I	Initial	8.12±0.39	8.12±0.39	NS
II	One week	7.40±0.32	6.85±0.35	3.70**
III	Two week	6.47±0.42	5.72±0.48	3.75**
IV	Three week	5.15±0.64	3.25±1.10	4.72**

't' values for refrigerator		't' values for room temperature	
I Vs II	4.51**	I Vs II	8.11**
II Vs III	5.56**	II Vs III	6.01**
III Vs IV	5.54**	III Vs IV	5.71**
IV Vs I	12.53**	IV Vs I	13.19**

** Significant at 5 per cent level

NS Non significant

Table 14 : Mean score for overall acceptability of *Shankarpale* stored in refrigerator and room temperature on varying period

Sr. no	Parameter	Overall acceptability score for *Shankarpale*		't' values
		Refrigerator Mean ± SD	Room temperature Mean ± SD	
I	Initial	7.75±0.35	7.75±0.35	NS
II	One week	7.45±0.58	6.57±0.37	3.74**
III	Two week	6.27±0.43	5.70±0.53	2.64**
IV	Three week	4.95±0.60	2.65±1.09	5.84**

't' values for refrigerator		't' values for room temperature	
I Vs II	1.4NS	I Vs II	7.32**
II Vs III	5.16**	II Vs III	4.25**
III Vs IV	5.65**	III Vs IV	7.95**
IV Vs I	12.74**	IV Vs I	14.08**

** Significant at 5 per cent level

NS Non significant

temperature was significantly low than that of kept *Shankarpale* in refrigerator from one to three weeks.

In conclusion, it can be said that as the period of storage was increased, the acceptability of *Shankarpale* was found to be decreased. More acceptability was noticed for *Shankapale* kept in refrigerator than that of room temperature upto storage period two weeks for both the sample.

The mean scores of overall acceptability of *Besan wadi* stored in refrigerator and room temperature for varying periods presented in Table 15.

Mean score of overall acceptability of *Besan wadi* kept in refrigerator and room temperature were significantly more at initial than that of stored for one, two and three weeks of period.

Besan wadi kept in refrigerator had secured high scores for overall acceptability from one to three weeks period of storage than those stored in room temperature. But significant difference was noticed only in sample stored for three weeks period.

On the whole, findings inferred that, as storage period of *Besan wadi* increases, the acceptability found to be decreases. Significant difference in acceptability was noticed between *Besan wadi* kept for refrigerator (5.20) and room temperature (2.52) for the storage period of three weeks. In nutshell, it can be said that the samples kept in room temperature was accepted upto two weeks of period of storage, whereas the sample kept in refrigerator was well accepted upto three weeks period of storage.

Table 15 : Mean score for overall acceptability of *Besan wadi* stored in refrigerator and room temperature on varying period

Sr. no	Parameter	Overall acceptability score for *Besan wadi*		't' values
		Refrigerator Mean ± SD	Room temperature Mean ± SD	
I	Initial	7.75±0.27	7.75±0.27	NS
II	One week	7.15±0.50	6.70±0.54	1.97NS
III	Two week	6.30±0.44	5.57±0.41	1.93NS
IV	Three week	5.20±0.66	2.52±0.80	8.17**

't' values for refrigerator		't' values for room temperature	
I Vs II	3.33**	I Vs II	5.49**
II Vs III	4.03**	II Vs III	5.28**
III Vs IV	4.38**	III Vs IV	10.72**
IV Vs I	11.30**	bIV Vs I	19.58**

** Significant at 5 per cent level

NS Non significant

4.8 Nutrient benefit ratio of the mushroom incorporated snacks

The nutrient benefit ratio of the five selected snacks calculated in terms of contents of protein and in vitro digestibility of proteins between the control snacks and the most accepted level (5 %) of mushroom incorporated snacks are presented in Table 16.

The value of nutrient benefit ratio with regard to protein content (g %) of *Sev*, *Chakli*, *Khari bundi*, *Shankarpale* and *Besan wadi* were 1.17, 1.22, 1.38, 1.06 and 1.06 (5 %) respectively. The highest nutrient benefit ratio of 1.38 was recorded by *Khari bundi* prepared with 5 per cent level of incorporation of mushroom while the lowest ratio was recorded by *Shankarpale* and *Besan wadi* (1.06).

