

Nutritional, Sensory and Physical Analysis of Pumpkin Flour Incorporated into Weaning Mix

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ABSTRACT

The objective of this study was to develop a cereal-pulse complementary food fortified with different concentrations of pumpkin powder (*Cucurbita moschata*), and to analyse its sensory and physico-chemical parameters. Fresh pumpkins (*Cucurbita moschata*) were procured from the market and dehydrated and powdered in the laboratory. Sorghum (*Sorghum vulgare*) and whole green gram (*Vigna radiata*) were germinated, dried, pulverised and combined with powdered rice (*Oryza sativa*) in the ratio of 2:1:1. Pumpkin powder was added to this mixture at 10%, 20% and 30% variations. The complementary weaning food mix was subjected to sensory analysis (appearance, colour, flavour, texture and overall acceptability) by semi-trained panelists. The mix was analysed for its moisture, energy, protein, fat, carbohydrates, fibre, beta-carotene and anti-oxidant content. Nutritional analysis of the weaning mix demonstrated that there was a significant increase in the protein, fibre, carbohydrate and antioxidant levels with an increase in concentration of pumpkin powder. The sensory analysis revealed that the complementary food mix with 20% pumpkin powder fortification had good sensory qualities.

Keywords: Green gram, pumpkins, quality, rice, sorghum, weaning

INTRODUCTION

Weaning is a period of transition for the infant during which the diet changes in terms of consistency and source. From a liquid milk-based diet, the child is gradually introduced to semi-solid foods (Draper, 1994). Such semi-solid foods are referred to as complementary foods. A complementary food should ideally be easily digestible, have high energy density and low bulk (Ezeji & Ojimekwe, 1993). The formulation and development of nutritional weaning foods from local and readily available raw materials has received a lot of attention in

many developing countries (Ijarotimi & Aroge, 2005).

Cereals form the major part of most weaning mixes and contribute to 70-80% of daily energy intake (Mahajan & Chattopadhyay, 2000). However, they are deficient in one or two essential amino acids (Gopalan, Rama Sastri & Balasubramanian, 1991). Legumes are largely replacing milk and other sources of animal proteins, which are expensive and not readily available in India as suitable substitutes for high quality protein. Therefore, supplementing with legumes and other nutrient dense food products improves the nutritional quality of

cereals by complementing their limited amino acids, lysine and tryptophan (Hulse, 1991; Ijarotimi & Aroge, 2005).

Pumpkin belongs to the family of *Cucurbitaceae* and is widely grown throughout the world (Dhiman, Sharma & Surekha Attri 2009). Pumpkins are sweet when fully mature with yellow or orange flesh rich in carotene, vitamins, minerals and dietary fibre (Sirohi, Choudhary & Kalda, 1991). Carotenoids are a primary source of vitamin A for most of the people living in developing countries (Boileau, Moore & Erdnma, 1999) where vitamin A deficiency is still common (Chakravarthy, 2000). Young children with vitamin A deficiency are usually more susceptible to severe infection, particularly dehydrating diarrhea, complications from measles, and respiratory infection. An infection usually precedes xerophthalmia, making the child more susceptible to vitamin A deficiency which eventually leads to blindness (Guthrie & Picciano, 1995). One way to increase vitamin A intake of infants is to incorporate high carotenoid food in their diet (Normah & Pongjata, 2000).

β -carotene present in pumpkin is converted to vitamin A in the body and plays a crucial role in the prevention of chronic diseases during adult life due to their antioxidant abilities (Blumberg, 1995). Besides, as the amount of organic acids and cellular tissues are low in infants, they can be consumed to cure stomach and intestinal disorders (Dhiman *et al.*, 2009). Pumpkin flour used in this weaning mix is also a rich source of fibre. There have been several studies that have considered the role of low-fibre diets in the etiology of childhood constipation (Morais *et al.*, 1999). Thus a diet rich in dietary fibre can act as a potential cure to this condition. Therefore, the purpose of this study was to develop a complementary food using cereal-pulse combination with the fortification of pumpkin flour in three variations of 10%, 20%, 30% and to evaluate the sensory and nutritional parameters of the three variations.

