



# DEVELOPMENT AND EVALUATION OF VITAMIN-D AND CALCIUM RICH PRODUCTS USING DIFFERENT COOKING TECHNIQUES

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## Abstract

Vitamin D and Calcium plays a vital role in our body. The following study was conducted to develop various products rich in Vitamin-D and Calcium content using different cooking techniques and also to evaluate the retention amount of both the nutrients in each respective developed products. While developing the products, sundried mushrooms, also known as *Agaricus bisporus*, were used in the powder form as the main source of Vitamin-D along with Ragi flour and chia seeds as the source of Calcium. Mushrooms have the tendency to absorb sufficient amounts of Vitamin-D when exposed to adequate amount of sunlight. Through lab testing by HPLC method, it was assessed to be 860 IU of vitamin-D per 100g of sundried mushrooms powder. The study is divided in three different stages. Beginning from first stage, mushrooms, ragi flour and chia seeds were procured for further development of products. Sliced mushrooms were exposed to sunlight for few days to dry them and grind it to powder form. It was proceeded by developing various products using different cooking techniques; Muffins (Baking), Mathri (Frying), Parantha and Pancakes (Direct Heat) and Jawa (Boiling). The second phase consists of assessment of acceptance through sensory evaluation on 100 subjects, 50 each for Composite score card and 9 point Hedonic scale. The final stage consists of assessment of the effect of various cooking techniques on the developed product through proximate analysis to analyse the retention levels of Vitamin-D and Calcium in all the developed products. In the following study, Vitamin-D maximum retained in Jawa with 88.37% and 24.75% of calcium, whereas, Calcium maximum retained in Mathri as 71.62% and Vitamin D as 86.05%.

## Introduction

Our Indian traditional diet lacks in fulfilling the daily RDA of Vitamin-D and Calcium due to which their deficiencies prevails the most in our country. It is one of the most under treated and under diagnosed nutritional deficiencies which prevails about 70-100% in the general population irrespective of age, gender, race, geography and socio religious and cultural practices. (Gupta, A., 2014).

Such high prevalence is because of inadequate intake of vitamin-D and calcium sources in the diet. Sunlight being the major source providing vitamin-D is still not sufficient due to less exposure to our skin which results in less absorption of calcium in our body. Milk is the only source of both these nutrients. Diet which lacks in calcium will therefore provide less vitamin-D. (Dawson-Hughes, B. *et al.*, 1997).

Dietary sources of calcium are majorly from milk and other dairy products such as yogurt, lassi, cheese, butter, paneer, etc. Green Vegetables also provide

sufficient amounts of calcium which vary on their cultivation process and cooking method. Among all the cereals, Ragi flour contains the highest amount of calcium which is easily digestible and is thus beneficial. Other sources include egg, salmon, egg yolk, whitebait and sardines. (Ross, A. *et al.*, 2011).

Complementing diet with nuts and seeds, Chia seeds are known to be rich source of fat and also have high levels of proteins, dietary fibre, B-complex vitamins and minerals like Calcium, phosphorus, potassium and other bio active compounds and antioxidant properties. (Melo, D. *et al.*, 2019).

Dietary sources of Vitamin-D are very less in vegetable diet and others which contain are from animal sources such as egg yolk, fish liver oil and fatty fish. Sunlight is the main source of Vitamin-D and our bodies should be given enough exposure to it. (Ross, A. *et al.*, 2011).

Button Mushrooms when exposed to UV-B rays (sunlight) have the propensity to absorb ample amount of

vitamin-D and can be incorporated in our daily diet to meet its daily RDA. (P. Ložnjak and J. Jakobsen 2018).

## Materials and Methods

### Sundried mushrooms:

Various studies reveal the ability of mushrooms absorbing ample amounts of vitamin-D when exposed to sunlight for few days. These can be incorporated in our diets to meet the daily RDA. Sun drying technique to generate ample amounts of vitamin-D depends on the time of exposure, climatic conditions, time of the day, latitude and season.

Button mushrooms were procured, sliced and then exposed to sunlight until fully dried to absorb noticeable and nutritionally sufficient amounts of vitamin-D depending on the weather conditions and exposure time.