The values of nutrient benefit ratio of the five snacks with regard to digestibility of protein, varied from 0.94 to 1.14 at 5 per cent levels of incorporation of mushroom powder. Maximum nutrient benefit ratio was noticed to be in *Besan wadi* (1.14) followed by *Chakli* (1.13) and minimum in *Khari bundi* (0.94).

On the whole, *Khari bundi* recorded the highest nutrient benefit ratio (1.38) and lowest in *Besan wadi* in terms of the content of protein.

On the contrary, highest nutrient benefit ratio for protein digestibility was noticed that in *Besan wadi* and the lowest in *Khari bundi*.

Table 16 : Nutrient benefit ratio of the mushroom incorporated snacks

Snacks with (5%) incorporated mushroom.	Nutrient benefit ratio	
	Protein (g%)	Protein digestibility (%)
Sev	1.17	1.06
Chakli	1.22	1.13
Khari bundi	1.38	0.94
Shankarpale	1.06	1.09
Besan wadi	1.06	1.14

Summary and Conclusion

Chapter 5

SUMMARY AND CONCLUSION

The investigation was carried out to study value addition of selected snacks by incorporating mushroom. Five snacks namely *Sev, Chakli, Khari bundi, Shankarpale* and *Besan wadi* were prepared with different levels of incorporation of mushroom powder. Mushroom powder was incorporated in the preparation by replacing besan flour / maida, the major ingredient of the selected snacks. The level of incorporation of mushroom powder in the preparation of selected snacks were 0, 5, 10, 15 and 20 per cent.

The prepared snacks were evaluated for their organoleptic quality by using nine point hedonic scale. Most accepted level of incorporation of mushroom powder in each snacks was assessed by using organoleptic evaluation by the trained panel member. Further, they were analyzed for protein and protein digestibility; and keeping quality.

The organoleptic characteristics revealed that 5 per cent level of incorporation of mushroom powder in *Sev* registered maximum score for all the organoleptic characteristics like colour (7.63), texture (7.86), taste (8.03), flavour (8.16) and overall acceptability (7.91). The scores obtained for *Sev* with 15 and 20 per cent level of incorporated mushroom powder were significantly low. From the results, it can be said that 5 per cent level of incorporation of mushroom powder was found to be most accepted level of incorporation in *Sev*.

The scores obtained for taste and flavour of *Chakli* prepared with 10, 15 and 20 per cent level of mushroom powder differed significantly. In

case of overall acceptability of *Chakli* with 5 per cent level of incorporation secured significantly more score than that of *Chakli* prepared with 10, 15 and 20 per cent level. Hence, 5 per cent level of incorporation of mushroom powder in *Chakli* was considered as the most suitable and accepted level, as it secured higher rating for all the organoleptic characteristics.

Five per cent level of incorporation of mushroom powder in *Khari bundi* attained the maximum score in terms of all the evaluated organoleptic characteristics. On the other hand, *Khari bundi* with 20 per cent level of mushroom powder recorded minimum score for organoleptic characteristics. Results of organtoleptic evaluation indicated that the scores recorded for colour, texture and overall acceptability by *Khari bundi* prepared with 10, 15 and 20 per cent level of incorporation of mushroom powder differed significantly from one another. Whereas, in case of taste and flavour significant difference was noticed only between 15 and 20 per cent level of incorporation of mushroom powder in *Khari bundi.* Hence, 5 per cent level of incorporation of mushroom powder was regarded as the most acceptable level in the preparation of *Khari bundi.*

Mean scores of organoleptic characteristics like colour, taste, flavour and overall acceptability of *Shankarpale* found to be significantly low with 15 and 20 per cent level of incorporation of mushroom powder as compared to 5 and 10 per cent level. Even the scores for texture of the *Shankarpale* with 15 and 20 per cent level of incorporation of mushroom powder were found to be low, but it was not significant statistically. On the whole, among the varying level of incorporation of mushroom powder, 5 per cent level of incorporation of mushroom powder in *Shankarpale* was more accepted than other.

Besan wadi prepared with 5 per cent level of incorporation of mushroom powder recorded the maximum score for organoleptic characteristics like colour (8.02), texture (7.73), taste (7.94), flavour (7.90) and overall acceptability (7.80) than that of 10, 15 and 20 per cent level of incorporation of mushroom powder. Statistical results indicated that the scores obtained for all the organoleptic characteristics with 10, 15 and 20 per cent levels of incorporation were found to differ significantly. In nutshell, it can be said that *Besan wadi* with 5 per cent level of mushroom powder considered to be most suitable and acceptable than other levels of incorporation.

