AJHS.
Asian Journal of Home Science
Volume **9** | Issue 1 | June, 2014 | 100-105

Research Paper

e ISSN-0976-8351 | Open Access - *www.researchjournal.co.in*

Development and organoleptic evaluation of nutritious products by incorporation of broccoli leaves and floret powder for non-insulin dependent diabetics

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Received: 30.11.2013; **Revised:** 22.03.2014; **Accepted:** 10.04.2014

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■ **ABSTRACT :** The present study was planned with the objectives to develop and evaluate value added products organoleptically using broccoli floret and leaves powder with optimum nutrition and sensory attributes. Broccoli floret and leaves were prepared by washing, blanching, drying at 40-50°C for 4- 6 hrs. Five products were developed *i.e., Missi roti, Dalia, Dhokla, Chana dal* and Barley snack in the laboratory by using 5 per cent, 10 per cent and 15 per cent of broccoli floret and leaves powder. Organoleptic evaluation of developed products was done at 9 point hedonic scale from the Faculty of Department of Foods and Nutrition. Incorporation of broccoli floret and leaves powder in *Missi roti* was acceptable at 15 per cent and 10 per cent and in *Dalia* was acceptable at 10 per cent and 5 per cent and in *Dhokla* was acceptable at 10 per cent and 5 per cent and in *Chana dal* was acceptable at 5 per cent and 5 per cent and in barley snacks was acceptable at 5 per cent and 5 per cent, respectively. Mean scores of *Missi roti, Dalia, Dhokla, Chana dal* and *Barley snack* were significantly different ($P<0.05$) at different levels *i.e.*, 5 per cent, 10 per cent and 15 per cent in all attributes. Incorporation of broccoli floret powder at 5-15 per cent and broccoli leaves powder at 5-10 per cent was highly acceptable in all five products. So, broccoli floret and leaves powder can be safely incorporated in daily diet of diabetics.

■ **KEY WORDS:** Broccoli floret, Leaves powder, Organoleptic evaluation, Diabetics

■ **HOW TO CITE THIS PAPER :** Madhu and Kochhar, Anita (2014). Development and organoleptic evaluation of nutritious products by incorporation of broccoli leaves and floret powder for non-insulin dependent diabetics *Asian J. Home Sci.,* **9** (1): 100-105.

Diabetes is an increasingly important condition globally and robust estimates of its prevalence are required for allocating resources. Worldwide, the prevalence of diabetes in 2011 was 366 million people with diabetes, and this is expected to rise to 552 million by 2030. (Whiting *et al.,* 2011). At present, India has more diabetics than any other country in the world, according to the International Diabetes Foundation, although more recent data suggest that China has even more. The disease affects more than 50 million Indians, 7.1 per cent of the nation's adults and kills about 1 million Indians a year (Gale, 2011). The average age on onset is 42.5 years. The bioactive components in functional foods are efficacious for the improvement of health which has recently gained much importance. Increased oxidative stress is a widely accepted participant in the development and progression of diabetes and its complications. Diabetes is usually accompanied by increased production of free radicals or impaired antioxidant defenses. The cruciferous vegetables which include broccoli, cabbage and cauliflower are excellent source of phytochernicals including gIucosinolates and their byproducts, phenolics and antioxidant vitamins as well as dietaiy minerals. Consumption of Brassica vegetables such as broccoli, cabbage, brussel sprouts and cauliflower, belonging to crucifers provide modest support for the hypothesis that their high intakes reduce the risk of degenerative disorders such as cancer of

all types (Comblatt *et al.,* 2007; Gill *et al.,* 2004; Michaud *et al.,* 1999; Parnaud *et al.,* 2004 and Brandi *et al.,* 2005) and cardio-vascular diseases (Jackson *et al.,* 2004).

