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Original Research Article

Influence of Corn Silk Powder Supplementation on Sensory and Chemical Characteristics of Developed Food

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A B S T R A C T

Corn silk a dried stigmata of maize (*Zea mays*) female flowers is distributed widely throughout the world. Corn silk is a well-known traditional herb that has been used for treatment of varied diseases. In spite of various pharmacological activities, corn silk is still considered as a waste during corn processing. So, the present study is designed to develop value added food products using different level of corn silk powder up to 10% to assess its organoleptic quality as well as nutritional composition of prepared product. Fresh Corn silk variety of CMVL Sweet corn-1were harvested from NEBCRC, G.B.P.U.A.T. Pantnagar, Uttarakhand, India. Fresh corn silks were chopped and dried in tray dryer for 6 hours at 40°C temperature. Dried corn silks were crushed manually and grind it in an electric grinder then sieving through 60 mesh size used for preparation of value-added food products. Other ingredients required for the development of value-added products were procured from local market. Organoleptic analysis was done to assess the sensory attributes by using nine-point hedonic scales. The prepared product was analyzed for its nutritional composition by using the standard procedure Mean scores of organoleptic parameters indicated that all levels were acceptable in terms of their colour, appearance, aroma, texture and taste. So, the sensory evaluation of products showed that amaranth could be incorporated up to, 10% in development of food products. Considering the findings of study on nutritional composition of products showed that after incorporation of different levels of corn silk, the content of dietary fiber, protein and ash increased significantly ($P \leq 0.05$). Hence, it was concluded that the different amount of corn silk plays an important role in product development by enhancing nutritional parameters and overall product quality.

Keywords

Nutritional, Cornsilk, Value added, Sensory evaluation

Introduction

One of the agricultural by-products of corn is corn hair or commonly known as corn silk. Corn silk (a thread which is soft, fine, yellowish color with mild sweetish taste) is a collection of the stigmas from the female flowers of maize plant. Corn silk (also known as *Maydis stigma*) after dried is rich in a variety of chemical composition such as protein (±13.0%), ash (±5.3%), fat (±1.3%) and particularly TDF (±38.4%) (Rosli *et al.*, 2011). Besides that, elemental study performed by Energy Dispersive X-Ray (EDX) showed that oven-dried corn silk contains potassium, calcium magnesium, iron, aluminium and other minerals (Rosli *et al.*, 2007). Corn silk is a well-known traditional herb that has been used for

treatment of varied diseases such as treating obesity, weight loss (Du *et al.*, 2007), immune enhancement, anti-diabetic activity, regulation of blood sugar (Zhao *et. al.*, 2012), anti-proliferative effects on human cancer cell lines, improvement of gastrointestinal movement and antioxidant activity.

In spite of various pharmacological activities, corn silk is still considered as a waste during corn processing. Being healthy and nutrient dense waste, corn silk can be used for formulation of nutritious health food product, which will on one hand improve the nutrient quotient of individuals and add on to the livelihood security of the farmers on the other hand. So, use of corn silk may provide additional income to farmers and corn silk may provide additional health benefits to population as well as increase diet diversity of population. The wastage of the corn silk in food service industry can cause negative impact to the environment. Apart from benefits of its flesh, corn silk also contains nutrients. Thus, the study been conducted to overcome the problem of wastage corn silk, we suggest to make value added food products by incorporating corn silk powder. Hence there is a need to increase the nutrients consumption to deal with many health risks and also there is great opportunity to enhance the market with the different choices of food products with good nutritional content.