MATERIAL AND METHODS

Pumpkin (*Cucurbita moschata*), rice (*Oryza sativa*), green gram (*Vigna radiate*) and sorghum (*Sorghum vulgare*) were procured from the local markets. An amount of 200g of each was rinsed with distilled water before subjecting them to the different processing methods.

Preparation of pumpkin flour

Pumpkin fruits (*Cucurbita moschata*) were obtained from the local market. The rind, fibrous matter and seeds were removed and the flesh cut into 1 inch cubes. The pumpkin pieces were then cut into slices of 1 mm thickness using a stainless steel knife and were then dried in a tray drier (Mechanical Dehydrator, HI-Tech equipments, India) to a moisture content of 10-12% at 60°C for 24 hours. The dried slices of pumpkin were pulverised in a pulveriser (Lincon pulveriser LP-20) and then sieved through a standard sieve (mesh size 60). The flour was stored in an air tight container (Wan Nadiah & Noor Aziah, 2007).

Preparation of weaning flour

Germinated sorghum (*Sorghum vulgare*), germinated green gram (*Vigna radiate*) and rice (*Oryza sativa*) flour were used in the preparation of the weaning mix. It was prepared in the laboratory as shown in Figure 1.

Preparation of pumpkin incorporated weaning mix

The standard weaning mix was prepared in the laboratory by combining germinated sorghum, germinated green gram and rice flour in the ratio 2: 1: 1. The three variations of the mix were prepared by addition of 10%, 20% and 30 % pumpkin flour to the standard. The formulation of the complementary food mix is shown in Table 1.