Broccoli is known as the "Crown jewel of nutrition" since it possesses all the nutrients namely, vitamins, minerals, secondary metabolites and fibre proclaiming its exceptional health benefits. The breakdown products of the sulfur containing glucosinolates, isothiocyanates are the active principles in exhibiting the anticancer property at every stage (Vasanthi *et al.,* 2009). So, the present study was undertaken to develop commonly consumed salty food preparations for diabetics by incorporating broccoli floret and leaves powder and evaluate their nutritional attributes and organoleptic acceptability.

■ RESEARCH METHODS

The raw material broccoli floret and leaves were procured from the vegetable farm of Punjab Agricultural University, Ludhiana.

Broccoli floret and leaf powder preparation:

Fresh floret and leaves were thoroughly washed to remove unwanted material and dirt, blanched in boiling water for 10-15 sec and dried at room temperature for 1-2 h by spreading on filter paper followed by drying in hot air oven at 40-50°C for 4-6 hours. Dried leaves and floret were powdered.

Development and standardization of food preparations:

Various preparations namely, *Missi roti*, *Dalia, Dhokla, Chana dal* and Barley snack were prepared in the laboratory (Table 1). These were prepared using standardised recipes (mentioned herewith) with supplementation of either broccoli floret and leaf powder. The following treatments were given:

–Treatment I (Control) - Cooked products with standardized method without supplementation of broccoli floret / broccoli leaves.
–Treatment II (BFP1) - Same as I + 5% broccoli floret
–Treatment III (BFP2) - Same as 1 +10% broccoli floret
–Treatment IV (BFP3) - Same as I + 15% broccoli floret
–Treatment V (BLP1) - Same as I + 5% broccoli leaves
–Treatment VI (BLP2) - Same as I + 10% broccoli leaves
–Treatment VII (BLP3)- Same as I + 15% broccoli leaves.

Sensory evaluation:

All the developed food preparations were organoleptically evaluated using nine point Hedonic scale (Amerine *et al.,* 1965). The evaluation was done by a panel of twelve judges comprising of Faculty of Department of Food and Nutrition and diabetic people.

Nutrient content:

Nutrient content per serving of the most acceptable levels of broccoli floret and leaves incorporated salty food preparations were calculated from the values given in nutritive value of Indian foods (Gopalan *et al.,* 2004)

Statistical analysis:

The data were subjected to statistical analysis using Statistical Package for Social Sciences (SPSS) version 16.0. ANOVA and Tukey HSD (Honestly significant difference) tests were used to obtain the differences in organoleptic scores, within different level of incorporation of broccoli floret and leaves in food preparations. Level of significance was accepted at $p \leq 0.05$.

■ RESEARCH FINDINGS AND DISCUSSION

The results of the present study as well as relevant discussions have been presented under following sub heads:

Sensory evaluation:

All the food products incorporated with broccoli floret powder (BFP) and broccoli leaves powder (BLP) were found to be organoleptically acceptable. However, the acceptable level of incorporation of BFP/BLP varied in different food preparations. It has been found that when the level of incorporation of BFP/BLP increased beyond the accepted levels in any food preparation, the mean scores for all the organoleptic characteristics decreased. In broccoli floret and leaves powder (BFP/BLP), incorporated food preparations (Table 1), namely, *Missi roti* the most acceptable level of

