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## Preparation of pumpkin powder and pumpkin seed kernel powder for supplementation in weaning mix and cookies

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### Abstract

Pumpkin powder and seed kernel powder was utilised for the development of weaning mix and cookies. Six different treatments of weaning mix in which wheat flour was supplemented with pumpkin powder viz. T<sub>1</sub> (100 %), T<sub>2</sub> (90:10), T<sub>3</sub> (80:20), T<sub>4</sub> (70:30), T<sub>5</sub> (60:40) and T<sub>6</sub> (50:50) were subjected to sensory evaluation and based on the results best four combinations viz. T<sub>1</sub> (100 %), T<sub>2</sub> (90:10), T<sub>3</sub> (80:20) and T<sub>4</sub> (70:30) were selected for nutritional studies. The treatment T<sub>4</sub> (70:30) recorded the highest amount of crude protein (12.51 %), crude fibre (0.89 %) and  $\beta$ -carotene (7.81 mg/100 g) followed by T<sub>3</sub> (80:20), T<sub>2</sub> (90:10) and T<sub>1</sub> (100 %). Among different treatments of weaning mixes prepared by supplementing wheat flour with pumpkin seed kernel powder, treatment T<sub>3</sub> (80:20) was awarded with the highest scores followed by T<sub>2</sub> (90:10), T<sub>4</sub> (70:30) and T<sub>1</sub> (100 %) on the basis of sensory evaluation. Cookies of six different treatments in which wheat flour was supplemented with pumpkin powder (*i.e.* T<sub>1</sub> (100 %), T<sub>2</sub> (90:10), T<sub>3</sub> (80:20), T<sub>4</sub> (70:30), T<sub>5</sub> (60:40) and T<sub>6</sub> (50:50)) were subjected to sensory evaluation and based on the results, the best four combinations viz. T<sub>1</sub> (100 %), T<sub>2</sub> (90:10), T<sub>3</sub> (80:20), T<sub>4</sub> (70:30) were selected for storage studies. The treatment T<sub>4</sub> (70:30) recorded the highest amount of crude protein (10.08 %), crude fibre (0.863 %) and  $\beta$ -carotene (4.29 mg/100 g) followed by T<sub>3</sub> (80:20), T<sub>2</sub> (90:10) and T<sub>1</sub> (100 %). Among different treatments tried for cookies preparation by supplementing wheat flour with pumpkin seed kernel powder (T<sub>1</sub> (100 %), T<sub>2</sub> (90:10), T<sub>3</sub> (80:20), T<sub>4</sub> (70:30), T<sub>5</sub> (60:40) and T<sub>6</sub> (50:50)), treatment T<sub>1</sub> (100 %), T<sub>2</sub> (90:10), T<sub>3</sub> (80:20), T<sub>4</sub> (70:30) were selected on the basis of sensory evaluation for nutritional studies. The maximum amount of crude protein content (12.50 %), crude fibre (0.830 %) and  $\beta$ -carotene (3.50 mg/100 g) was observed in T<sub>4</sub> (70:30) followed by T<sub>3</sub> (80:20), T<sub>2</sub> (90:10) and T<sub>1</sub> (100 %). With supplementation of pumpkin powder in weaning mix and cookies, the  $\beta$ -carotene content increased, while with increase in pumpkin seed kernel powder there was increase in crude protein and fat.

**Keywords:** pumpkin powder, pumpkin seed kernel powder, crude fiber,  $\beta$ -carotene, supplementation, weaning mix, cookies

### Introduction

Pumpkin belongs to the family *cucurbitaceae* and is widely grown vegetable all over the world. The main season for growing cucurbits is the summer and rainy months in most parts of India. Winter pumpkins are also grown in some parts of southern and western India (Seshadri, 1989) [25]. Large number of pumpkin varieties varying in shape, size and colour of flesh are available (Dhiman *et al.*, 2017) [10]. The varieties of pumpkin like CM-14, Pusha vishwas, Arka chandan, Arka suryamukhi, CM-350 and NDPK-24 are found in India (Kalloo *et al.*, 2006) [19]. The colour of flesh ranges from yellow to crimson and flesh thickness often varies widely (Seshadri, 1986) [26]. On an average, pumpkin contains 78.69 per cent flesh portion, 17.95 per cent peel, 3.63 per cent seeds, 82.58 per cent water, 7.29 per cent protein, 0.383 per cent fat, 1.26 per cent pectin, 2.34 per cent crude fibres, 16.78 mg per 100 g ascorbic acid and 13.30 mg per 100 g  $\beta$ -carotene of edible portion (Ramachandran *et al.*, 2017) [10]. The minerals present in pumpkin pulp are sodium, potassium, calcium, iron and phosphorous (Demery, 2011) [9]. Fresh seeds of *Cucurbita moschata* contain moisture, 28.5 per cent; protein, 37.7 per cent; and ash, 4.4 per cent; whereas, dried pumpkin seeds contain moisture content of 5.6 per cent, protein content of 37.4 per cent and ash content of 4.4 per cent (Fedha *et al.*, 2010) [16]. Pumpkin is a valuable source of carotenoids which have major role in the form of pro-vitamin A, when used at the ripening stage or after storage.  $\beta$ -carotene present in pumpkin is converted in to vitamin A in the body and plays a crucial role in the prevention of cancer (Danilchenko *et al.*, 2000) [8] and (chronic diseases during the adult life due to their antioxidant