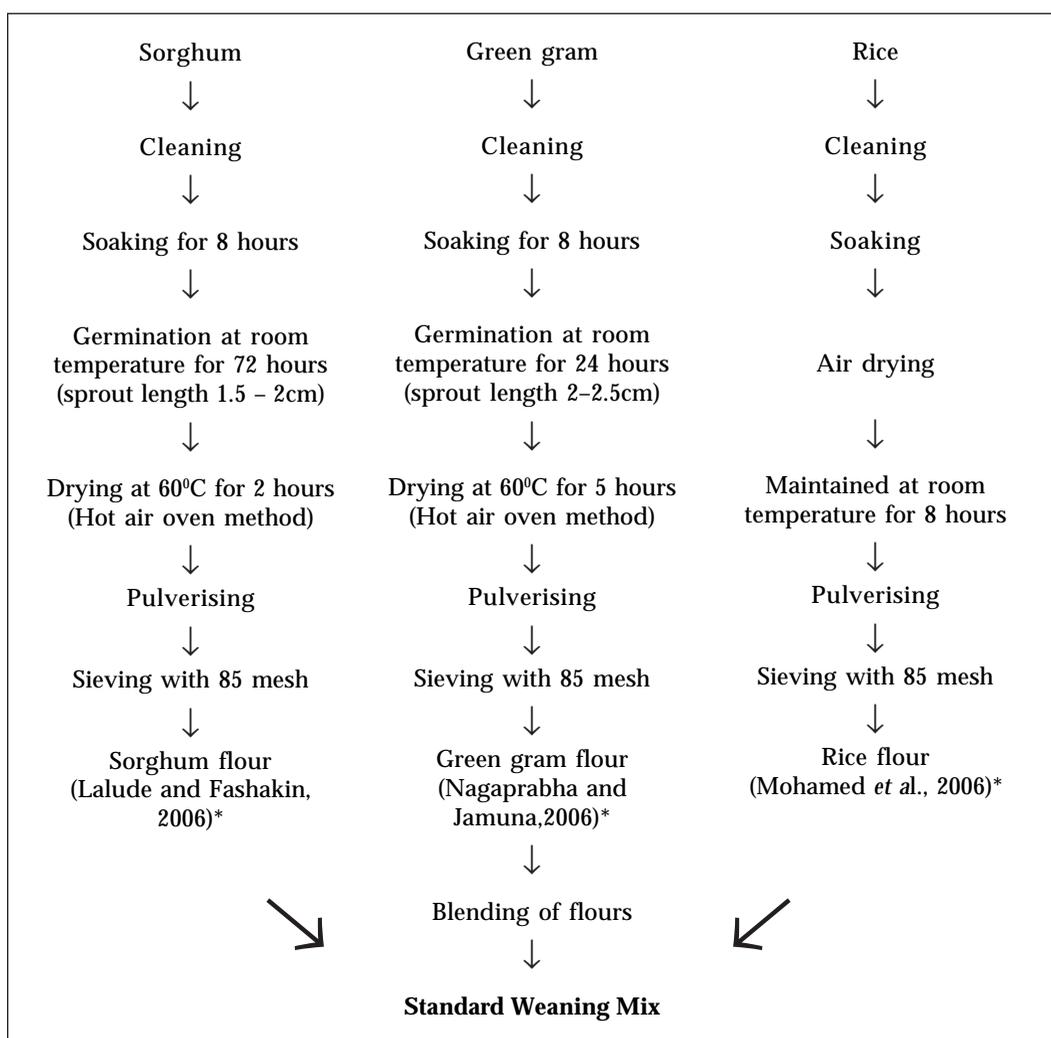


Figure 1. Preparation of standard weaning mix

* Method modified

Table 1. Formulation of weaning mix

Sample	Germinated sorghum flour(g)	Rice flour(g)	Germinated green gram flour(g)	Pumpkin flour(g)
Std	50	25	25	-
S1	45	22.5	22.5	10
S2	40	20	20	20
S3	35	17.5	17.5	30

* Std- standard with 0% incorporation of pumpkin flour; S1-sample weaning mix with 10% incorporation of pumpkin flour; S2- sample weaning mix with 20% incorporation of pumpkin flour; S3- sample weaning mix with 30% incorporation of pumpkin flour.

Physical analysis

Estimation of cooking time and gelatinisation temperature

A sample of 15 g of each variation was taken in separate pans and mixed with 100 ml of water. The mixture was kept on high flame and held till it reached 100°C. It was then simmered and cooked till it formed a soft gel and the top of the mixture was observed to have a glassy appearance. The gelatinisation temperature of all three variations and the standard sample of the complementary food mix was observed and recorded.

Sensory analysis

The weaning mix and its three variations were evaluated for acceptability by 25 semi-trained panelists. The panelists were asked to score the products for appearance, colour, flavour, taste, odour and overall acceptability using a 9-point hedonic scale. The samples were labelled with a three digit code and a side-by-side presentation protocol was followed for all the four samples. The rating of the scale ranged from 1 (dislike extremely) to 9 (like extremely) as described by Peryam and Pilgrim (1957).

Nutrient analysis

The standard and the three variations of S1 (weaning mix with 10% incorporation of pumpkin flour), S2 (weaning mix with 20% incorporation of pumpkin flour) and S3 (complementary food mix with 30% incorporation of pumpkin flour) were analysed for energy, carbohydrates, fat, protein, moisture, fibre, antioxidants and β -carotene using standard AOAC methods (AOAC, 1990).

Statistical analysis

The mean and standard deviation of the quality properties of the weaning mix were determined. The statistical significance of sensory values of the experimental samples and the standard were evaluated by analysis of variance. The association

between varying concentrations of pumpkin flour incorporated weaning mix (10%, 20%, 30%) and physical parameters and sensory characteristics were determined using correlation analysis.

RESULTS

The results of physical, sensory and nutrient analysis of the standard and experimental samples of the weaning mix incorporated pumpkin flour ensues.

In relation to the gelatinisation temperature for each of the weaning samples, the results showed that S3 had the highest gelatinisation temperature (101°C) followed by S2 (98.3°C) and S1 (96.3°C) while the gelatinisation temperature of the standard sample was 82°C. The highest gelatinisation temperature was noted in 30% incorporation of pumpkin flour, while the least temperature was observed in the standard sample with 0% incorporation of pumpkin flour. Hence from Figure 2, it is inferred, that the gelatinisation temperature increased with increasing amounts of incorporation of pumpkin flour.