Table 1: Organoleptic evaluation of *Missi roti*

Incorporation level (%)		Mean sensory score					
		Colour	Flavour	Texture	Taste	Appearance	Overall acceptability
	Missi roti						
BFP	Control	8.3±0.15^{a}	8.1±0.23^{a}	8.2±0.20^{a}	8.1±0.20^{a}	8.3±0.15^{a}	8.2±0.10^{a}
	5	8.2±0.20^{ab}	7.9±0.23^{ab}	8.2±0.13^{a}	7.6±0.16^{b}	7.9±0.13^{b}	7.9±0.10^{b}
	10	7.8±0.13^{ab}	7.7±0.15^{b}	7.5±0.22^{b}	7.5±0.26^{b}	7.7±0.15^{b}	7.6±0.25^{b}
	15	7.6±0.16^{c}	7.4±0.16^{b}	7.4±0.32^{b}	7.2±0.29^{b}	7.7±0.21^{b}	7.4±0.29^{b}
BLP	5	7.9±0.17^{ab}	7.6±0.16^{ab}	7.9±0.17^{ab}	7.8±0.13^{ab}	7.9±0.13^{ab}	7.8±0.10^{a}
	10	7.0±0.29^{bc}	7.0±0.25^{bc}	7.0±0.21^{bc}	6.9±0.23^{b}	7.0±0.29^{bc}	7.0±0.25^{b}
	15	6.1±0.31^{c}	6.8±0.32^{c}	6.5±0.34^{c}	5.8±0.35^{c}	6.7±0.36^{c}	6.3±0.29^{c}

incorporation of broccoli floret and leaves was 15 per cent and 10 per cent the mean scores for overall acceptability were 7.40 ± 0.29 and 7.0 ± 0.25, respectively. In *Missi roti*, incorporated with BLP significant differences appeared in scores for flavour and overall acceptability but in BFP non-significant difference was found. Analysis by Tukey HSD test, further revealed that in scores for flavour and overall acceptability of *Missi roti*, significant differences ($p \leq 0.05$) appeared within 5,10 and 15 per cent level of incorporation with BLP (Fig. 1).

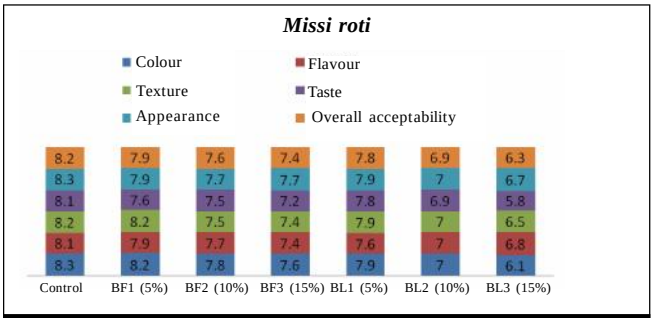

Fig. 1: Organoleptic evaluation of *Missi roti*

Kushwaha (2011) mean scores for an overall acceptability for drumstick and amaranthus leaves powder at 15 per cent level was 7.75 and 8.00 which was liked very much. Singh (2007) reported significantly lower scores in *Missa parantha* with respect to all sensory attributes on addition of cauliflower leaf powder at a higher level *i.e.*, 7.5 per cent but comparable scores to the control at 5 per cent cauliflower leaf powder supplementation. According to Goel *et al.* (2011) reported that in *Missi roti*, non-significant difference was obtained within 2.0, 2.5 and 3.0 per cent level of incorporation of ADPHM (antidiabetic polyherbal mixture) in scores for colour, appearance, texture and taste. Significant differences were noticed for flavour and overall acceptability in *Missi roti*.

Incorporation of BFP and BLP at 10 and 5 per cent level, the vegetable *Dalia* was best acceptable and the scores for their overall acceptability awarded by the panel of judges were 7.70 ±0.21 and 7.7±0.15, respectively (Fig. 2). Non-

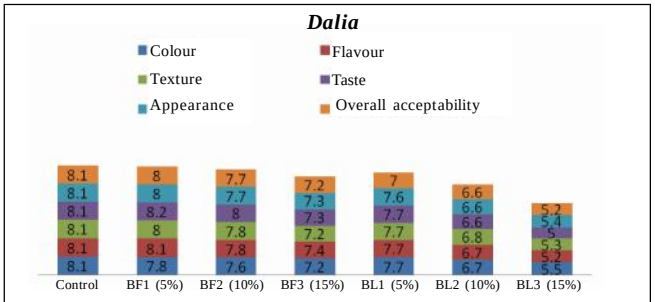

Fig. 2: Organoleptic evaluation of *Dalia*

significant difference was noticed in scores for all the organoleptic characteristics of vegetable *Dalia* within 5,10 and 15 per cent level of incorporation of BFP (Table 2). Goel *et al.* (2011) revealed that at 2 per cent level of incorporation antidiabetic polyherbal mixture (ADPHM), vegetable *Dalia* were best acceptable and the scores for their overall acceptability awarded by the panel of judges were 7.0 ±0.84. Non-significant difference was noticed in scores for all organoleptic characteristics of vegetable *Dalia* within 1.5, 2.0 and 2.5 per cent level of incorporation of antidiabetic polyherbal mixture (ADPHM).

