

# Sun Dried Mushroom (*Agaricus Bisporus*) Powder Incorporated Paneer and its Impact on Vitamin D Status of Selected Women

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**Abstract:** *Drying mushrooms is a wonderful way to preserve them for long-term storage. The increasing demands and the accompanying value addition present a great opportunity for the dairy industry to take up the production and marketing of various dairy products especially traditional products on an industrial scale. The study focussed on value-added product development by sun-drying mushrooms and incorporating its powder into a dairy product such as paneer, further supplementing the product for raising the serum levels of vitamin-D in Vitamin-D deficient women. Mushrooms were sundried under UV light for 6 hrs and then powdered and incorporated into paneer in two variations (Variation 1 and Variation 2). The proximate analysis revealed significant increase in the nutrient content in variations of sundried mushroom powder enriched paneer. The vitamin D content of sundried mushroom powder enriched paneer increased significantly. Supplementation of sun dried mushroom powder enriched paneer (variation 1) in vitamin D deficient women significantly increased the serum levels of vitamin D after feeding trial for one week. This improvement in vitamin D status could be attributed to the bioavailability of vitamin D2 from vitamin D2 enhanced mushroom through sunlight exposure. The results of sensory evaluation showed that the incorporation of sun dried mushroom powder in blends of cow milk was found suitable without affecting the sensory characteristics significantly.*

**Keywords:** Value-addition, Bio-availability

## 1. Introduction

India is a country where the major proportion of the population are vegetarians. Milk plays important role in diet of such persons as a source of animal protein and its products such as ghee, curd, butter, khoa, paneer, cheese, ice cream and milk powders adds diversity to plant-based diets. It is a major source of dietary energy, protein and fat and also contains numerous nutrients like calcium, magnesium, selenium, riboflavin, vitamin B12 and pantothenic acid which make it a complete food.

Domestic market for value added products like butter, ice cream, cheese, dairy whiteners and spreads is growing at 8-10 percent per year. The increasing demands and the accompanying value addition present a great opportunity for the dairy industry to take up the production and marketing of various dairy products especially traditional products on an industrial scale.

Paneer is an acid coagulated product obtained when standardized milk coagulated with the permitted acids at specified temperature, resultant coagulum is filtered and pressed to get the solid curd mass. Paneer is mainly prepared from buffalo milk and used for large number of culinary dishes. It is generally sold as blocks or slices, also referred as Indian fresh cheese.

Mushrooms are non-green, edible fungi which are good sources of non-starchy carbohydrates, dietary fiber, protein, mineral and vitamin. Mushrooms are the only non-animal food source of vitamin D where the precursor to vitamin D occurs naturally. Ergosterol, found in mushrooms is converted to ergocalciferol or vitamin D2 by exposure to

UV light. This conversion can be accelerated by exposure to UV light for 15-20 seconds during processing. The dose and length of treatment can affect the amount of D2 synthesized during exposure (Roberts et al, 2008). The current recommended Adequate Intake (AI) for Vitamin D for most adults is 5 µg (200 IU).

Mushrooms have been found effective against cancer, cholesterol reduction, stress, insomnia, asthma, allergies and diabetes (Bahl, 1984). Due to high amount of proteins, they can be used to bridge the protein malnutrition gap. Mushrooms as functional foods are used as nutrient supplements to enhance immunity in the form of tablets. Due to low starch content and low cholesterol, they suit diabetic and heart patients. One third of the iron in the mushrooms is in available form. Their polysaccharide content is used as anticancer drug. Even, they have been used to combat HIV effectively (Nanba, 2000). Biologically active compounds from the mushrooms possess antifungal, antibacterial, antioxidant and antiviral properties, and have been used as insecticides and nematocides as well.

When dietary calcium intake is inadequate to satisfy the body's calcium requirement, 1,25(OH) 2D, along with PTH, mobilizes calcium stores from the bone. In the kidney, 1,25(OH) 2D increases calcium reabsorption by the distal renal tubules. The presence of Vitamin D 2 can result in a 10-30 percent increase in calcium absorption. Thus keeping in view the tremendous applications of mushrooms, the study was conducted to increase the nutritional bioavailability of vitamin D by developing value-added dairy product with sun-dried mushroom powder.

