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DEVEOLPMENT OF VITAMIN D RICH PRODUCT PREPARED FROM MUSHROOM POWDER

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ABSTRACT

Vitamin D is an essential vitamin that boosts the immune system and plays vital roles in human population. Low vitamin D status has been reported worldwide. Enhancement of foods with vitamin D can be one of the possible modes for improving the vitamin D status. Mushrooms are one of the few plant foods which contain ergosterol, a precursor to vitamin D_2. The amount of vitamin D_2 in mushrooms can be significantly increased by exposing mushrooms to ultraviolet (UV) light or in sunny areas. The objective of the study was to develop a vitamin D rich mushroom cookies by using sun dried mushroom powder with whole wheat flour. The mushroom cookies were prepared in two different concentrations (15% and 25%).Sensory evaluation was done by hedonic rating scale. Proximate analysis and vitamin D level content of mushroom cookies was done. The proximal data revealed that as the mushroom powder concentration increased the moisture, ash, protein, energy, fat content and the vitamin D content also increased. The study concluded that mushroom cookies with (15% incorporation of mushroom powder) was highly acceptable and could be beneficial in increasing the vitamin D status of the population.

KEYWORDS: Vitamin D, Mushroom and Sun drying.

INTRODUCTION

Vitamin D is a fat-soluble vitamin that is naturally present in very few foods and added to others, and available as a dietary supplement. It is also produced endogenously when ultraviolet rays from sunlight strike the skin and trigger vitamin D synthesis.[1] There are two sources of Vitamin D: exposure to sunlight, which allows the body to produce its own vitamin D using ultraviolet light and cholesterol in the skin; and a limited number of food sources including fortified milk, fish, eggs and mushrooms. Mushrooms are the only vegetable that contain natural vitamin D. They contain a compound called ergosterol that is turned into vitamin D in the body.[2] Currently, the Adequate Intake (AI)* of vitamin D for infant (0-12 months) is 10 mcg (400 IU) per day. And the adequate intake of vitamin D for children (1-13 years) is 15 mcg (600 IU) per day and for those adults to age 70 is 15 mcg per day (600 IU) per day and those who are older than 70 years is 20 mcg (800 IU) per day.[1] Recent studies have shown that a 100 gram serving (approximately ½ cup) of sliced fresh raw white mushrooms has 7 IU of vitamin D.[3] Absorption and metabolism of vitamin D in the body: Vitamin D are the fat soluble vitamin. Bile salts are essential for the absorption of vitamin D. Vitamin D_3 either from the photolysis in skin or from dietary sources is transported by specific vitamin D-binding protein, to liver where it is stored or further metabolized to 25-hydroxy vitamin D3 (25 OH D_3). Liver is the major storage organ for vitamin D. 25-hydroxy vitamin D_3 is further metabolized to 1,25 dihydroxy vitamin D_3[1,25$(OH)_2D_3$] in the kidney.1,25$(OH)_2D_3$ is the active hormonal form of vitamin D which bring about all the biological function in the body.[4]

Deficiency of vitamin D: A vitamin D deficiency can occur when usual intake is lower than recommended levels over time, exposure to sunlight is limited, the kidneys cannot convert 25(OH)D to its active form, or absorption of vitamin D from the digestive tract is inadequate. Vitamin D-deficient diets are associated with milk allergy, lactose intolerance, ovo-vegetarianism, and veganism.[1] Rickets and osteomalacia are the classical vitamin D deficiency diseases. In children, vitamin D deficiency causes rickets, a disease characterized by a failure of bone tissue to properly mineralize, resulting in soft bones and skeletal deformities.[5]

Mushrooms are considered as a delicacy with high nutritional and functional value, and they are also accepted as nutraceutical foods; they are of considerable interest because of their organoleptic merit, medicinal properties, and economic significance.[6] The nutritional value

of edible mushrooms is due to their high protein, fiber, vitamin and mineral contents, and low-fat levels.[7] Mushrooms contain a high moisture percentage. Edible mushrooms are a good source of protein. They are low-calorie foods since they provide low amounts of fat and contain high amounts of ash (mainly potassium, phosphorus, magnesium, calcium, copper, iron, and zinc).[8] Mushrooms are the only nonanimal food source that contains vitamin D and hence they are the only natural vitamin D ingredients for vegetarians.[9]

Therefore the present study was conducted to develop a vitamin D rich whole wheat flour cookies which will be beneficial in increasing the vitamin D status of the population.