Materials and Methods

Locale of the study and harvesting of Corn silk

Maize variety of CMVL Sweet corn-1 were cultivated at NEB CRC field G.B. Pant University of Agriculture & Technology, Pantnagar, Uttarakhand. Corn silk (female inflorescences) harvested from corn variety CMVL Sweet corn-1, which was conducted during March, 2019 and September, 2019 just before pollination from NEB CRC, G.B.P.U.A.T. Pantnagar, Uttarakhand, India. Picking of corn silk was did manually, firstly slitting by knife on the cob for removal of cover then separation of corn silk and corn cob individually. Corn silk was used in our study and cob used by another industry for different purpose as well as animal feed. For the preparation of value-added food products required ingredients were purchased in a single lot from local market of Pantnagar. The processing of corn silk, nutritional analysis and development of value-added products were conducted in the Department of Foods and Nutrition, College of Community Science, G.B. Pant University of Agriculture and Technology, Pantnagar, Uttarakhand, India.

Processing of corn silk to obtain powder

Step 1. Pre- treatment of corn silk

The corn silk harvested according to said above was stored in cleaned butter paper bag and bring it land to lab for further treatment. In laboratory, corn silk was washed in 0.1% concentration of salt solution to remove foreign matter and salt added water eliminates the fishy flavor of corn itself. The washed corn silk sprayed on a clean surface then after 10-minute cut into a proper size.

Step 2. Drying of corn silk

At same day or second day washed corn silk was dried in tray drier for 6 hours at 40°C resulting final moisture content of 7-10%.

Step 3. Preparation of corn silk powder

Dried corn silks was crushed manually and grind it in an electric grinder then sieving through 60 mesh size used for preparation of value-added food products.

Development of value products by incorporating corn silk

Six types of value-added products, *viz. Stuffed Paratha, Chapatti*, Corn Silk *Raita and dal* were prepared by incorporating dried corn silk powder at 5 per cent (Type-I) and 10 per cent (Type-II). Processed corn silk was incorporated at 5 per cent and 10 per cent level along with control with 0 per cent incorporation in the basic recipe.

Corn silk stuffed *Parantha*

Blends of wheat flour and corn silk powder were prepared by replacing wheat flour with corn silk at 0, 5 and 10% showed in table no.1.

Method for preparation of *stuffed Parantha*

Prepared soft dough of wheat flour with addition of corn silk powder, Ajwain, salt and water. Then divided dough into equal portion made into small balls and rolled out with the help of rolling pin and applied ghee on both sides and cooked *Parantha* on hot griddle from both the sides until brown.

Chapatti

Two types of *chapattis* were prepared by incorporating corn silk powder, *i.e*., Type-I *chapatti* prepared by using 5% corn silk and 95% wheat flour and Type-II by 10% corn silk and 90% wheat flour. Wheat flour *chapatti* served as control. The proportion of ingredients used for preparation of value-added *Chapatti* is presented in Table 2.

Method for preparation of *Chapatti*

Prepared soft dough of wheat flour with addition of dried corn silk powder, salt and water. Divided dough into equal portions, made into small balls and rolled out with the help of rolling pin. Cooked *Chapati* on a hot griddle from both the sides until brown.

Corn silk *Raita*

Blends of curd and corn silk powder were at 0, 5 and 10% showed in table no.3.

Method for preparation of Corn silk *Raita*

Mix the spices, salt and sugar in the curd and whisk till it is smooth. Add two tablespoons of this water and strain into curd and corn silk powder and mix well, then garnish with the coriander leaves and serve cool.

Dal

Table 4 reveals the ingredients for the dal preparation by using corn silk powder at 0, 5 and 10% level.

Method for preparation of *Dal*

Wash and soak the red gram *Dal* in water for 1/2 hour. Soaking dal into water reduces the cooking time. Drain out the water and put dal with water, salt and turmeric in a pressure cooker. Close the lid and cook dal. After first whistle turn the heat down and cook on medium flame for 3-4 minutes than turn off the flame. Once pressure ends open the lid and check either dal is cooked or not and if it requires some more water. If the *Dal* is thick in consistency then add some water for the desired flow and now move the dal to a serving bowl. Before serving garnish it with the coriander leaves and add lemon juice to it, stir it properly.