The results of sensory analysis of the formulated weaning food samples are shown in Table 2. The data on sensory quality obtained by semi-trained panelists showed that there was no significant ($p < 0.05$) difference in the odour, texture, colour, appearance, and taste of the samples S1, S2, S3 and Standard. In terms of colour, S2 (20%) and S3 (30%) was less acceptable than S1 (10%). However, correlation between each of the sensory parameters - odour, colour, texture, taste, appearance and overall acceptance of the mix was observed (Figure 3).

Table 3 shows the nutritive value of fresh pumpkin (100g), pumpkin powder (100g) and weaning mix with 0 and 20% substitution levels. It was observed that pumpkin flour (4857.6 $\mu\text{g}/100\text{g}$) had higher beta-carotene content than fresh pumpkin (1079.6 $\mu\text{g}/100\text{g}$).

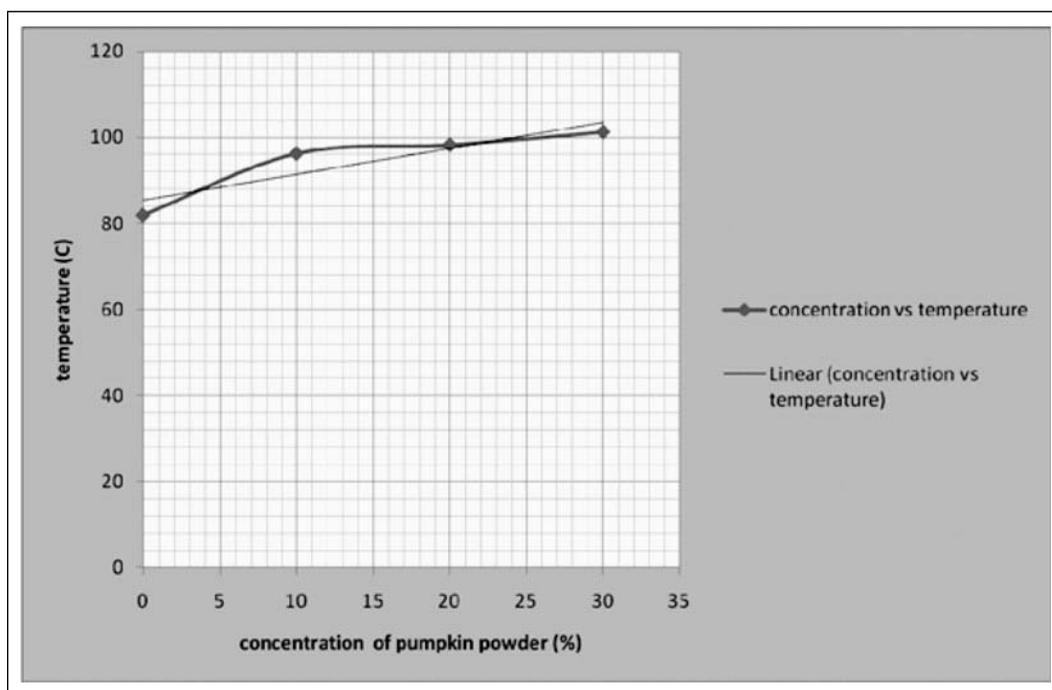


Figure 2. Concentration of pumpkin powder vs temperature of gelatinisation

Table 2. Sensory parameters

Sample	Odor	Texture	Taste	Color	Appearance	Overall acceptance
Std	4.4±1.7	5.04±1.36	4.08±1.97	5.24±1.09	5.8±1.38	4.91
S1	4.8±1.9	5.6±1.55	3.84±2.15	5.64±1.48	5.84±1.31	5.16
S2	4.56±1.98	5.04±1.81	3.8±2.25	5.48±1.58	5.44±1.41	4.864
S3	4.92±1.75	5.44±1.70	3.8±2.19	5.44±1.47	5.64±1.46	5.03

* Std- standard with 0% incorporation of pumpkin flour; S1-sample weaning mix with 10% incorporation of pumpkin flour; S2- sample weaning mix with 20% incorporation of pumpkin flour; S3- sample weaning mix with 30% incorporation of pumpkin flour.