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abilities and prevent skin diseases and eyes disorder. Pumpkin has a high amount of biological active compounds. Pumpkin is recommended for arteriosclerosis, reduction of cholesterol in people suffering from obesity (Danilchenko *et al.*, 2000) [8]. Pumpkin seeds are reported to be a good source of B-complex vitamins (Mansour *et al.*, 1993) [20]. The seeds of pumpkin are an excellent source of proteins and also has pharmacological activities such as anti-diabetic (Quanhong *et al.*, 2003) [23], antifungal (Wan and Ng, 2003) [28], antibacterial and anti-inflammation (Caili *et al.*, 2006) [6] and antioxidant (Nkosi *et al.*, 2006) [21].

Pumpkin can be profitably converted in to a variety of value added products such as jam, jelly, marmalade, puree, sauces, chutney, pickle (Dhiman *et al.*, 2009) [17] and halwa (Dhiman *et al.*, 2017c) [13]. Pumpkin can be processed in to flour (Dhiman *et al.*, 2017a) [11] for their supplementation in to bakery products, soups (Dhiman *et al.*, 2017b) [12], instant noodles and natural colouring agents in pasta and flour mixes (Dhiman *et al.*, 2017a) [11]. Pumpkin seeds can be converted in to snacks which are rich in fibre, unsaturated lipids, minerals and proteins (Carames *et al.*, 2008) [7]. Pumpkin seeds can be processed in to flour (Hamed *et al.*, 2008) [17] which can be used for biscuit making (Atuonwu and Akobundu, 2010) [5], bread and cookies (Hamed *et al.*, 2008) [17].

Cookies are considered as snacks for people of all age groups. They must be acceptable to masses besides having high nutritional quality. Cookies are small, flat, baked treat, usually containing fat, flour, eggs and sugar. 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, child is gradually introduced to semi-solid food (Draper, 1994). Weaning foods should be given to the baby at about the age of four to six months. During weaning period more nutritious diet is required for infant because it is a critical period of child life, when it is mostly at risk from malnutrition and other diseases. Since the pumpkin is produced in bulk in India, especially in rural areas and the crop has high nutritional as well as therapeutic value, hence with a view to utilize the production of pumpkin in the development of such products as weaning mix and cookies which can be used by large spectrum of population, the proposed investigation was undertaken.

## Methodology

### Procurement of raw material

The fully ripe pumpkins were procured from *Sabzi mandi* of Solan and the local market. Other materials like wheat flour, sugar, salt, milk powder, ghee, polyethylene pouches etc. were also purchased from the Solan market. Local *chakki* wheat flour was used for the preparation of weaning mix and cookies.

### Preparation of pumpkin powder and pumpkin seed powder

For the development of recipes for weaning mix and cookies, pumpkin powder and pumpkin seed kernel powder were prepared by following the methods discussed below:

**Preparation of pumpkin powder:** Ripe pumpkin fruits were washed and cut into halves. After removing the seeds and fibrous strains, pumpkin halves were cut in to slices. The slices were peeled and grated into shreds. The shreds were steam blanched for 4 minutes followed by dipping in 500 ppm of potassium metabisulphite (KMS) solution for 15 minutes. The shreds were then dried in a mechanical dehydrator at 60 ±

2°C for 8-10 hours. The dried shreds were ground using a grinder followed by sieving through a 48 mesh metallic sieve to yield powder. The pumpkin powder was packed in polyethylene bags for subsequent use in the preparation of weaning mix and cookies.

**Preparation of pumpkin seed kernel powder:** Ripe pumpkin was cut into halves and seeds were extracted from the fluffy portion (fibrous strains). The seeds were washed, oven-dried and manually decorticated. The seeds were crushed by using a mechanical grinder and defatted (Atuonwu and Akobundu, 2010) [5] by soaking in n-hexane for 36 hours with change of solvent every 8 hours. The defatted crushed seeds were kept on filter paper to remove the extra n-hexane, then the crushed seeds were dried at room temperature and ground to pass through a 355 mesh sieve. The powder was packed in polyethylene bags and stored at ambient temperature for further use in preparation of weaning mix and cookies.