Organoleptic evaluation of value-added products

A panel of 15 members of Foods and Nutrition Department was selected. They

were staff members and Ph.D. scholars of the department. A 9-point Hedonic scale and score card was used for sensory evaluation of the all developed products with different parameters, *viz*. colour, texture, flavour, taste and overall acceptability (Amerine *et al.,* 1965). Between tasting different samples, participants rinsed their mouth with warm water.

Nutritional evaluation of value-added products

Developed value added products were evaluated for their nutritional analysis by calculation method using Nutritive value of Indian Food (Gopalan *et al.,* 2017).

Statistical analysis

The data were statistically analyzed in complete randomized design for analysis of variance, mean, standards deviation and critical difference according to the standard method (Sheoran and Pannu, 1999).

Results and Discussion

Sensory evaluation of the products

Sensory evaluation of developed *stuffed paratha*

The mean sensory scores of *Paratha* for all the parameters, *i.e*., colour, appearance, flavour, taste, texture and overall acceptability is presented in Table 5.

Among higher levels of corn silk powder incorporation, significant difference was seen in all the parameters between all levels. Corn silk incorporated up to 10% *Paratha*, which was found to be organoleptically acceptable. The mean scores of organoleptic acceptability of Type-I *Paratha* (5% corn silk incorporated) were in the range of 'liked very much'. However, the mean score for all sensory parameters of Type II *Paratha (*10% corn silk incorporation) was in the category of 'liked moderately'. The average scores of all sensory parameters were in the range of 7-8, which falls among good and very good suggesting their overall acceptability till 10 per cent. As per the findings of Rosli *et al.* (2011) the scores of all attributes were decreased with the level of cornsilk powder in patties increases up to 6 per cent. Kulapichitr *et al.,* (2015) also studied about the effect of the incorporation of corn silk powder (3 per cent) in deep-fried battered chicken showed that only the color and general appearance scores were poor and other sensory characteristics were accepted.

Sensory evaluation of developed *Chapatti*

The data on organoleptic acceptability of *Chapatti* are exhibited in Tables 4.6.

A significant difference was observed in flavoure, taste, texture and overall acceptability parameters. However, chapatti with 5 per cent level of corn silk incorporation scored highest among all the parameters, whereas, when the scores of different parameters of chapatti with 10 per cent level of corn silk incorporation were fell in the category of 'liked moderately'. The differences in the scores of colour and appearance were found to be non-significant in reference to all sensory parameters.

Sensory evaluation of developed corn silk *Raita*

The mean sensory scores of *Raita* for all the parameters, *i.e*., colour, appearance, flavour, taste, texture and overall acceptability are presented in figure 1.

On the basis of sensory score, it can be said that there was no significant difference in

various parameters, *viz.* colour, appearance, aroma, taste and overall acceptability among the control and supplemented raita with corn silk 5 and 10 per cent. In case of texture, raita with 10 per cent level of corn silk incorporation scored significantly different. It was observed that among all types of blends of *raita* were acceptable and 5 per cent level of corn silk incorporated raita scored highest scores in compare with control and 10 % level of corn silk incorporation.

Sensory evaluation of developed *dal*

The mean sensory scores of *dal* for all the parameters, *i.e*., colour, appearance, aroma, taste, texture and overall acceptability is presented in figure 2.

A non-significant difference in all the sensory parameters except overall acceptability was observed in control as well as dal prepared by substituting corn silk powder at 5 and 10 per cent levels. Dal with 5 per cent corn silk had significantly ($P<0.05$) different with control and scored higher sensory score in comparison with 10 per cent level of corn silk.

The mean scores for control and Type-I dal (5 per cent corn silk incorporated) were ranged between 7-8, which were 'liked very much' by the judges and scores of Type-II dal (10 per cent corn silk) fell in the category of 'liked moderately' except aroma, which responded by panelist in the category of 'liked slightly'.