MATERIAL AND METHODS

The study was done under four phases. Phase I was product development. Firstly the mushrooms were dried by two methods – Sun dried and oven dried and grinded to form powder. Then the assessment of vitamin D level between the sun dried and oven dried mushroom powder was done. The results revealed that vitamin D level was high in the sun dried mushroom powder as compared to oven dried mushroom powder. Therefore, for further analysis sun dried mushroom powder was used. The mushroom cookies were prepared by standardized recipe by using sun dried mushroom powder and whole wheat flour. After the standardized of normal cookies two variations of mushroom cookies were made.

The two variation of mushroom cookies were made, Sample T_1 (Mushroom cookies incorporated with 15 g of mushroom powder), Sample T_2 (Mushroom cookies incorporated with 15 g of mushroom powder). Phase II include sensory evaluation of the samples was carried out using 21 panelists from Manav Rachna International University. A nine-point Hedonic scale one (1) and nine (9) representing “extremely dislike” and “extremely like”, respectively, was used.

The qualities assessed include taste, texture, colour, flavour and overall acceptability. Phase III includes proximal analysis and vitamin D level analysis of the product. The proximal analysis was done for moisture, ash, and crude fiber contents were determined by the AOAC.(2000) Vitamin D was determined using the standard method of (AOAC, 1995). The last phase was statistically test was done by using SPSS version 20 software. The analysis includes mean, standard deviation, t – test, ANOVA for comparative results.

RESULTS AND DISCUSSION

Table 1: Level of vitamin D in mushroom powder.

level of vitamin D (mcg/100g)	methods for drying mushroom powder		P-value
M±SD	SUN DRYING	OVEN DRYING	0.000
	195.5±4.24	28.89± 0.43	

*Significance difference at 0.05 level.

Table 1 and depicts the level of vitamin D in mushroom powder After sun drying the mean value of the vitamin D in mushroom powder was 195.5±4.24 and after oven drying the mean value of the vitamin D in mushroom powder was 28.89±0.43. The result revealed that there was statistically significant difference ($p<0.05$) between the vitamin D level in the sun dried and oven dried mushroom powder. This state that vitamin D level was high in the sun dried mushroom powder as compared to oven dried mushroom powder.

Therefore, for further analysis Sun dried mushroom powder was used. The cookies were made by incorporating the mushroom powder of sun dried as vitamin D level was higher in sun dried mushroom powder.

Table 2: Mean Acceptability Score of Attributes between the Sample T1 and Sample T2: Mushroom Cookies (By Hedonic Scaling).

Sample	T 1(Sample) M±SD	T 2(Sample) M±SD	t -value	P- Value (T test)
Taste *	7.52±1.0	6.33±0.8	4.07	0.00
Color *	7.19±1.0	6.47±0.9	2.24	0.030
Texture*	7.38±0.9	6.52±1.0	2.77	0.003
Flavor *	7.33±1.0	6.47±1.1	2.59	0.013
Overall acceptability*	7.09±1.0	6.38±1.2	2.05	0.046