Food type, cooking method and duration are considered to be the important factors in the retention of Vitamin-D and calcium amounts in the developed products using Vitamin-D induced sun-dried mushrooms along with other ingredients, Ragi flour and chia seeds. The cooking methods include Boiling, Steam Cooking, Microwave Cooking, Oven Baking and Pan Frying. (P. Ložnjak and J. Jakobsen 2018).

### Ragi flour and chia seeds:

Calcium is the major nutrient required for our bones and its maintenance. Milk and dairy products being the major source of calcium are taken in less quantity in our diet which leads to calcium deficiency. Among all the cereal grains, Ragi flour, also known as finger millet, provides the sufficient amount of calcium (344mg/100g). (Shobana, S. *et al.*, 2013).

Ragi flour can easily be incorporated in our diet to overcome calcium deficiency which causes bone and teeth disorders and also helps in curing iron deficiency which leads to anaemia. (P. Singh and R.S. Raghuvanshi 2012).

Ragi flour can be replaced with the consumption of many other grains such as wheat, rice and other starchy cereals and can be incorporated in many forms in our diet of all the age groups including weaning foods for infants to chapatti, noodles, soups, snacks and fermented foods like idli and dhokla for adults. (Gull, A. *et al.*, 2014).

Chia seeds are also known for its high dietary fibre, protein, lipids and calcium content and thus increases the nutritional value of the products developed along with other health benefits such as lowering blood pressure, reducing appetite, improving gut health and digestibility, controls weight and reduces fat, improves glucose levels,

and improves blood sugars and many more and helps in increasing the nutritive value of the foods. (Suri, S. *et al.*, 2014) (Da Silva, B.P., 2016).

### Development of products

Various products rich in Vitamin-D and Calcium were developed using different cooking techniques to evaluate the amount of retention of vitamin-D and Calcium in every cooking method. The products developed include sundried mushroom powder, ragi flour and chia seeds as the main ingredients fulfilling the needs of Vitamin-D and Calcium along with the other essential ingredients. Products such as Muffins (using 20g Ragi flour, 20g Sun-dried Mushroom powder, 5g Chia seeds, 40g Refined flour, 55g egg, 50ml Milk, 50g Butter, 20g Sugar per 100g) by Baking method, Mathri (using 20g Ragi flour, 20g Sun-dried Mushroom powder, 5g Chia seeds, 40g Refined flour, 20g Semolina, 10g Oil per 100g) by Frying method, Parantha (using 20g Ragi flour, 20g Sun-dried Mushroom powder, 5g Chia seeds, 20g Whole wheat flour, 5g Oil) and Ragi-Banana Pancakes (using 20g Ragi flour, 20g Sun-dried Mushroom powder, 5g Chia seeds, 40g Refined flour, 60g Banana, 250ml Milk, 15g Butter, 10g Sugar) by Direct heat method and Jawa (using 10g Ragi flour, 20g Sun-dried Mushroom powder, 5g chia seeds, 20g Refined flour, 10g Oil, 250ml Milk) by Boiling method were developed and assessed through sensory evaluation for taste, colour, texture, mouth-feel, aroma and overall acceptance by 100 subjects using composite scale card and 9 point Hedonic scale (50 each). Proximate analysis was done for all the developed products.

## Results and Discussion

The study reveals that the maximum amount of Vitamin-D retention was observed in Jawa as 88.37% and 24.75% of calcium. Whereas, highest amounts of calcium is retained in Mathri as 71.62% and Vitamin D retained as 86.05%, Muffins retained 72.67% of Vitamin D and 22.81% of Calcium, Parantha retained 72.09% of Vitamin D and 51.50% of Calcium, Pancakes retained 82.56% of Vitamin D and 11.20% of Calcium.

In the following study products developed using different cooking techniques retained sufficient amounts of Vitamin-D and Calcium and also mushrooms have the tendency to absorb Vitamin-d in sunlight exposure.

The latest studies by FSSAI reveal the daily RDA for Vitamin-D to be 400 IU/d for all the age groups and for Calcium is 600-800 mg/d. All the products developed are nutritionally rich as retaining sufficient amounts of both the nutrients and are providing 25% of the daily RDA. (FSSAI, 2019)

Table 1 depicts the amounts of Vitamin-D absorbed through sunlight exposure and calcium content in sun-dried mushroom powder. Both the nutrients were nutritionally sufficient to fulfil the daily RDA. Products were developed using different cooking techniques to evaluate the amount of Vitamin-d and Calcium retention after cooking.