Kulapichitr *et al.,* (2015) also found that the sensory quality of corn silk added (15 per cent) cakes were significantly inferior ($p\leq0.05$) to the control formula in all characteristics but still acceptable. Color changes could also happen by the alteration of pH from the ability of dietary fiber to act as a buffer and a change in water availability.

Nutritive value of developed food products

The observations made on the nutritional composition of developed food products obtained by calculation method. Nutritive value was calculated as per 100 g presented in table 7.

From the results presented in Table no.7 it can revealed that among all formulated products paratha, chapatti and dal showed decrease in its energy content with the increase in level of incorporation of corn silk from 0 to 10 per cent, whereas, *Raita* showed an increase in its energy value as level of incorporation of corn silk increased. The present study reveals that the protein content of formulated products increased with the increase in level of corn silk incorporation from 0 to 10 per cent (Table 7). The high protein content in the products was probably due to high protein content found in corn silk incorporated in the products. Among all the ready to eat incorporated products, addition with 10 per cent corn silk had the highest value, whereas, control had lowest value for protein content.

Data given in Table no.7 depicted that apparently, though the values of supplemented products like *Paratha*, *Chapatti*, and *Dal* showed decrease in level of fat content, whereas, Raita for fat content were increased after incorporation up to 10 per cent as compared to the values of control. It is evident from result corn silk incorporated products, *viz. Paratha*, *Dal* and *Raita* showed an increase in ash content as the level of incorporation of corn silk increased from 0 to 10 per cent, but there was slight decrease in ash content of chapati with after supplementation with 5 and 10 per cent corn silk as compare to control (wheat flour chapati). Formulated products showed an increase in carbohydrate content as the level of corn silk incorporation increased from 0 to

10 per cent. On dry weight basis, value added products supplemented with 10 per cent had the highest dietary fiber followed by 5 per cent supplemented products and without supplementation (control products). From the above finding of nutritional analysis of developed products by using dried corn silk powder up to 10 per cent, it can show that maximum products had got increasing trend in their nutritional value mainly protein, ash and fiber. Similar results were found in study of Aukkanit *et al*. (2015), who observed that the substitution of corn silk powder up to 4 per cent in meatballs increases the amount of ash and crude fiber content. In another study on effect of utilizing corn silks dietary fibre in processed food products by Rosli *et al.* (2011). They noticed that the Cooked chicken patties incorporated with 6 per cent corn silk had highest protein and the lowest fat concentration. According to Priyadharshini and Parameshwari (2020) the addition of corn silk powder to cracker formulation increased the nutritional contents generally protein, carbohydrates, fat, fiber and minerals (Ca, Mg) content. According to the research by Schafter and Zabik (1978) dietary fiber extracted from corn bran was used to increase the fiber content of widely consumed foods like bread.

Table.1 The proportion of ingredients used for preparation of *stuffed Parantha*

S. No.	Ingredients	Control	5%	10%
1.	Wheat flour (g)	25	50	75
2.	Corn silk powder (g)	75	50	25
3.	Ajwain (g)	5	5	5
4.	Salt	½ tsp	½ tsp	½ tsp
5.	Water (ml)	80	80	80
6.	Ghee (g)	For shallow frying		

Table.2 The proportion of ingredients used for preparation of *Chapatti*

S. No.	Ingredients	Control	5%	10%
1.	Wheat flour (g)	100	95	90
2.	Corn silk powder (g)	0	5	10
5.	Water (ml)	80	80	80
6.	Salt (g)	½ tsp		

Table.3 The proportion of ingredients used for preparation of Corn silk *Raita*

S. No.	Ingredients	Control	5%	10%
1.	Curd (ml)	100	100	100
2.	Corn silk powder (g)	0	5	10
3.	Raita spice (g)	½ tsp	½ tsp	½ tsp
4.	Salt	½ tsp	½ tsp	½ tsp
5.	Water (ml)	80	80	80
6.	Coriander leaves (g)	For garnishing		