The most acceptable level of incorporation of BFP and BLP in *Dhokla* was 10 and 5 per cent and the respective scores for overall acceptability ranged from 7.0 ±0.33 to 7.3 ± 0.16 (Fig. 3). Significant differences were found in scores for all organoleptic characteristics

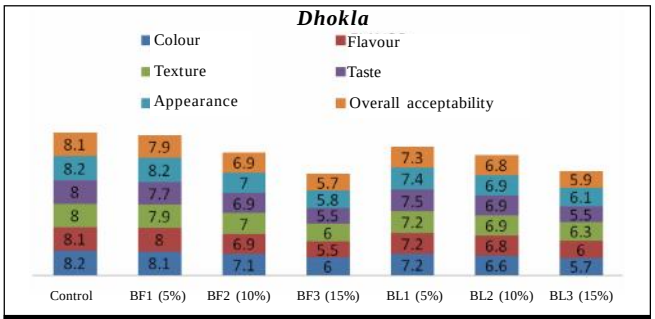

Fig. 3: Organoleptic evaluation of *Dhokla*

Table 2: Organoleptic evaluation of *Dalia*

Incorporation level (%)		Mean sensory score					
		Colour	Flavour	Texture	Taste	Appearance	Overall acceptability
	Dalia						
BFP	Control	8.1±0.17 ^{a}	8.1±0.17 ^{a}	8.1±0.17 ^{a}	8.1±0.17 ^{a}	8.1±0.17 ^{a}	8.1±0.17 ^{a}
	5	7.8±0.17 ^{ab}	8.1±0.17 ^{a}	8.0±0.0 ^{a}	8.2±0.13 ^{ab}	8.0±0.0 ^{ab}	8.0±0.17 ^{a}
	10	7.6±0.13 ^{ab}	7.8±0.13 ^{a}	7.8±0.13 ^{ab}	8.0±0.21 ^{ab}	7.7±0.15 ^{ab}	7.7±0.21 ^{ab}
	15	7.2±0.16 ^{c}	7.4±0.33 ^{a}	7.2±0.24 ^{b}	7.3±0.30 ^{b}	7.3±0.30 ^{c}	7.2±0.24 ^{b}
BLP	5	7.7±0.15 ^{a}	7.7±0.21 ^{a}	7.7±0.15 ^{a}	7.7±0.15 ^{a}	7.6±0.16 ^{a}	7.7±0.15 ^{a}
	10	6.7±0.26 ^{b}	6.7±0.26 ^{b}	6.8±0.24 ^{b}	6.6±0.16 ^{b}	6.6±0.16 ^{b}	6.7±0.21 ^{b}
	15	5.5±0.25 ^{c}	5.2±0.24 ^{c}	5.3±0.38 ^{c}	5.0±0.33 ^{c}	5.4±0.21 ^{c}	5.3±0.21 ^{c}

of *Dhokla* (Table 3). Antidiabetic polyherbal mixture incorporated at different levels of incorporation that is, 2.0, 2.5 and 3.0 per cent, non-significant difference was obtained within all organoleptic characteristics of *Dhokla* except for overall acceptability (Goel *et al.*, 2011).