On the whole, results of organoleptic evaluation of 5 selected snacks namely *Sev, Chakli, Khari bundi, Shankarpale* and *Besan wadi* prepared with varying levels of incorporation of mushroom powder indicated that 5 per cent level of incorporation of mushroom powder in the above snacks found to be most accepted level of incorporation. Therefore, value addition of these snacks in terms of protein and protein digestibility was determined.

Results of nutrient analysis showed that incorporation of mushroom powder at 5 per cent level in *Sev* preparation resulted in significant increase in protein content and protein digestibility from 15.46 to 18.95 g per cent and 60.40 to 68.44 per cent respectively.

The contents of moisture (g %), protein (g %) and digestibility of proteins (%) of *Chakli* with (5 %) and without incorporation of mushroom powder ranged from 4.80 to 4.60, 11.66 to 9.91 and 65.03 to 60.81

respectively. Incorporation of mushroom powder in *Chakli* preparation resulted in increased protein and protein digestibility. However, the results were not significant statistically.

Kharibudi prepared with mushroom (5 %) found to have significantly more (13.70 g %) protein than that of *Khari bundi* prepared without mushroom powder. But the digestibility of proteins was found to be more in *Khari bundi* prepared without mushroom powder.

Moisture (g %), protein (g %) and protein digestibility (%) of *Shanakarpale* prepared with incorporation of mushroom powder were 3.93, 10.49 and 77.77 respectively. Their respective values for corresponding *Shankarpale* prepared without incorporation of mushroom powder were 4.06, 9.91 and 71.03. Though the protein content and protein digestibility were more in *Shankarpale* prepared with mushroom powder but it was not significant.

The values obtained for moisture (g %), protein (g %) and digestibility of proteins (%) in *Besan wadi* prepared with (5 %) and without incorporation of mushroom powder were 5.70, 5.54 and 63.17; and 5.40, 5.24 and 55.17 respectively. The obtained values did not differ significantly.

The keeping quality of five snacks was assessed by recording the scores for overall acceptability. Results indicated that the *Sev* stored in refrigerator for two to three weeks found to have significantly low score in comparison with score obtained at initial stage. Whereas, significant difference was noticed in *Sev* stored for period of one, two and three weeks at room temperature.

The mean scores of overall acceptability of *Chakli* kept in refrigerator stored for varying period were ranging from 8.15 to 6.02, whereas it was ranging from 8.15 to 3.17 for *Chakli* kept at room temperature. Overall acceptability scores of *Chakli* stored for two to three weeks in refrigerator and room temperature differed significantly. On the whole, it can be said that *Chakli* kept at room temperature was well accepted upto storage period of two weeks while, it was three weeks for *Chakli* kept in refrigerator.

Wide variations were noticed in acceptability scores obtained for *Khari bundi* at initial to three weeks period of storage. It was also observed that significantly high score was secured *by Khari bundi* stored in refrigerator than that of room temperature from initial to three weeks of period. Hence, *Khari bundi* kept in refrigerator was found to have better keeping quality as compared to room temperature. Also overall acceptability of *Khari bundi* kept at refrigerator and room temperature found to be decreased as the period of storage was increased.

The results indicated that overall acceptability of the *Shankarpale* stored in refrigerator was significantly more than that of *Shankarpale* kept in room temperature for three weeks period of storage. Also it was found that overall acceptability of *Shankarpale* were significantly low from one to three weeks period of storage. More acceptability score was noticed for *Shankarpale* kept in refrigerator than that of stored at room temperature upto two weeks.

The mean scores of overall acceptability of *Besan wadi* kept in refrigerator and room temperature were significantly more initially than that

of stored for one, two and three weeks of period. In nutshell, it can be said that the sample kept at room temperature was accepted upto two weeks period of storage. Whereas, the sample kept in refrigerator was well accepted upto three weeks period of storage.

