jpht

Research Article

Journal of Postharvest Technology
02 (02): 146-151, April' 2014
www.jpht.info

Nutritional Quality Evaluation of Cowpea Supplemented Food Products

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Received : 22 Feb 2014
Revised : 24 Mar 2014
Accepted : 27 Mar 2014

Keywords

Cowpea
Supplementary foods
Nutrient composition
Sensory evaluation

Abstract

An experiment was conducted to develop and evaluate nutritional and sensory characteristics of food products supplemented with cowpea flour. Cowpea flour was incorporated at the levels of 20%, 40%, 60% and 80% to products made from whole wheat flour in *khajure*, semolina in *halwa* and refined wheat flour in *mathri*. Products prepared without cowpea flour served as control. Cowpea flour incorporation levels of 20%, 40% and 20% for *khajure*, *mathri* and *halwa*, respectively, was found to be significantly acceptable. Nutrient composition of acceptable cowpea supplemented food products show an increase in protein, fibre, calcium, iron , magnesium and zinc content ranging from 5.3-13.0%, 0.4 -1.5 %, 16.1-89.2%, 1.3-5.5%, 31.8-98.4% and 0.7-1.8%, respectively as compared to their control counterparts. Present study indicates that cowpea supplemented food products could be considered the best from both nutritional and sensory points of view, especially for young children.

INTRODUCTION

Nutrition is a basic human need and a prerequisite to a healthy life. Inadequate nutrition may lead to malnutrition, growth retardation, reduced work capacity and poor mental and social development (Manna et al., 2011). Children constitute one of the important segments accounting for 39% of total population of our country, out of which, about 33.6% fall in the preschool age i.e. 0-6 years (Census, 2011). Nutritional status of preschool children is a sensitive indicator of community health and nutrition. Almost half of children under age five years (48 percent) are chronically malnourished i.e. stunted (NIN, 2010). National Nutrition Monitoring bureau (NNMB, 2006) has indicated preschool children consume nearly 60% and 84% of recommended energy and protein, respectively. Dietary inadequacies are reported to be a major determinant of malnutrition. Energy consumption less than 80% of the requirement is reported to be a risk factor for malnutrition of preschool children (Khandait et al., 1998). High malnutrition is associated with consumption of foods of low energy density. It is well known that cereal based foods are low in energy and nutrient density. Pulses will continue to be the major source of dietary protein for vegetarian population. Food products based on cereals lack of an essential amino acid lysine and this can be achieved through legume supplementation.

Cowpeas (*Vigna unguiculata*) are an important grain legume in developing countries like India. High protein (18 to 35%) and carbohydrate (50 to 65%)

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ISSN 2348-4330

contents, together with an amino acid pattern complementary to that of cereal grains, make cowpeas potentially important to nutritional supplement to cereals in the human diet from a nutritional standpoint. A cowpea/cereal blend would provide a nutritionally balanced food for both children and adults because of the expected improved protein quality as well as abundant energy content. Research has emphasized expanding the utilization of cowpeas in the form of meal and flour (McWatters, 1990) for use as functional ingredients in food products. Dietary improvement through better choice of foods, improved quality and greater variety is a well documented appropriate and sustainable approach to correct nutritional deficiencies. To compensate the nutritional deficits in children, supplementary foods need to be developed at low cost using locally available foods such as cereals and pulses. Therefore, an attempt was made to develop nutritious supplementary foods i.e. *khajure*, *halwa*, and *mathri* by replacing cereal flours with whole cowpea flour.

MATERIALS AND METHODS

Raw Materials

Grain samples of cowpea and other ingredients for formulation of different food products were procured from the local market.

Preparation of cowpea flour

Whole cowpea seeds were cleaned free of dirt and other impurities and then dried in oven at 60°C for one hour before milling. The cowpea grains were ground to flour up to 36 mesh sieve particle size in an electric grinder. Cowpea flour was packed in airtight containers and stored.