Likewise, in *Chana dal* incorporation of BFP and BLP was best acceptable at 5 per cent in both and the respective scores for overall acceptability were 7.6±0.21 and 7.0±0.14 (Fig. 4). However, *Channa dal* incorporation with BFP was found non - significant difference at 5 and 10 per cent in colour and texture. For all organoleptic characteristics of incorporated with BLP 5,10 and 15 per cent level of incorporation were found significantly different ($p \leq 0.05$), except in flovour and taste at 5 and 10 per cent (Table 4).

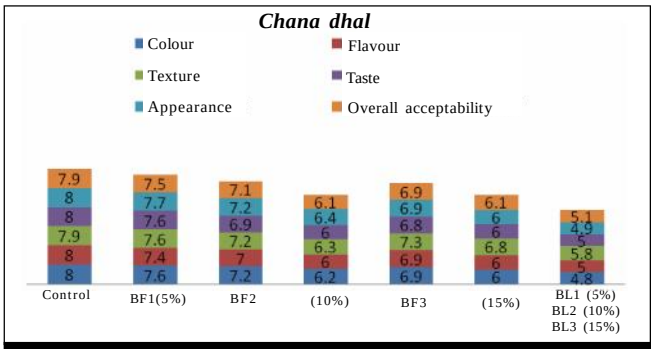

Fig. 4: Organoleptic evaluation of *Channa dhal*

BFP and BLP incorporated barley snacks scored highest scores at 5 per cent level of incorporation in both and the best

Table 3: Organoleptic evaluation of *Dhokla*

Incorporation level (%)		Mean sensory score					
		Colour	Flavour	Texture	Taste	Appearance	Overall acceptability
	Dhokla						
BFP	Control	8.2±0.13 [a]	8.1±0.14 [a]	8.0±0.21 [a]	8.0±0.21 [a]	8.2±0.13 [a]	8.1±0.17 [a]
	5	8.1±0.23 [ab]	8.0±0.25 [a]	7.9±0.23 [a]	7.7±0.33 [a]	8.2±0.22 [a]	7.9±0.21 [ab]
	10	7.1±0.23 [b]	6.9±0.27 [b]	7.0±0.25 [ab]	6.9±0.27 [a]	7.0±0.21 [b]	7.0±0.33 [b]
	15	6.0±0.14 [c]	5.5±0.37 [c]	6.0±0.42 [b]	5.5±0.42 [b]	5.8±0.35 [c]	5.8±0.35 [c]
BLP	5	7.2±0.24 [ab]	7.2±0.24 [ab]	7.2±0.24 [ab]	7.5±0.16 [ab]	7.4±0.22 [ab]	7.3 ±0.16 [ab]
	10	6.6±0.26 [bc]	6.8±0.24 [bc]	6.9±0.27 [b]	6.9±0.27 [b]	6.9±0.27 [bc]	6.8±0.29 [b]
	15	5.7±0.24 [c]	6.0±0.26 [c]	6.3±0.32 [b]	5.5±0.32 [c]	6.1±0.31 [c]	6.0±0.29 [c]

Table 4: Organoleptic evaluation of *Channa Dal*

Incorporation level (%)		Mean sensory score					
		Colour	Flavour	Texture	Taste	Appearance	Overall acceptability
	Chana Dal						
BFP	Control	8.0±0.0 [a]	8.0±0.0 [a]	7.9±0.10 [a]	8.0±0.0 [a]	8.0±0.0 [a]	8.0±0.0 [a]
	5	7.6±0.22 [a]	7.4±0.30 [ab]	7.6±0.22 [a]	7.6±0.33 [ab]	7.7±0.26 [ab]	7.6±0.21 [ab]
	10	7.2±0.25 [a]	7.0±0.20 [b]	7.2±0.20 [a]	6.9±0.27 [b]	7.2±0.20 [b]	7.1±0.20 [b]
	15	6.2±0.32 [b]	6.0±0.25 [c]	6.3±0.21 [b]	6.0±0.29 [c]	6.4±0.22 [c]	6.2±0.21 [c]
BLP	5	6.9±0.17 [b]	6.9±0.17 [b]	7.3±0.21 [a]	6.8±0.2 [b]	6.9±0.17 [b]	7.0±0.14 [b]
	10	6.0±0.25 [c]	6.0±0.36 [b]	6.8±0.32 [ab]	6.0±0.33 [b]	6.0±0.21 [c]	6.1±0.17 [c]
	15	4.8±0.20 [d]	5.0±0.28 [c]	5.7±0.47 [d]	5.0±0.28 [c]	4.9±0.22 [d]	5.1±0.20 [d]