In conclusion, the findings inferred that keeping quality of selected snacks was dependent upon the period of storage. Keeping quality of snacks was found to be decreased as storage period was increased. Sample of snacks kept in the refrigerator had better keeping quality than that of kept at room temperature. It was also noticed that sweet snacks preparations like *Shankarpale* and *Besan wadi* had better keeping quality than that of fried snacks like *Sev, Chakli* and *Khari bundi.*

The nutrient benefit ratio was calculated for most accepted snacks (5 %) in terms of protein and protein digestibility and compared with snacks prepared without incorporation of mushroom powder. The value of nutrient benefit ratio of five snacks with regard to protein content and digestibility of proteins varied from 1.06 to 1.38 and 0.94 to 1.14 respectively. On the whole, *Khari bundi* recorded the highest nutrient benefit ratio (1.38) and the lowest by *Besan wadi* (1.06) in terms of the content of protein. On the contrary, the highest nutrient benefit ratio for digestibility of proteins was noticed in *Besan wadi* (1.14) and lowest in *Khari bundi* (0.94).

Hence, it can be suggested that to increase the nutritive value especially in terms of protein on daily diet. Mushrooms can be incorporated in various food preparations. It can serve to improve the nutritional status of Indians and can help in alleviating protein deficiency.

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Appendices

APPENDIX - I

1. Preparation of *Sev*

Ingredients	Amount
Bengal gram flour	80 g
Cumin Seeds	1.5 g
Omum	795 mg
Turmeric powder	290 mg
Chilli powder	430 mg
Oil for mixing	15 ml
Water	50 ml
Salt	4.5g
Oil for frying	as required.

Method of preparation

1. Heat oil, add in bengal gram flour and rub it
2. Add cumin seed powder, omum powder, turmeric powder, red chilli powder and salt in bengal gram flour and mix well
3. Prepare a stiff dough by using water
4. Heat oil, press batter through mould into hot oil
5. Stirr it and fry it till crisp.

2. **Preparation of *Chakli***

Ingredients	Amount
Raw rice	15 g
Bengal gram dhal	30 g
Jowar	7 g
Coriander leaves	1 g
Cumin seeds	0.5 g
Oil	14 g
Gingelly seeds	1g
Turmeric powder	0.6 g
Chilli powder	1 g
Salt	2.5 g
Oil for frying	As required

Method of preparation

1. Roast and powder the rice, bengal gram dhal and Jowar
2. Add all the ingredients and hot oil in mixture.
3. Prepare a dough by using the required amount of water.
4. Kept it a side for half an hour.
5. Put the dough into the *chakli* mould and press on to a paper to form a pattern.
6. Deep fat fry the pressed pattern *chakli* till brown colour is obtain on both sides.

3. Preparation of *Khari bundi*

Ingredients	Amount
Bengal gram flour	100 g
Chilli powder	2 g
Turmeric Powder	0.2 g
Salt	1.8 g
Water	192 ml
Oil	For frying

Method of preparation

1. Mix bengal gram flour with water to a thin batter.
2. Add chilli, salt, turmeric powder and mixed well.
3. Pass through perforated spatula into hot oil.
4. Deep fry till crisp.
5. Remove from oil and drain to remove the excess oil.

4. Preparation of *Shankarpale*

Ingredients	Amount
Maida	100 g
Sugar	50 g
Fat for mixing	8 g
Water	25 ml
Fat for frying	As required.

Method of preparation

1. Heat fat, add in maida and rub it
2. Make sugar syrup and mix in maida and make a smooth dough
3. Roll it into round chapati
4. Cut into desired pieces
5. Fry in fat till light brown

5. Preparation of *Besan wadi*

Ingredients	Amount
Bengal gram flour	40 g
Sugar	65 g
Fat	35 ml
Cardamum	No
Water	25 ml

Method of preparation

1. Roast bengal gram flour with fat
2. Make sugar syrup of two string consistency by adding water in sugar
3. Add cardamum powder in syrup
4. Add sugar syrup in roasted bengal gram flour
5. Mix well. cook till it leaves the sides grease plate with fat
6. Pour mixture in it and flatten it evenly
7. Cut into desired shape
8. When get cooled, take out wadies

APPENDIX -II

Department of Foods and Nutrition

College of Home Science

Marathwada Agricultural University,

Parbhani

Sensory evaluation for :

Name of the Judge :

Designation :

Treatment	Colour	Texture	Taste	Flavour	Overall acceptability
1					
2					
3					
4					
5					