**Table 1:** Physical analysis of sundried mushroom powder.

S.No.	Parameter	Test Result (per 100g)
1	Calcium	3.50 mg
2	Vitamin D	860 IU

Table 2 depicts the proximate analysis as per 100g of all the developed products which indicates the sufficient retention in the amount of Vitamin-D and calcium and can be consumed by an individual of any age group according to the preference, hence meeting the nutritional requirements of the body and overcome nutritional deficiencies.

**Table 2:** Proximate analysis result of all the developed products as per 100g:

S. No.	Parameter	Sample1 (Muffin)	Sample2 (Mathri)	Sample3 (Jawa)	Sample4 (Parantha)	Sample5 (Pancakes)
1	Total Energy (kcal)	352.38	495.28	253.7	364.65	364.65
2	Carbohydrates (g)	64.80	59.47	43.07	64.55	64.55
3	Total fat (g)	4.70	23.80	5.58	6.45	6.45
4	Saturated fat (g)	1.10	8.19	3.90	2.30	2.30
5	MUFA (g)	0.92	4.74	1.10	7.19	7.19
6	PUFA (g)	0.23	2.32	0.20	0.65	0.65
7	Crude fibre (g)	5.38	2.90	1.25	3.40	3.40
8	Protein (g)	12.72	10.80	7.80	12.10	12.10
9	Sugar (g)	4.32	1.20	6.48	6.80	6.80
10	Iron (mg)	2.90	2.75	19	3.20	3.20
11	Moisture (g)	7.20	9.37	39.45	11.20	11.20
12	Total ash (g)	3.19	2.66	2.85	2.30	2.30
13	Vitamin D (IU)	125	148	152	124	142
14	Calcium (mg)	52	65	142	45.3	70

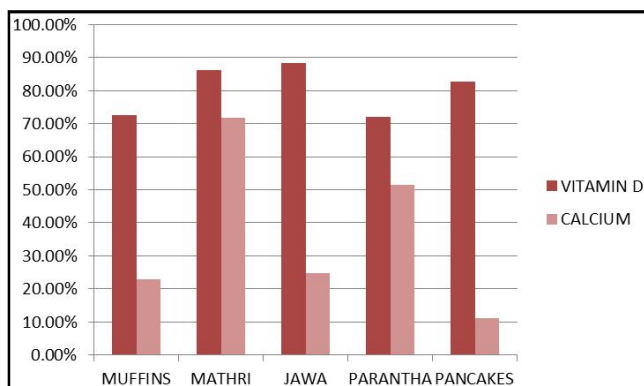
Fig. 1 shows the significant values for Vitamin-d and Calcium retention in all the developed products using different cooking techniques. Varying differences in the values were seen the developed products as Jawa shows the highest value of retention of Vitamin D as 88.37% and calcium as 24.75%.

Whereas, highest amounts of calcium is retained in Mathri as 71.62% and Vitamin D retained 86.05%.

Muffins retained 72.67% of Vitamin D and 22.81% of Calcium.

Parantha retained 72.09% of Vitamin D and 51.50% of Calcium.

Pancakes retained 82.56% of Vitamin D and 11.20%



**Fig. 1:** Depicting Percentage Retention of vitamin D and calcium in all the products developed using different cooking techniques.

of calcium.

## Conclusion

Ragi flour and Chia seeds being the rich source of Calcium and Sun-dried Mushrooms being rich in Vitamin-D, when given enough exposure to sunlight having tendency to absorb Vitamin-D, can be incorporated in the diet of an individual of all the age groups from infants to elderly to reduce the nutritional deficiencies of Vitamin-D and Calcium. Sun-dried mushroom powder, ragi flour and chia seeds can be easily incorporated in our diet by replacing other cereals and are nutritionally rich to meet the 25% of the daily RDA, hence nutritionally rich. Different cooking techniques have some effect on the nutrients retention still fulfilling the RDA and making the products Vitamin-D and Calcium rich.

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