Table 5: Organoleptic evaluation of *Barley snack*

Incorporation level (%)		Mean sensory score					
		Colour	Flavour	Texture	Taste	Appearance	Overall acceptability
	Barley snacks						
BLP	Control	8.4±0.18 [a]	8.3±0.70 [a]	8.4±0.18 [a]	8.3±0.22 [a]	8.5±0.16 [a]	8.3±0.16 [a]
	5	7.3±0.20 [b]	7.2±0.20 [b]	7.2±0.17 [b]	7.0±0.17 [c]	7.2±0.25 [c]	7.1±0.14 [c]
	10	6.4±0.21 [c]	6.5±0.31 [b]	6.3±0.23 [c]	6.4±0.21 [c]	6.5±0.21 [c]	6.4±0.16 [bc]
	15	5.8±0.21 [c]	6.1±0.29 [b]	6.0±0.25 [c]	6.3±0.20 [c]	6.2±0.20 [c]	6.0±0.20 [bc]
BFP	5	7.2±0.20 [b]	7.0±0.20 [b]	7.1±0.17 [b]	6.9±0.17 [c]	7.0±0.25 [c]	7.0±0.14 [c]
	10	6.3±0.21 [c]	6.1±0.31 [b]	6.1±0.23 [c]	6.3±0.21 [c]	6.3±0.21 [c]	6.2±0.16 [bc]
	15	5.7±0.21 [c]	6.0±0.29 [b]	6.0±0.25 [c]	6.2±0.20 [c]	6.2±0.20 [c]	6.0±0.20 [bc]

scores for overall acceptability awarded by the panel of judges was 7.0 ±0.14 (Table 5). Organoleptic differences were found in scores of all the characteristics of barley snacks, but statistically they were found non - significantly different in taste and appearance at 5,10 and 15 per cent (Fig. 5).

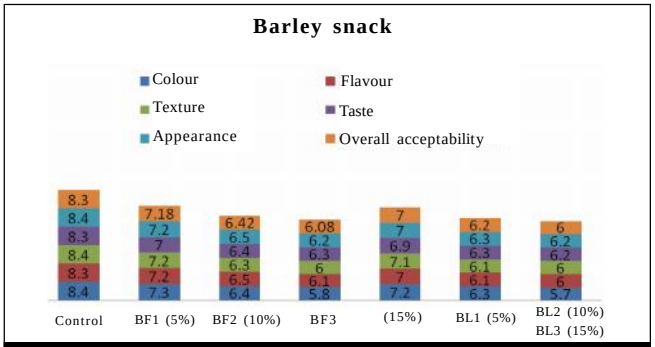

Fig. 5: Organoleptic evaluation of barley snack

Nutritive contents of products:

Nutrient content of most acceptable level of broccoli enriched products anaylsed in which BLP/BFP incorporated products increased in all proximate contents as shown in Table 6. Protein and energy content in *Missi roti* with BFP was highest in protein as compared to control as 17.3±0.27 and