Hedonic scale for scores

Like extremely	9
Like very much	8
Like moderatly	7
Like fairly	6
Neither like nor dislike	5
Dislike fairly	4
Dislike moderately	3
Dislike very much	2
Dislike extremely	1

Date

Signature

APPENDIX - III

1. Individual scores for organoleptic characteristic of evaluation acceptability of *Sev* prepared with different levels of incorporation of mushroom powder

Level of mushroom incorporation	Colour	Texture	Taste	Flavour	Overall acceptability
	8.0	8.0	7.6	8.6	8.1
	8.6	7.0	7.6	7.6	8.2
	9.0	9.0	7.3	9.0	8.6
	7.6	7.0	7.0	7.6	7.2
0 per cent (control)	7.6	7.3	7.3	7.3	7.5
	6.6	8.0	7.6	6.6	7.2
	7.3	8.3	7.3	7.6	7.7
	9.0	8.0	9.0	8.0	8.5
	8.0	8.3	7.3	8.6	8.1
	7.3	7.6	7.0	8.0	7.5
Mean	**7.90**	**7.85**	**7.50**	**7.89**	**7.86**
	7.3	7.3	7.3	8.6	7.8
	7.3	7.6	7.3	7.3	7.4
	9.0	9.0	8.6	9.0	8.9
	7.6	7.3	8.3	7.6	7.7
5 per cent	7.0	6.6	7.6	7.6	7.2
	8.3	8.3	8.0	8.3	8.2
	7.3	7.6	8.0	8.6	8.0
	7.3	8.3	8.6	8.0	8.1
	7.6	8.6	8.6	8.6	8.2
	7.6	8.0	8.0	8.0	7.6
Mean	**7.63**	**7.86**	**8.03**	**8.16**	**7.91**
	8.3	8.3	8.3	6.3	8.3
	8.0	8.3	8.3	8.0	8.1
	8.3	8.6	9.0	8.0	8.7

	7.6	8.0	7.6	7.3	7.6
10 per cent	6.3	7.3	7.3	7.6	7.0
	8.6	8.6	8.6	6.6	8.1
	7.3	7.0	8.3	6.0	7.1
	7.3	7.6	6.3	7.3	7.0
	7.0	7.6	7.3	7.3	7.3
	7.6	8.0	8.3	7.3	7.8
Mean	**7.63**	**7.93**	**7.93**	**7.17**	**7.70**
	5.6	5.6	5.3	5.3	5.5
	7.6	7.6	7.6	7.3	7.6
	6.0	8.3	7.3	8.0	7.5
	7.0	7.3	6.3	7.0	6.9
15 per cent	6.0	7.3	8.3	8.3	7.3
	7.3	8.6	5.3	6.6	7.0
	5.3	5.6	5.3	3.6	5.1
	7.3	8.0	6.0	5.3	6.7
	7.0	6.3	7.3	7.3	5.2
	8.3	8.0	6.0	8.0	7.7
Mean	**6.74**	**7.26**	**6.47**	**6.67**	**6.65**
	4.0	5.3	3.3	3.3	4.0
	5.3	5.6	5.0	5.3	5.3
	6.6	5.0	7.0	7.0	6.4
	6.3	6.3	6.3	6.3	6.1
20 per cent	4.0	7.3	6.0	6.3	5.9
	5.6	5.6	4.0	4.0	4.8
	3.6	6.3	3.6	3.0	4.1
	5.3	5.0	5.6	5.3	5.3
	4.0	4.0	4.0	4.0	4.0
	6.3	6.3	7.0	6.6	6.6
Mean	**5.04**	**5.67**	**5.18**	**5.11**	**5.25**

2. **Individual scores for organoleptic characteristic of evaluation acceptability of *Chakli* prepared with different levels of incorporation of mushroom powder**