Sample T_1: Mushroom cookies with 15% incorporation of mushroom powder

Sample T_2: Mushroom cookies with 25% incorporation of mushroom powder

* Significant at $p<0.05$

Table 2 depict mean acceptability score of attributes between the sample T_1 and sample T_2: Mushroom cookies. With regards to taste, sample T_1 had the highest mean i.e. 7.52 ±1.0 whereas sample T_2 had the mean score of 6.33±0.8, and the results were statistically significant ($p<0.05$) which means that sample $T_1$was more acceptable regarding taste as compared to sample T_2. In colour, the mean score of sample T_1 was 7.19±1.0 whereas for sample T_2 the mean score was 6.47±0.9 and the difference were statistically significant

($p<0.05$) between the sample T_1 and the sample T_2. Sample T_1 had the highest mean score 7.38±0.9 regarding texture, as compared to sample T_2 which had the mean score of 6.52±1.0, and the results were statistically significant ($p<0.05$) which means that sample T_1 was more acceptable then sample T_2. In flavour, sample T_1 had the mean score of 7.33±1.0 whereas sample T_2 had the mean score of 6.47±1.1 and there was statistically difference ($p<0.05$) between the standard sample and the sample T_2. The overall acceptability, of the sample T_1 had the highest mean score of 7.09±1.0 whereas sample T_2 had the mean score of 6.38±1.2, and the result were statistically significant ($p<0.05$) which means sample T_1 was more acceptable regarding overall acceptability as compared to sample T_2.

The result depict that sample T_1 (Mushroom cookies with 15% incorporation of mushroom powder) was more acceptable regarding all attributes as compared to sample T_2 (Mushroom cookies with 25% incorporation of mushroom powder).

Table 3: Mean acceptability score of attributes between the samples: Mushroom cookies (By Hedonic Scaling).

Parameters	Standard M±SD	T1(Sample) M±SD	T2(Sample) M±SD	P-Value (ANOVA TEST)
Taste	7.57±0.92	7.57±1.03	7.52±1.03	0.98
Colour*	7.47±0.98	7.19±1.07	6.47±0.98	0.007
Texture *	7.71±1.10	7.38±0.97	6.52±1.03	0.001
Flavour*	7.42±1.02	7.33±1.01	6.47±1.12	0.008
Overall acceptability*	7.47±1.07	7.09±1.04	6.38±1.20	0.008

Standard sample: Normal wheat flour cookies

Sample T_1: Mushroom cookies with 15% incorporation of mushroom powder

Sample T_2: Mushroom cookies with 25% incorporation of mushroom powder

*Significant at the $p<0.05$ level.

Table 3 depict mean acceptability score of attributes between the sample T_1 and sample T_2: Mushroom cookies. In taste, there was no statistically significant difference between the samples as determined by one way ANOVA i.e. ($p=0.98$). Sample T_1 had the highest mean value i.e. 7.57±1.03 whereas sample T_2 had the lowest mean value i.e. 7.52±1.03. The result revealed that T_1 was most acceptable regarding taste as compared to standard sample and sample T_2.

Regarding colour, the highest mean value was of standard sample (7.47±0.98) and the lowest for sample T_2 (6.47±0.98). However the difference were statistically significant ($p<0.05$) which means that standard sample was most acceptable regarding colour as compared to other products.

Standard sample had the highest mean value for the texture i.e. 7.71±1.10 whereas sample T_2 had the lowest mean value i.e. 6.52±1.03. The difference were statistically significant ($p<0.05$) among samples. The result stated that standard sample was most acceptable regarding texture as compared to other samples.

In flavour, there was statistically significant difference between the samples as determined by one way ANOVA ($p<0.05$). Standard sample had the highest mean value i.e. 7.42±1.02 whereas sample T_2 has the lowest mean value i.e. 6.47±1.12 which means that standard sample was most acceptable regarding flavour as compared to other samples.

The overall acceptability, of standard sample was highest with mean value of 7.47±1.07, however it was lowest for sample T_2 with the mean value 6.38±1.20 and the difference were statistically significant ($p<0.05$).

The result depict that sample T_1 (Mushroom cookies with 15% incorporation of mushroom powder) was more acceptable regarding taste attributes as compared to other samples, and the standard sample was more acceptable regarding all the attributes(colour, texture, flavour) as well as had the highest overall acceptability to other product.