Table.4 The proportion of ingredients used for preparation of dal

S. No.	Ingredients	Control	5%	10%
1.	Red gram dal (g)	100	100	100
2.	Corn silk powder (g)	0	5	10
3.	Turmeric powder (g)	1/4 tsp	1/4 tsp	1/4 tsp
4.	Salt	½ tsp	½ tsp	½ tsp
5.	Water (ml)	500	500	500
6.	coriander leaves (finely chopped	For garnishing		

Table.5 Mean scores for organoleptic acceptability of of *parantha* (n=15)

Corn silk powder Incorporated	Colour	Appearance	Flavour	Taste	Texture	Overall acceptability
Control (0 per cent)	8.60±022	8.26±0.42	7.76±0.12	7.83±0.20	7.96±0.33	8.10±0.10
5 per cent	7.83±0.11	7.76±0.36	7.73±0.16	7.86±0.18	7.83±0.36	7.86±0.11
10 per cent	7.66±0.08	7.63±0.30	7.70±0.22	7.66±0.28	7.43±0.30	7.76±0.15
sem	0.180	0.171	0.161	0.197	0.165	0.180
CD(P<0.05)	0.507*	0.483*	0.455*	0.555*	0.465*	0.506*

Values are mean ± SE of fifteen observations
(*): Significant

Table.6 Mean scores for organoleptic acceptability of *Chapatti* (n=15)

Corn silk powder Incorporated	Colour	Appearance	Flavour	Taste	Texture	Overall acceptability
Control (0 per cent)	8.26±0.32	8.33±0.13	8.23±0.08	8.23±0.22	8.16±0.20	8.23±0.14
5 per cent	7.96±0.28	7.76±0.18	7.86±0.14	8.00±0.18	8.03±0.18	8.13±0.10
10 per cent	7.50±0.22	7.13±0.20	7.56±0.10	7.70±0.24	7.30±0.24	7.63±0.15
sem	0.25	0.27	0.23	0.28	0.30	0.26
CD(P<0.05)	0.73	0.76	0.66*	0.78*	0.79*	0.74*

Values are mean ± SE of fifteen observations
(*): Significant

Table.7 Nutritive value of developed food products per 100 g

Developed Food Products	Formulations	Energy (kcal)	Protein(g)	Fat(g)	Ash (g)	Carbohydrate(g)	Fiber(g)		
							IDF	SDF	TDF
Paratha	A	1419.75	11.36	2.58	1.69	65.39	10.59	1.78	12.37
	B	1367.73	11.64	2.56	191	64.98	12.69	1.90	14.59
	C	1315.91	11.92	2.55	2.05	64.35	14.78	2.00	16.78
Chapati	A	1340	10.57	1.53	1.28	64.17	9.73	1.61	11.34
	B	1287.95	10.85	1.51	1.47	63.75	11.83	1.54	13.37
	C	1235.90	11.13	1.50	1.20	63.33	13.93	1.49	15.42
Dal	A	1400.67	21.8	2.00	4.13	55.92	6.93	2.42	9.35
	B	1346.42	21.52	1.61	5.21	55.94	9.18	2.50	11.67
	C	1292.17	21.25	1.59	5.33	55.97	11.43	2.58	14.01
Raita	A	61	3.3	3.3	0	61	0	0	0
	B	75.95	4.31	3.36	0.25	75.95	0	0	0
	C	90.9	5.12	3.42	0.5	90.9	0	0	0