Level of mushroom incorporation	Colour	Texture	Taste	Flavour	Overall acceptability
	7.6	7.0	7.3	7.6	7.4
	7.6	8.0	7.6	7.6	7.7
	8.0	7.6	7.6	8.6	8.1
	8.0	7.6	7.6	7.6	7.7
0 per cent (control)	7.3	7.0	8.0	8.0	7.5
	6.6	8.0	7.3	8.6	7.6
	8.3	8.3	8.0	8.0	8.2
	8.3	8.3	8.3	8.0	8.3
	9.0	7.0	7.6	7.6	7.8
	7.3	7.3	9.0	8.3	8.0
Mean	**7.80**	**7.61**	**7.83**	**7.99**	**7.83**
	7.6	7.0	8.3	7.6	7.7
	7.6	8.0	7.6	7.6	7.8
	7.3	7.6	6.6	9.0	7.6
	6.6	8.6	7.6	7.6	7.6
5 per cent	8.6	8.3	8.6	8.6	8.6
	8.0	8.6	8.0	8.0	8.1
	7.3	8.0	6.6	7.3	7.3
	8.3	7.0	9.0	8.3	8.0
	8.3	8.3	8.0	8.6	8.3
	7.3	7.3	8.3	7.6	7.7
Mean	**7.69**	**7.87**	**7.86**	**8.02**	**7.87**
	8.3	8.3	8.0	9.0	8.4
	7.3	7.6	7.3	7.3	7.5
	7.6	7.3	7.6	7.6	7.2
	7.6	7.3	7.6	7.3	7.5
10 per cent	6.6	8.3	7.3	7.3	7.4

	7.5	7.3	7.6	7.6	7.5
	6.3	8.0	7.0	6.3	6.9
	7.3	8.6	8.3	8.3	8.2
	8.0	8.0	8.3	8.6	8.3
	6.6	7.6	7.0	8.0	6.8
Mean	**7.31**	**7.83**	**7.60**	**7.73**	**7.57**
	7.0	6.6	6.3	7.3	6.8
	7.0	7.3	7.0	7.0	7.1
	7.6	7.2	7.3	7.3	7.3
	7.6	7.0	7.3	7.3	7.3
15 per cent	6.0	6.6	6.6	4.0	5.9
	6.3	7.6	6.3	6.3	6.7
	6.6	6.6	6.3	6.6	6.6
	6.3	6.3	6.3	5.3	6.0
	7.3	8.0	7.0	6.0	7.1
	6.3	6.6	7.3	6.6	5.9
Mean	**6.80**	**6.98**	**6.77**	**6.37**	**6.67**
	7.6	6.3	5.3	7.0	6.9
	6.3	6.6	7.0	4.0	6.0
	7.3	6.6	6.0	6.6	6.6
	7.3	6.0	6.3	3.6	5.8
20 per cent	6.6	5.6	3.6	3.6	5.4
	6.6	6.3	6.3	6.0	6.3
	5.3	5.3	6.0	6.0	4.2
	5.3	6.0	5.0	4.0	5.1
	4.3	6.0	6.6	6.6	6.4
	6.6	6.6	6.6	4.6	6.1
Mean	**6.32**	**6.13**	**5.90**	**5.20**	**5.88**

3. **Individual scores for organoleptic characteristic of evaluation acceptability of *Khari Bundi* prepared with different levels of incorporation of mushroom powder**

Level of mushroom incorporation	Colour	Texture	Taste	Flavour	Overall acceptability
	8.6	8.3	8.3	8.3	8.4
	7.0	7.0	8.0	8.0	7.7
	8.3	7.3	7.3	8.6	7.9
	6.3	7.6	6.3	7.0	6.7
0 per cent (control)	7.6	9.0	8.6	7.6	8.2
	8.0	8.6	8.3	8.3	8.3
	7.3	7.6	7.3	8.0	7.6
	6.3	6.6	6.3	7.3	6.6
	7.0	8.0	9.0	8.0	8.0
	8.0	7.3	8.0	8.3	7.8
Mean	**7.44**	**7.73**	**7.74**	**7.94**	7.72
	8.6	8.6	9.0	7.3	8.1
	8.3	8.3	8.3	8.3	8.3
	7.0	8.0	8.0	9.0	8.0
	7.0	7.0	7.0	7.0	7.0
5 per cent	8.3	7.6	8.0	8.3	8.1
	7.0	7.3	7.6	7.6	7.4
	8.0	7.0	8.3	7.6	7.7
	6.3	7.3	7.6	7.6	7.3
	7.0	8.0	9.0	9.0	8.3
	9.0	8.6	7.3	8.0	8.3
Mean	**7.65**	**7.77**	**8.01**	**7.97**	**7.85**
	7.6	8.6	7.6	7.6	7.9
	8.6	6.6	6.6	6.6	7.1
	8.3	7.6	8.3	8.0	8.1
	7.0	8.3	7.3	7.3	6.7
10 per cent	7.3	6.6	7.6	6.6	6.6