Table 6 :Composition of developed product

Ingredients	Quantity (g)	Ingredients	Quantity (g)	Ingredients	Quantity (g)
Missi roti :125		**Dhokla : 100**		**Channa dal : 200**	
Wheat flour	100	Bengal gram flour	25	Bengal gram Dal	100
Bengal gram flour	25	BLP/BFP	5/10/15	BLP/BFP	5/10/15
BLP/BFP	5/10/15	Semolina	25	Cumin seeds	2
Salt	5	Dahi	50	Onion	20
Fat	5	Ginger and green chillies	5	Tomatoes	20
Water	30	Salt	2	Green chillies	5
Dalia : 125		Eno	1 sachet	Oil	5
Wheat dalia	100	**Barley snacks :125**		Salt	5
BLP/BFP	5/10/15	Soaked barley	90	Water	500
Tomatoes	15	Boiled Bengal gram whole	25		
Green peas	15	Green chillies	5		
Salt	5	Oil	5		
Oil	5	Salt	5		
Green chillies	5	Water	100		

Table 7: Proximate composition of broccoli enriched products

Ingredients	Moisture	Crude fat	Crude protein	Crude fibre	Ash	Carbohydrate	Energy
Missi roti							
Control	2.5 ± 0.20	7.76±0.17	15.31±0.27	0.23±0.02	2.54±0.24	71.36	416.52
BFP 15%	2.75±0.15	8.37±0.16	17.3±0.27	0.39±0.03	3.9±0.05	67.29	414.89
BLP 10%	2.60±0.20	8.22±0.19	15.49±0.03	0.27±0.02	4.9±0.30	68.52	410.02
Wheat dalia							
Control	3.55±0.11	6.5±0.29	11.9±0.18	1.70±0.12	8.0±0.20	68.35	379.5
BFP 10%	3.95±0.14	6.93±0.35	13.16±0.04	2.77±0.08	8.33±0.06	64.86	374.45
BLP 5%	3.75±0.14	6.76±0.31	11.95±0.04	2.67±0.13	5.30±0.88	69.57	386.92
Dhokla							
Control	3.80±0.14	2.44±0.05	8.83±0.14	0.5±0.06	4.5±0.12	79.93	377
BFP 10%	3.9±0.15	2.93±0.03	10.19±0.16	1.33±0.08	5.6±0.29	76.05	368.4
BLP 5%	3.7±0.14	2.71±0.05	9.02±0.6	1.76±0.09	6.5±0.11	76.31	365.71
Chana dal							
Control	2.42±0.01	9.26±0.12	16.47±0.20	0.76±0.06	5.1±0.11	65.99	413.18
BFP 5%	2.65±0.02	9.33±0.13	16.67±0.10	0.87±0.06	5.84±0.01	64.64	409.21
BLP 5%	2.55±0.1	9.35±0.13	16.10±0.20	0.97±0.01	5.92±0.01	65.11	408.99
Barley snack							
Control	1.32±0.03	7.62±0.14	15.76±0.21	2.33±0.06	4.76±0.17	68.21	404.46
BFP 5%	1.35±0.11	7.84±0.11	16.4±0.25	3.29±0.10	4.81±0.08	66.31	401.4
BLP 5%	1.38±0.14	7.84±0.12	15.83±0.11	3.80±0.12	5.03±0.02	66.12	398.36

414.89, respectively. However, in *Dalia* also protein and fibre contents increased in BFP incorporated products as 13.16±0.04 and 2.77±0.08 from control and BLP was at par with control. *Dhokla* with BFP and BLP for protein was 10.19±0.16 and 9.02±0.6 which was higher than control. As well as fibre icresed 1.33 and 1.76, respectively. Energy value for *Chana dal* with BFP and BLP were 409.21 and 408.99, respectively which was almost equal to control *i.e.*, 413.18 (Table 6).

Barley snacks is newly developed products which is rich in protein and carbohydrates as well as in energy. With this new concept, this snack was incorporated with BFP/BLP which was found increased in proximate composition specially in fibre *i.e.*, 3.29±0.10 and 3.80 ± 0.02 (Table 7).