## 2. Objectives

- 1) To develop vitamin D enriched paneer by the addition of sun dried mushroom powder.
- 2) To analyse and compare the proximate composition (moisture, ash, crude fiber, fat, protein, calcium) and Total soluble solids of paneer variations and compare it with the standard paneer (control).
- 3) To analyse the vitamin D content of paneer variations.
- 4) To evaluate and compare the organoleptic parameters of paneer variation with that of the control.
- 5) To study the impact of sun dried mushroom powder incorporated paneer on the Vitamin D status of selected women

## 3. Materials and Methods

### Sample Selection

Milk and white button mushrooms were procured from a local market for its ease of availability. Mushrooms were thoroughly cleaned before further processing. For the experimental study homemade paneer was used as control and the variations were prepared by adding sun dried mushroom powder to the paneer.

### Preparation of Samples

Cleaned and washed mushrooms were sliced into 5mm thick slices (approx.), dried under direct sunlight for 6 hours and ground into fine flour. Two variations of experimental paneer were prepared for the study. Table 1 shows the composition for preparation. The sun-dried mushroom powder was introduced into milk after coagulation with lemon juice and then pressed into paneer cubes.

**Table 1:** Composition of Experimental paneer (Net weight: 100g)

Ingredients	Control	Variation 1	Variation 2
Paneer (100 g)			
Milk	500 ml	500 ml	500 ml
Curd	100 ml	100 ml	100 ml
Lemon Juice	50 ml	50 ml	50 ml
Mushroom Powder	-	15 g	20 g

### Experimental Analysis

The paneer variations were analysed for its proximate composition – moisture, ash, crude fibre, crude fat, protein, calcium using AOAC methods of food Analysis, 2012. The Total soluble solids was determined by Bradley method, 2001. The Vitamin D content of enriched paneer variations were determined by HPLC method (Henk Van den Berg, 1986). The vitamin D for analysis was extracted from enriched paneer using solvent.

### Sensory analysis

The enriched paneer variations were prepared into gravy recipes for the purpose of supplementation study. The sensory analysis was carried out for the paneer curries prepared from the experimental paneer variations by 15 panel members. The products were tested for color and appearance, body and texture, flavor, taste, and overall acceptability. Standard 9 point hedonic scale was used with scales 9-Like extremely, 8-Like very much, 7-Like

moderately, 6-Like slightly, 5-Neither like nor dislike, 4-Dislike slightly, 3-Dislike moderately, 2-Dislike very much and 1-Dislike extremely for analysis. Supplementation of sun dried mushroom powder enriched paneer: The selected paneer variation was introduced for supplementary feeding trials for vitamin D deficient women. Serum samples of the subjects were analysed for vitamin D content before supplementation. The supplementation was done on five random subjects of age group ranging between 20-50 years. The subjects were fed with 50g of enriched paneer for one week in the form of gravy preparation during lunch. At the end of one week serum analysis for vitamin D content was repeated. (Raghuramulu et al., 2003)

## 4. Results and Discussion

The contents of moisture, ash, fiber, fat, protein, calcium and total solids of control (paneer) were 54.78 %, 1.94 %, 0 %, 24.2 g %, 15.5 g %, 233 mg % and 44.51 g % respectively. The above analyzed content of variation 1 paneer made by addition of 15 g of sun dried mushroom powder had 45.85g %, 2.25g %, 10.37g %, 4.59g %, 20.9 g, 353.9 mg% and 47.82 g % respectively. The variation 2 was made by adding 20 g of sun dried mushroom powder and it had 47.19g %, 2.35g %, 11.56 g %, 4.85g %, 21.08g %, 355.2 mg% and 48.72 g % respectively.

The lower percent of moisture in experimental sample can be attributed to the diffusion of mushroom powder added into the paneer cubes causing increased total solids. It was observed that values obtained in the present investigation are similar to those reported by Rani et al., (2014)

The ash and the fiber content of the variations had significantly increased due to the addition of sun dried mushroom powder which is the good source of minerals and fiber. The fat content of the variations had significantly decreased which paves way for further study.