Preparation of cowpea supplemented food products

Whole wheat flour, semolina and refined wheat flour were used to prepare control *khajure*, *halwa* and *mathri*, respectively. Cowpea flour was batched into four composites for preparing *khajure*, *halwa* and *mathri* separately. Proportions of cowpea flour/ whole wheat flour used in preparation of experimental *khajure* were 20:80; 40:60; 60:40 and 80:20. For experimental *halwa*, ratios of cowpea flour/semolina were 20:80; 40:60; 60:40 and 80:20. Experimental *mathri* were prepared using 20:80; 40:60; 60:40 and 80:20 proportions of cowpea flour/ refined wheat flour. Each blend was mixed homogeneously by sieving 2-3 times through a sieve. The ingredients and methods used for preparation of food products are given in Table 1.

Sensory evaluation of food products

Evaluation of food products for sensory quality was done by score card method given by Amerine et al. (1965). A panel of 10 semi-trained members evaluated food products for colour, texture, flavor, aftertaste and overall acceptability on a score scale of 1 to 5 where 1= very poor, 2= poor, 3= fair, 4= good and 5= very good.

Nutritional quality of food products

Nutrient composition of acceptable food products was computed on the basis of analysed values (Gopalan et al., 1989).

Statistical analysis

ANOVA technique was used for detection of significant differences between sensory characteristics of food products (Snedecor and Cochran, 1967).

RESULTS AND DISCUSSION

Sensory Evaluation

The results of sensory evaluation of cowpea supplemented food products are shown in Table 2. For *khajure*, mean score for colour (4.1), taste (4.2), texture (4.1) and after taste

(3.8) were not significantly affected by the 20% cowpea flour replacements for whole wheat flour as compared to the control sample of 100% whole wheat flour (mean scores 4.3, 4.4, 4.3 and 4.1, respectively). Supplementation of *khajure* with cowpea flour beyond 20% significantly affected all the sensory attributes. This might be due to beany flavour of cowpea (Glover-Amengor et al., 2013). In summary, *khajure* supplemented with 20% cowpea flour scored highest value for overall acceptability.

Results revealed that colour, taste, texture, after-taste and overall acceptability of *halwa* scored significantly lower than the control samples at 40% incorporation levels of cowpea flour and above. For halwa, data confirm that cowpea flour can be incorporated successfully till 20% level to provide better sensorial characteristics.

The colour, taste, texture, after-taste and overall acceptability of *mathri* were not significantly affected upto 40% incorporation of whole cowpea flour as compared to control sample. All the sensory attributes were significantly affected ($p<0.05$) by substitution of cowpea flours beyond 40% level. Therefore, the results confirm that cowpea flour can be incorporated till 40% level without affecting its sensory characteristics.

In all the food products, scores for all sensory attributes i.e. colour, taste, texture, after-taste and overall acceptability, decreased with the increase in amount of cowpea flour. Siddiqui et al. (2003) have reported similar findings.

Nutrient composition of cowpea supplemented food products

The nutrient composition of most acceptable cowpea supplemented food products is given in Table 3. *Khajure* prepared from whole wheat flour/ cowpea flour (80:20) showed an increase in protein 19.3%, fibre 15.4%, calcium 4.8%, iron 10%, magnesium 11.8%, zinc 20% and minor decrease in carbohydrate, fat and energy content as compared to control (without cowpea). Similarly, *halwa* prepared from semolina and cowpea flour (80:20) depicted an increase in protein 26.2%, fibre three times, calcium 43.7%, iron 85.7%, magnesium 69.1%, zinc 75% and minute decrease carbohydrate, fat and energy content as compared to control (without cowpea). *Mathri* made from 40% cowpea and 60% refined wheat flour showed an increase in protein 47.7%, fibre seven times, calcium 94%, iron 81.8%, magnesium double, zinc three times and negligible decrease in carbohydrate and energy content in comparison to control (without cowpea).

Results show that supplementing cereals with legume flour has enhanced protein and mineral content of these foods, indicating nutritional benefits of cowpea incorporation in food products. Results of present study are in accordance with study by Alozie et al. (2009) wherein cakes were supplemented with African yam bean flour.