Conclusion:

Incorporation of broccoli floret and leaves powder in products was good concept it is highly acceptable in all products on different levels. *Missi roti* was acceptable at 15 per cent and 10 per cent and in *Dalia* was acceptable at 10 per cent and 5 per cent and in *Dhokla* was acceptable at 10 per cent and 5 per cent and in *Chana dal* was acceptable at 5 per cent and 5 per cent and in barley snacks was acceptable at 5 per cent and 5 per cent, respectively. Mean scores of *Missi roti, Dalia, Dhokla, Chana dal* and Barley snack were significantly different ($P \leq 0.05$) at different levels *i.e.*, 5 per cent, 10 per cent and 15 per cent in all attributes. So, broccoli floret and leaves powder can be safely incorporated in daily diet of diabetics. It has reported recently that broccoli may help diabetics with a number of complications, including vascular and coronary disease and cancer.

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■ REFERENCES

Amerine, M.A., Pangborn, R.M. and Roessler, E.B. (1965). *Principles of Sensory Evaluation of Food*. Academic Press, NEW YORK, U.S.A.

Brandi, G., Schiavano, G,F., Zaffaroni, N., Marco, C.D., Paiardini, M., Cervasi, B. and Magnani, M. (2005). Mechanisms of action and antiproliferative properties of *Brassica oleracea* juice in human breast cancer cell lines. *J. Nutr*., **135** (6) : 1503-1509.

Comblatt, B.S., Ye, L., Dinkova-Kostova, A.T., Erb, M.J., Fahey, W., Singh, N.K., Chen, M.S.A., Stierer, T., Garrett-Mayer, B., Argani, P., Davidson, N.E., Talalay, P., Kensler, T.W. and Visvanathan, K. (2007). Preclinical and clinical evaluation of sulforaphane for chemoprevention in the breast. *Carcinogenesis*, **28** (7) : 1485- 1490.

Gale, Jason (2010). India's diabetes epidemic cuts down millions who escape poverty. *Bloomberg*. Retrieved 8 June 2012.

Gill, C.I.R., Haldar, S., Porter, S., Matthews, S., Sullivan, S., Coulter, J., McGlynn, H. and Rowland, I. (2004). The effect of cruciferous and leguminous sprouts on genotoxicity *in vitro* and *in vivo*. *Cancer Epidemiol. Biomarkers Prev*., **13** (7) : 1199-1205.

Goel, S., Kochhar, G.K. and Kaur, T. (2011). Development and organoleptic evaluation of food preparations incorporated with selected antidiabetic medicinal plants. *Ethno. Med.*, **5**(2): 101-106.

Gopalan, C., Ramasastri, B.V., Balasubramanian, S.C., Narasinga Rao, B.S., Deosthale, Y.G. and Pant, K.C. (2004). *Nutritive value of Indian foods*. National Institute of Nutrition (ICMR), Hyderabad (A.P.) INDIA.

Jackson, S. J. and Singletary. K.W. (2004). Sulforaphane inhibits human MCF-7 mammary cancer cell mitotic progression and tubulin polymerization. *J. Nutr.*, **134** (9) : 2229-2236.

Michaud, D.S., Spiegelman, D., Clinton, S.K., Rimm, E.B., Willett, W.C. and Giovannucci, E.L. (1999). Fruits and vegetable intake and incidence of bladder cancer in a male prospective cohort. *J. Natl. Cancer Inst*., **91** (7) : 605-613.

Parnaud, G., Li, P., Cassar, G., Rouimi, P., Tulliez, J., Combaret, L. and Gamet-Payrastre, L. (2004). Mechanism of sulforaphane-induced cell cycle arrest and apoptosis in human colon cancer cells. *Nutr. Cancer*, **48** (2) : 198-206.

Vasanthi, H.R., Mukherjee, S. and Das, D.K. (2009). Potential health Benefits of Broccoli- A Chemico-Biological Overview. *Mini-Rev. Med. Chem.*, **9** (6) :749-759.

Whiting, D.R., Guariguata, L., Clara Weil, C. and Shaw, J. (2011). IDF diabetes atlas: Global estimates of the prevalence of diabetes for 2011 and 2030. *Diabetes Res. & Clinical Practice*, **94** (3) : 311–321.