The mix samples with 0 and 20% incorporation of pumpkin flour showed an increased level of moisture content in 20% sample when compared to the standard mix. The carbohydrate content in the samples ranged from 33.28 g to 38.51 g as shown in Table 3. A significant increase of 5.3% in carbohydrate content was observed with increasing incorporation of pumpkin flour.

Similar results were observed in the case of protein and fat content of the weaning

mix samples. An increase in protein (1.26%) and fat (0.69%) content was observed. Higher proximate protein, carbohydrate and fat in the mix with pumpkin flour showed a corresponding increase in energy content. The energy content increased from 175 kcal in standard to 202 kcal in sample with 20% incorporation of pumpkin flour.

β -carotene levels in the 20% sample (110.8 μ g) were higher as compared to the standard with trace amounts. An increase

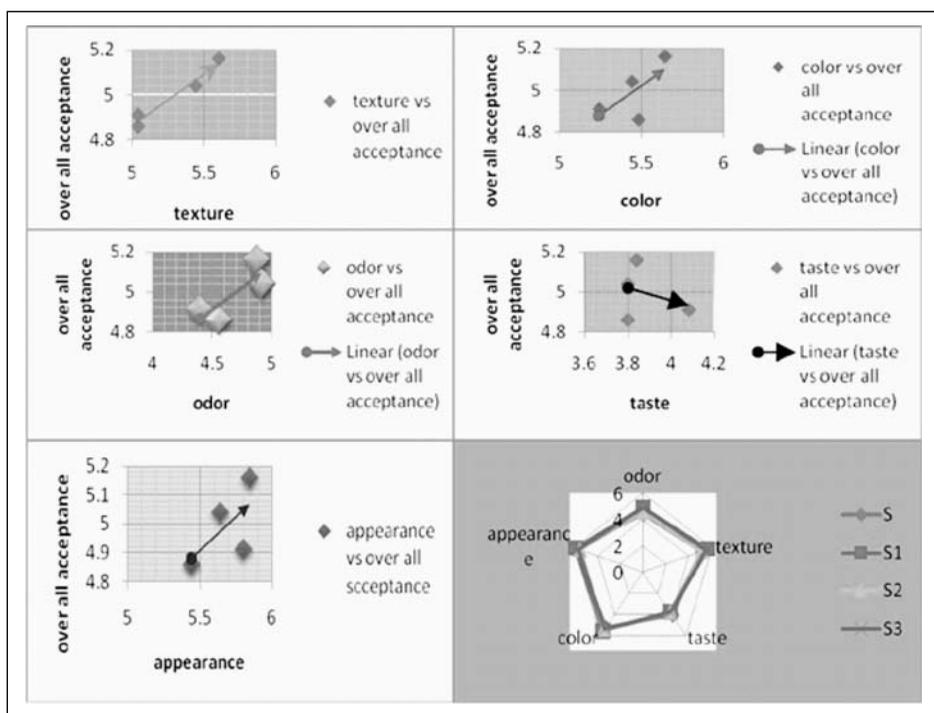


Figure 3. Correlation of sensory parameters and overall acceptance in studied weaning mix

Table 3:. Nutrient analysis of fresh pumpkin, pumpkin powder, standard mix and 20% mix

Parameter	Pumpkin (Fresh)	Pumpkin powder	Standard weaning mix	Weaning mix (20%)*
Moisture	87.3 g	14.956 g	5.98 g	6.07 g
Fat	0.089 g	1.621 g	2.96 g	3.59 g
Protein	1.345 g	15.69 g	4.61 g	5.86g
Carbohydrates	4.38 g	4.218 g	33.28 g	38.51 g
Ash	2.48 g	5.788 g	---	---
â-carotene	1079.6 mcg	4857.6 mcg	traces	110.8mcg
Fibre	0.668 g	3.078 g	1.23mcg	2.21mcg
Iron	0.418 mg	1.47 mg	---	---
Anti oxidants	---	---	traces	0.898mcg(total)
Energy			175 Kcal(approx)	202 Kcal (approx)

* Weaning mix 20% - sample with 20% incorporation of pumpkin flour

in fibre content with incorporation of pumpkin flour was also observed. The increase ranged from 1.23 g in standard to 2.21 g in 20% sample. Antioxidant content also increased to 0.898µg in 20% sample from trace amounts that were observed in the standard sample with 0% incorporation of pumpkin flour.