	6.6	7.3	7.6	7.6	7.3
	7.7	7.3	7.3	7.3	7.3
	6.6	8.6	8.3	7.6	7.4
	9.0	8.0	8.0	8.0	8.2
	8.3	8.0	8.0	8.0	8.1
Mean	**7.70**	**7.69**	**7.66**	**7.46**	**7.47**
	6.7	6.3	5.7	6.7	6.3
	7.0	7.0	7.0	7.0	7.0
	6.7	5.7	6.6	6.7	6.4
	7.0	6.6	7.0	6.3	6.7
15 per cent	6.0	5.0	6.0	6.0	5.7
	6.6	7.0	8.3	8.0	7.7
	7.3	7.0	6.6	7.0	7.0
	6.0	5.0	6.0	6.0	5.7
	7.6	8.3	8.0	8.0	7.9
	7.3	8.3	7.0	7.7	7.6
Mean	**6.82**	**6.62**	**6.82**	**6.94**	**6.80**
	2.7	3.7	3.3	2.7	3.1
	5.3	5.3	5.3	5.3	5.3
	4.3	3.0	2.7	3.0	3.2
	4.3	4.3	5.3	5.3	4.8
20 per cent	5.0	3.7	5.3	5.3	4.8
	3.3	3.7	4.3	4.3	3.9
	4.7	4.3	4.0	4.0	4.2
	3.3	4.3	3.7	4.0	3.8
	5.0	4.0	2.0	4.3	3.8
	6.0	5.7	5.7	6.7	6.3
Mean	**4.39**	**4.20**	**4.16**	**4.49**	**4.32**

4. **Individual scores for organoleptic characteristic of evaluation acceptability of *Shankarpale* prepared with different levels of incorporation of mushroom powder**

Level of mushroom incorporation	Colour	Texture	Taste	Flavour	Overall acceptability
	8.0	7.3	7.6	7.6	7.7
	7.3	7.3	7.6	7.6	7.5
	8.6	8.0	8.0	8.6	8.3
	7.6	7.6	7.6	7.0	7.5
0 per cent (control)	7.6	7.6	7.6	7.6	7.7
	7.3	8.3	8.3	8.0	8.2
	7.3	8.6	7.6	7.3	7.7
	7.3	7.0	8.3	8.6	7.8
	7.6	9.0	7.6	7.6	8.0
	8.3	7.0	7.3	8.0	7.7
Mean	**7.69**	**7.77**	**7.75**	**7.79**	**7.81**
	8.6	7.3	7.6	7.6	7.8
	7.6	7.0	7.0	7.0	7.1
	8.3	8.0	8.3	8.6	8.2
	7.3	7.0	7.0	8.0	7.2
5 per cent	6.6	7.6	7.3	6.6	7.3
	6.6	8.3	8.3	8.3	8.3
	6.6	6.6	8.0	7.6	7.2
	8.3	7.6	9.0	6.6	7.9
	7.3	8.0	7.6	7.3	7.3
	7.6	8.6	8.0	8.3	8.1
Mean	**7.48**	**7.50**	**7.81**	**7.59**	**7.64**
	6.6	7.6	8.0	7.6	7.5
	7.0	7.0	7.0	7.0	7.0
	8.6	8.3	8.3	8.3	8.4
	7.6	7.3	7.3	7.6	7.5