A= Control B=5 per cent C=10 per cent

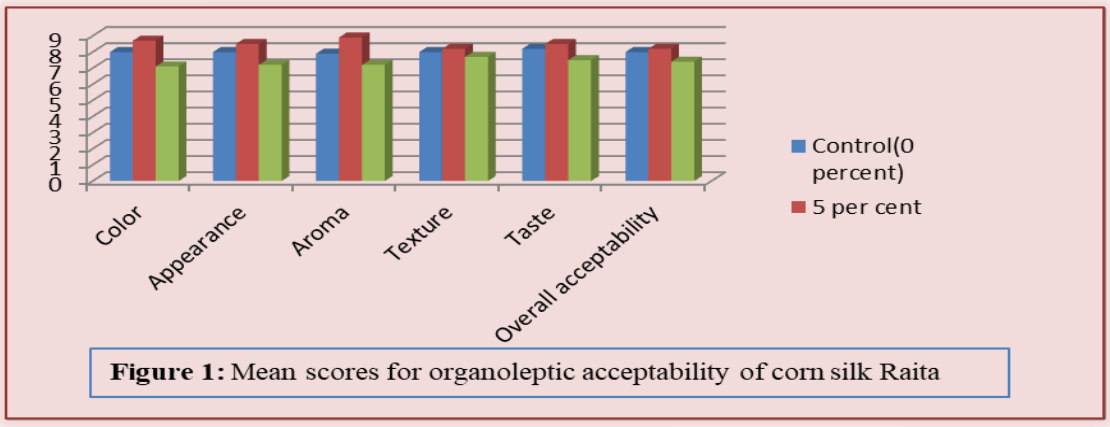

Figure 1: Mean scores for organoleptic acceptability of corn silk Raita

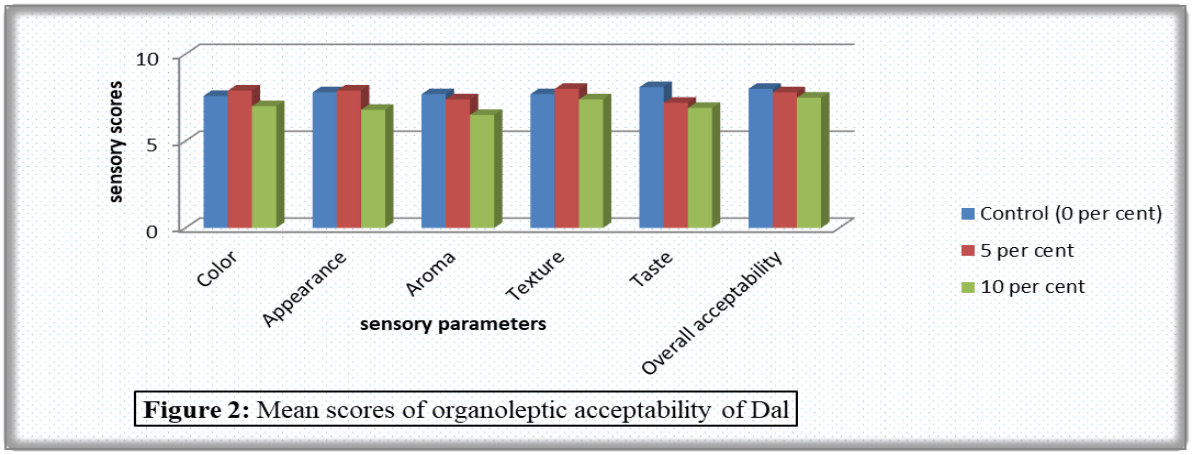

Figure 2: Mean scores of organoleptic acceptability of Dal

From present investigation it can be concluded that the corn silk powder can be very well utilized for preparation of palatable, nutritional food products. Thus, it may be suggested that among three varieties of corn silk powder from the CMVL Sweet corn-1 could be developed as a source of nutrients to convert corn silk from waste into value-added corn products. Overall, it is inferred that corn silk powder can be utilized in preparation of various traditional and snack products to enhance their nutritive value. The study demonstrated that corn silk has potential to contribute to the alleviation of dietary nutritional deficiencies. The development and utilization of corn silk on one hand will promote value addition of the products and on the other hand will provide low cost nutritious alternatives specially in poor developing countries for combating malnutrition among children and vulnerable sections of the society.

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