DISCUSSION

The results of the study revealed a considerable effect of pumpkin flour on the gelatinisation of the complementary food mix. This could be attributed to high fruit fibre and high pectin content of pumpkin (Chen, Piva & Labuza 1984). This property

of a mix for complementary feeding is ideal because diets that form gel at higher concentrations allow dilution in attempts to increase the digestibility of the weaning mix without losing the density of nutrients as compared to weaning mixes with least concentration (Ezeji & Ojmelukwe, 1993).

The sensory results showed that the texture and appearance of the samples (S1, S2, S3) were very close to the standard and the taste of the samples S1, S2, S3 obtained a similar rating. But there was lesser acceptance of the sample with 20% and 30% incorporation of pumpkin flour as assessed by the panelists. This can be attributed to the yellow colour imparted by the carotenoids pigment naturally present in pumpkin (Noor Aziah and Komathi, 2009). The acceptance level of the weaning mix with S3 (30% incorporation of pumpkin flour) scoring the least was similar to the results obtained by Pongjanta *et al.* (2006) who stated that the colour values of the product increased with higher incorporation of pumpkin flour and a corresponding decrease in acceptance of the product.

The assessment of nutrient content of fresh pumpkin and pumpkin flour showed that fresh pumpkin had higher moisture and lower fat, protein, fibre, iron, ash, and β -carotene content as compared to pumpkin flour. This was similar to the results reported by Tee (1985) and Gopalan *et al.* (1991). Thus a small quantity of pumpkin powder would alter the nutritive value of the mix to a considerable extent.

The higher moisture content in the 20% sample might be attributed to the higher water absorption capacity of pumpkin proteins as reported by Mansour *et al.* (1999). A similar increase was noted in protein and fat and energy values in the 20% sample.

The increase in β -carotene levels in the 20% sample (110.8 μg) as compared to the standard with trace amounts is in accordance with the research conducted by Pongjanta (2006) on utilisation of pumpkin flour in bakery products. The study

demonstrated a significant increase in the level of vitamin A.

The fibre values in the mixes are attributed to the germinated pulses. This was in accordance with observations made by Griffith & Griffith (1998) who stated that non-starch polysaccharides, which is a measure of dietary fibre, was significantly increased due to germination.

CONCLUSION

In recent years, the development and evaluation of functional foods to target populations has increased considerably among food scientists and technologists. Scientists are exploring the underutilised crops which are otherwise a rich source of nutrients. Pumpkin is one such vegetable which is rich in nutrients and its utilisation in India is limited to using it as a fresh vegetable or as a thickening agent in vegetable sauces. In this study, a weaning mix was developed from a combination of germinated sorghum, germinated green gram, and rice flour with incorporation of pumpkin flour at 10%, 20% and 30% concentrations. The mix was studied for its sensory, nutritional and physical parameters.

The sensory analysis revealed that the sensory parameters of the three samples of S1, S2, and S3 was similar to that of the standard. Since the incorporation did not significantly alter the sensory parameters, there is scope for further incorporation of pumpkin flour.

The nutrient analysis of the weaning mix highlighted that an increase in incorporation of pumpkin flour increased the energy, fat, protein, β -carotene, fibre, and antioxidant levels. It was also observed that cooking time and gelatinisation temperature increased with increasing incorporation of pumpkin flour. This property helps to offer the weaning infant a less viscous yet energy dense mix.

Besides, the pumpkin is economical and a nutrient dense source. Therefore, this study demonstrates that pumpkin flour fortified complementary food mix is economical, with highly acceptable sensory qualities and a rich nutritive value.

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