10 per cent	6.6	6.6	7.0	7.0	6.8
	6.0	6.3	6.3	6.3	6.2
	6.0	7.6	7.0	8.3	7.2
	8.6	8.0	8.6	6.6	8.0
	7.6	7.6	8.0	8.3	7.9
	6.6	7.0	6.6	5.0	6.3
Mean	**7.12**	**7.33**	**7.41**	**7.20**	**7.28**
	7.6	7.0	7.3	7.3	7.3
	6.3	6.3	6.3	6.3	6.3
	8.0	7.6	7.0	7.3	7.5
	7.0	7.0	6.6	6.6	6.8
15 per cent	6.6	6.6	3.3	4.0	5.2
	5.0	5.3	5.3	5.3	5.2
	7.0	7.3	7.0	7.3	7.2
	8.3	8.6	7.0	7.3	7.8
	8.0	6.6	6.6	7.0	7.1
	6.3	7.6	7.3	6.3	7.0
Mean	**7.01**	**6.99**	**6.37**	**6.47**	**6.74**
	6.3	6.6	6.6	6.0	6.7
	5.3	5.0	4.6	4.6	4.9
	7.3	7.3	6.3	5.0	7.4
	6.6	6.0	6.0	6.0	6.1
20 per cent	6.3	6.0	3.6	4.0	5.0
	3.6	4.3	4.3	4.6	3.1
	4.0	4.3	4.6	5.3	4.7
	6.3	6.3	5.6	5.3	6.1
	4.3	4.6	4.0	4.6	4.5
	5.6	5.3	5.3	6.6	5.7
Mean	**5.56**	**5.57**	**5.09**	**5.20**	**5.42**

5. **Individual scores for organoleptic characteristic of evaluation acceptability of *Besan wadi* prepared with different levels of incorporation of mushroom powder**

Level of mushroom incorporation	Colour	Texture	Taste	Flavour	Overall acceptability
	7.0	7.7	8.3	8.3	7.8
	7.3	7.0	7.7	7.0	7.4
	6.6	7.0	7.3	7.0	7.0
	7.0	7.3	7.7	6.7	7.1
0 per cent (control)	8.3	7.7	9.0	8.3	7.9
	6.7	7.3	8.0	7.3	7.5
	8.0	8.0	8.3	7.7	8.1
	7.6	6.3	7.0	8.0	7.2
	6.7	8.3	6.7	6.3	6.8
	8.7	7.7	8.7	8.3	8.3
Mean	**7.39**	**7.43**	**7.87**	**7.49**	**7.51**
	8.0	8.3	8.7	7.7	8.1
	7.3	7.0	7.0	7.0	6.7
	9.0	8.0	9.0	7.3	8.6
	8.0	7.7	7.0	7.0	7.4
5 per cent	8.0	8.0	8.0	8.0	8.0
	7.7	7.3	7.0	8.7	7.7
	8.3	8.0	8.3	8.3	8.2
	7.3	7.3	8.0	8.0	7.0
	8.3	7.7	8.7	9.0	8.4
	8.3	8.0	7.7	8.0	7.9
Mean	**8.02**	**7.73**	**7.94**	**7.90**	**7.80**
	8.7	8.3	8.0	7.3	8.25
	7.3	7.0	7.0	7.0	7.1
	8.0	7.0	8.7	7.0	7.6
	7.3	7.3	7.7	6.3	7.1
10 per cent	6.3	8.3	8.0	8.0	7.7

	8.0	8.0	6.7	7.7	7.7
	7.3	7.3	7.7	8.3	7.6
	8.0	7.0	6.0	6.7	6.9
	7.0	8.0	7.3	8.0	7.8
	8.3	7.3	7.7	7.3	7.7
Mean	**7.62**	**7.55**	**7.48**	**7.36**	**7.54**
	6.3	6.0	6.3	6.3	6.25
	7.3	7.0	7.0	7.0	7.1
	5.7	6.7	6.7	6.7	6.4
	6.7	6.7	6.7	6.3	6.6
15 per cent	7.3	8.0	7.3	6.7	7.3
	7.3	6.3	7.0	5.3	6.6
	5.3	6.3	6.7	7.0	6.3
	7.7	7.3	6.0	6.0	6.7
	7.3	8.0	7.7	7.0	6.8
	6.7	7.3	7.0	6.3	7.1
Mean	**6.76**	**6.96**	**6.84**	**6.46**	**6.71**
	5.0	6.0	5.7	5.7	5.6
	5.3	6.0	6.0	6.0	5.8
	3.7	4.0	4.3	4.0	4.0
	5.0	6.7	6.3	6.3	6.1
20 per cent	6.0	6.0	4.7	4.3	5.2
	2.7	5.0	4.7	3.7	4.0
	5.7	6.3	5.7	5.7	5.8
	3.7	4.3	4.3	3.0	3.8
	4.0	4.7	5.0	5.7	4.8
	3.7	5.7	4.7	3.3	4.3
Mean	**4.48**	**5.47**	**5.14**	**4.77**	**4.94**