The protein and the calcium content of the variation had increased significantly due to addition of sun dried mushroom powder. Increase in the protein content is due to the addition of various level of mushroom powder in paneer.

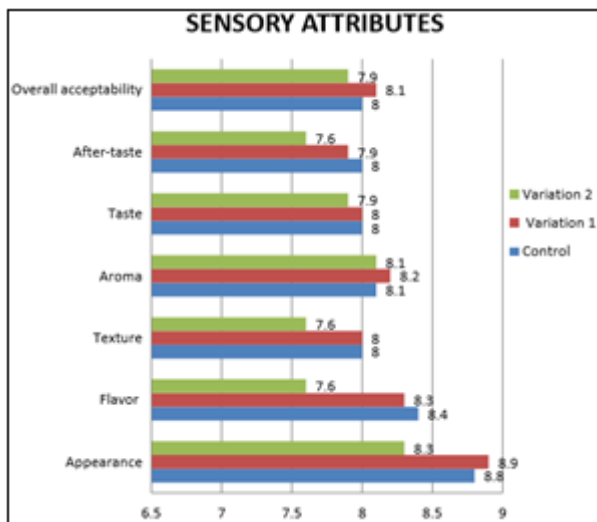
Calcium is an essential mineral required for the maintenance of skeletons, and bones, contraction of muscles, heart, blood clotting (Gopalan, C., et al., 2012). The result of the study showed that the control had 232.96 mg/100g and variation 1 and 2 had 353.1mg/100g and 354.88mg/100g. It was found that there is no significant difference between the variations.

Total solids are a measure of all suspended, colloidal and dissolved solid in a sample. It was observed that total solid content of paneer increased with increase in level of mushroom powder. It was found to be statistically significant at the level of p (<0.05). A similar study was done on formulation of paneer with a blend of soy bean by Biradar et al., 2012

The proximate analysis revealed significant difference in the nutrient content between the variations and the control but there was no significant difference between the variation 1 and 2. Hence this proved that addition of sun dried

mushroom powder in paneer increases the nutrient content in the final product.

The results of sensory evaluation showed that variation 1 significantly superior to variation 2 in overall acceptability for favourable results. Vitamin D was formed during UV exposure from sunlight as result of photochemical cleavage of the b-ring of ergosterol forming the intermediate pre vitamin D2. This then undergoes thermal rearrangement to ergocalciferol. (Vitamin D2) . Based on sensory evaluation, variation 1 was found to be more acceptable than variation 2. Hence variation 1 was considered for analysis of vitamin D content.



Vitamin D2 content of sun dried mushroom powder enriched paneer (V 1) per 100g was found to be 836.27 IU. Sun dried mushroom powder enriched paneer (variation 1) was introduced for supplementary feeding trial for vitamin D deficient women. The study revealed that serum vitamin D levels were 11.96 ng/ml before consumption and 12.53 ng/ml after the consumption of sun dried mushroom powder enriched paneer for one week. This showed that there is a significant difference after the consumption of sun dried mushroom powder enriched paneer at the significant level of p (<0.05).

A similar study demonstrated in humans that the bioavailability of vitamin D2 from vitamin D2 enhanced button mushroom through UV radiation was effective in improving the vitamin D status, Urbain et al., (2011).

This improvement in vitamin D status could be attributed to the bioavailability of vitamin D2 from vitamin D2 enhanced mushroom through sunlight exposure.

Before Consumption	After Consumption
11.96 ± 2.28 ng/ml	12.53 ± 2.36 ng/ml

## 5. Conclusion

The present investigation was envisaged with the objective of incorporation of sun dried mushroom powder for developing highly nutritious paneer by blending it with cow's milk. The effect of blending of sun dried mushroom powder to paneer, its proximate and sensory score were

studied. The proportion of mushroom blending with cow's milk to prepare paneer was optimized. It could be summarized on the basis of the above results that value added nutritious paneer could be prepared by blending 15 g of sun dried mushroom powder with cow's milk without significantly affecting the sensory characteristics of paneer. Therefore milk products could be enriched with vitamin D utilizing natural resources.

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