Table 4: Proximal analysis of standard and mushroom variants cookies.

Parameter	Standard M ±SD	T 1(Sample) M±SD	T 2(Sample) M±SD	P -Value (ANOVA TEST)
MOISTURE (%)*	8.54±0.34	9.22±0.19	7.89±0.68	0.021
ASH (%)	2.20±0.17	2.46±0.23	2.53±0.46	0.440
PROTEIN (gm)*	11.56±0.49	11.48±0.32	13.43±0.72	0.007
CRUDE FIBER (gm)*	4.30±0.25	3.60±0.17	3.58±0.46	0.056
ENERGY (Kcal)*	308.72±0.59	323.07±0.49	303.72±0.49	0.000
FAT (gm)*	16.28±0.24	18.24±0.47	15.60±0.43	0.000

Standard sample: Normal wheat flour cookies

Sample T_1: Mushroom cookies with 15% incorporation of mushroom powder

Sample T_2: Mushroom cookies with 25% incorporation of mushroom powder

*Significant at the $p<0.05$ level

Table 4 depicts the proximal analysis of standard sample, mushroom cookies with 15% incorporation of mushroom powder and 25% incorporation of mushroom powder. Regarding moisture, moisture was high in sample T_1 i.e. 9.22±0.19 and lowest in sample T_2 i.e. 7.89±0.68 but the difference were statistically significant ($p<0.05$).

Sample T_2 had the highest mean value for the presence of ash in the product i.e. 2.53±0.46 whereas standard sample has the lowest mean value i.e. 2.20±0.17 but the differences were not statistically significant among the samples ($p=0.440$)

Regarding protein, the highest mean value was of sample T_2 i.e. 13.43±0.72 and the lowest for sample T_1 i.e. 11.48±0.32 and thee was statistically significant difference ($p<0.05$) between the sample.

For crude fiber, standard sample had the highest mean value i.e. 4.30±0.25 whereas sample T_2 had the lowest, mean value i.e. 3.58±0.46 and the difference were statistically significant ($p<0.05$) among the samples.

Sample T_1 had the highest mean value energy i.e. 323.07±0.49 whereas the sample T_2 had the lowest mean value i.e. 303.72±0.49.The difference were statistically significant ($p<0.05$) among the samples.

Regarding fat, sample T_1 had the highest mean value i.e. 18.24±0.47 whereas sample T_2 had the lowest mean value i.e. 15.60±0.43.There was statistically significant difference between the sample as determined by one way ANOVA ($p<0.05$).

Table 5: Vitamin D level in mushroom cookies incorporated with 15% and 25% of mushroom powder.

Vitamin D (mcg/100g)	Mushroom Powder Concentration		P-value
	15% mushroom powder cookies	25% mushroom powder cookies	
M±SD	25.62±0.90	43.22±0.62	0.000

Table 5 depicts the vitamin D level of mushroom cookies incorporated with 15% and 25% of mushroom powder. The mean value of 15% mushroom powder cookies was 25.62±0.90, whereas the meanvalue of 25% mushroom cookies was 43.22±0.62 and the difference were statistically significant ($p<0.05$).

As 15% mushroom powder cookies were more acceptable by the panelist during the sensory evaluation. These mushroom cookies will fulfill the ½ of the RDA of vitamin D by just consuming 4-5 cookies in a day.

CONCLUSION

High sun dried mushroom powder concentration in mushroom cookies (25% mushroom powder) proved to be a high vitamin D rich product but the acceptability of the product contain 15% of sun dried mushroom powder was more as compared to 25% of sun dried mushroom powder. The study concluded that mushroom cookies with 15% incorporation of mushroom powder was highly acceptable and had vitamin D content of 26.15 mcg/100g which could be full fill the ½ of RDA of vitamin D content of the adult by just consuming 4-5 cookies per day.

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