Contribution (%) of nutrients per serving of cowpea supplemented food products towards 1-3 years age group children

Nutrient contribution of cowpea supplemented food products per serving towards 1-3 years age group children is shown in Table 4. Keeping in view the RDAs of various nutrients recommended for 1-3 years age group, it was observed that cowpea incorporated food products viz. *halwa, khajure* and *mathri* provided 14.8-19.5%, 26.6-30.2%, 12.3-20.7% of the daily protein, fat and energy requirement, respectively. Daily requirements of calcium, iron, magnesium and zinc fulfilled by one serving of these products were 1.3-3.7%, 7.2-15.3%, 31.8-49.2% and 7-9%, respectively.

Our results demonstrated that incorporating cowpea in different traditional food products significantly improved sensory characteristics of products as well as nutritive value. This implies that such protein and mineral dense food could be useful in preventing and treating malnutrition in children.

Table 1. Ingredients and methods for preparation of cowpea supplemented food products

Food product	Description of recipe	Ingredients per 50g of flour/ flour blend	Cooked weight (g)	No. of serving
Khajure	Jaggery syrup was prepared by heating jaggery and water together till jaggery dissolved. Flour/ flour blend was added to the jaggery syrup and hard dough was formed. Dough was cut into balls of uniform size and rolled in the form of *rotis* of uniform thickness. *Khajure* were cut in diamond shape and fried till golden brown in hot oil.	Jaggery (50g) + hydrogenated fat (10g) + water (15 ml) + Oil for frying (15 ml)	100	4
Halwa	Semolina/ semolina-flour blend was roasted in fat till it gave characteristic smell. Sugar syrup was made and added to roasted semolina/ semolina-flour blend and *halwa* was allowed to set by evaporating water.	Sugar (50g) + hydrogenated fat (20g) + water (100ml)	125	2.5
Mathri	Flour/ flour blend was sifted with salt and dried fenugreek leaves and carom seeds were added. Hydrogenated fat was rubbed into the dry ingredients and stiff dough was kneaded with cold water. Dough was divided into small balls of same size and rolled to uniform thickness of about 1mm. *Mathri* was cut in desired shapes. Oil was heated in a pan and *mathris* were fried in oil to light golden brown colour.	Hydrogenated fat (5g) + dried fenugreek leaves (1g) + carom seeds (1g) + salt (to taste) + Oil for frying (15ml)	75	3

Table 2. Organoleptic evaluation of cowpea supplemented food products

Product blends		Colour	Taste	Texture	Aftertaste	Overall acceptability
WWF/ Semolina/ RWF	Cowpea flour					
Khajure						
100	0	4.3±0.48^{a}	4.4±0.52^{a}	4.3±0.48^{a}	4.1±0.42^{a}	4.2±0.42^{a}
80	20	4.1±0.57^{a}	4.2±0.57^{a}	4.1±0.57^{a}	3.8±0.57^{a}	4.0±0.47^{a}
60	40	3.5±0.53^{b}	3.9±0.48^{b}	3.1±0.32^{b}	3.1±0.57^{b}	3.3±0.48^{b}
40	60	3.1±0.32^{b}	2.6±0.52^{b}	2.8±0.42^{b}	2.5±0.53^{b}	2.9±0.32^{b}
20	80	2.8±0.63^{b}	2.2±0.42^{b}	2.3±0.48^{b}	2.1±0.32^{b}	2.0±0.00^{b}
CD ($p \leq 0.05$)		0.41	0.39	0.35	0.36	0.31
Halwa						
100	0	4.4±0.84^{a}	4.2±0.92^{a}	4.2±0.79^{a}	4.4±0.52^{a}	4.4±0.53^{a}
80	20	4.2±0.63^{a}	3.9±0.74^{a}	3.9±0.74^{a}	4.0±0.79^{a}	4.0±0.57^{a}
60	40	3.8±0.63^{b}	3.4±0.52^{b}	3.6±0.70^{b}	3.5±0.53^{b}	3.6±0.52^{b}
40	60	3.3±0.95^{b}	3.1±0.88^{b}	3.2±0.79^{b}	2.9±0.57^{b}	3.2±0.92^{b}
20	80	3.0±0.82^{b}	2.6±0.70^{b}	3.1±0.57^{b}	2.8±0.63^{b}	2.9±0.74^{b}
CD ($p \leq 0.05$)		0.50	0.52	0.45	0.47	0.49
Mathri						
100	0	4.0±1.10^{a}	4.1±0.90^{a}	4.3±1.20^{a}	4.0±1.10^{a}	4.0±1.30^{a}
80	20	3.9±0.00^{a}	3.9±0.60^{a}	4.1±0.50^{a}	3.9±0.10^{a}	3.9±0.10^{a}
60	40	3.7±0.50^{a}	3.8±0.30^{a}	4.0±0.50^{a}	3.5±0.50^{a}	3.7±0.50^{a}
40	60	3.1±0.30^{b}	3.3±0.30^{b}	3.6±0.50^{b}	3.1±0.60^{b}	3.1±0.50^{b}
20	80	2.9±1.40^{b}	3.1±1.10^{b}	3.3±1.20^{b}	2.9±1.40^{b}	3.0±1.20^{b}
CD ($p \leq 0.05$)		0.78	0.67	0.76	0.85	0.78

WWF= Whole wheat flour; RWF= Refined wheat flour; Means along the same column with dissimilar superscripts are significantly different ($p \leq 0.05$) from each other.

Table 3. Nutrient composition of control vs. most acceptable cowpea supplemented food products (per 100g on fresh basis)

Product blends		Protein (g)	CHO (g)	Fat (g)	Energy (kcal)	Fibre (g)	Ca (mg)	Fe (mg)	Mg (mg)	Zn (mg)
WWF/ Semolina/ RWF	Cowpea flour									
Khajure										
100	0	8.3	110	31.20	754	1.3	85.3	5.0	88.0	1.5
80	20	9.9	108	31.10	752	1.5	89.2	5.5	98.4	1.8
Change over control (%)		+19.3	-1.8	.-0.30	-0.3	+15.4	+4.8	+10.0	+11.8	+20.0
Halwa										
100	0	4.2	70	16.32	442	0.1	11.2	0.7	18.8	0.4
80	20	5.3	68	16.34	440	0.4	16.1	1.3	31.8	0.7
Change over control (%)		+26.2	-2.8	+0.12	-0.45	+300	+43.7	+85.7	+69.1	+75.0
Mathri										
100	0	8.8	59.1	28.72	530	0.2	18.4	2.2	43.2	0.5
60	40	13.0	52.9	28.75	522	1.4	35.7	4.0	93.1	1.8
Change over control (%)		+47.7	-10.5	+0.10	-1.5	+600	+94.0	+81.8	+115.5	+260

WWF= Whole wheat flour; RWF= Refined wheat flour; CHO= Carbohydrate;

Table 4. Contribution (%) of nutrients per serving of cowpea supplemented food products towards 1-3 years age group children

Food	Serving (g)	Protein (g)	Fat (g)	Energy (kcal)	Ca (mg)	Fe (mg)	Mg (mg)	Zn (mg)
Khajure	25	14.8	28.8	17.7	3.7	15.3	49.2	9
Halwa	50	15.9	30.2	20.7	1.3	7.2	31.8	7
Mathri	25	19.5	26.6	12.3	1.4	11.1	46.5	9
RDA		16.7	27	1060	600	9	50	5

CONCLUSION

The findings of this study revealed that products viz. *halwa, khajure* and *mathri* were acceptable by incorporating cowpea flour up to levels of 20%, 40% and 20%, respectively. Nutrient composition of cowpea incorporated products is enhanced as the amount of cowpea flour increases. Per serving nutrient contribution by these products towards 1-3 years age group children was remarkable. Thus, cowpea incorporated products can be given to children in between two major meals to augment their daily nutrient consumption as well as add variety to their routine diet. These cowpea supplemented food products may be recommended as desirable for solving the problem of protein energy malnutrition among young children in developing countries.

ACKNOWLEDGEMENT

The authors wish to thank the Grain Cowpea Project of G.B. Pant University of Agriculture and Technology, Pantnagar, for funding this research.

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