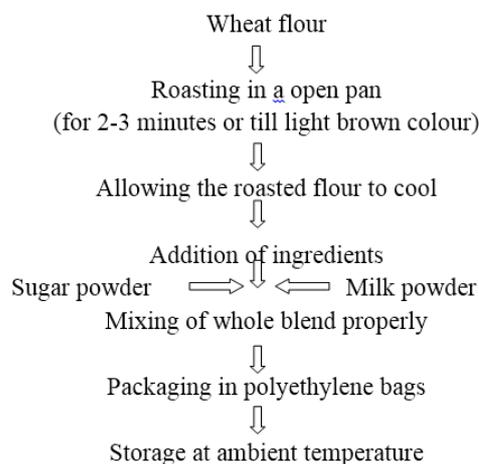
### Development of recipe for preparation of weaning mix and cookies supplemented with pumpkin flour

**Development and standardization of recipe for the preparation of weaning mix:** The recipe for weaning mix was developed by using different ingredients such as wheat flour, sugar and milk powder. Four weaning mixes were prepared by using different recipes comprising of various proportions of sugar and milk powder and keeping wheat flour as constant (Table 1). The method of preparation was standardized (Fig. 1). The weaning mixes were prepared and subjected to organoleptic evaluation by a panel of ten judges in order to select the best one to be used as base for further studies in which the mix will be supplemented with pumpkin powder (Table 2) and pumpkin seed kernel powder (Table 3).

**Preparation of weaning mix for serving:** At first clean drinking water was boiled for 5 minutes and allowed to cool. Then weaning mix was diluted with three times water with known quantity of sample in a bowl and stirred until the weaning food was smooth.

**Table 1:** Development and standardization of recipe for weaning mix

| Ingredients      | Recipe I | Recipe III | Recipe IV |
|------------------|----------|------------|-----------|
| Wheat flour (g)  | 100      | 100        | 100       |
| Sugar powder (g) | 16       | 20         | 22        |
| Milk powder (g)  | 30       | 40         | 45        |



**Fig 1:** Flow sheet for preparation of weaning mix

**Table 2:** Standardization of recipe for weaning mix supplemented with pumpkin flour

| Ingredients        | T <sub>1</sub> | T <sub>2</sub> | T <sub>3</sub> | T <sub>4</sub> | T <sub>5</sub> | T <sub>6</sub> |
|--------------------|----------------|----------------|----------------|----------------|----------------|----------------|
| Wheat flour (g)    | 100            | 90             | 80             | 70             | 60             | 50             |
| Pumpkin powder (g) | -              | 10             | 20             | 30             | 40             | 50             |
| Sugar powder (g)   | 20             | 20             | 20             | 20             | 20             | 20             |
| Milk powder (g)    | 40             | 40             | 40             | 40             | 40             | 40             |

The weaning mixes prepared from different treatments were subjected to taste panel evaluation and the best four were selected for further studies.

**Table 3:** Standardization of recipe for weaning mix supplemented with pumpkin seed flour

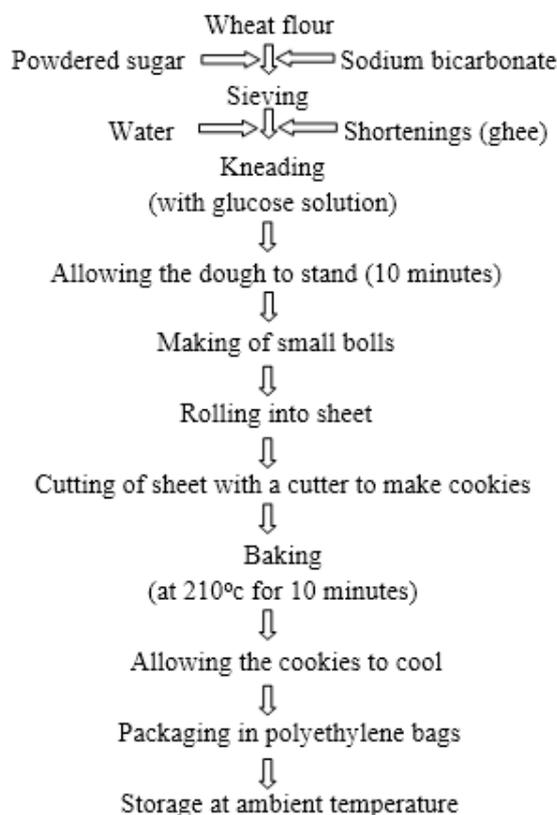
| Ingredients                    | T <sub>1</sub> | T <sub>2</sub> | T <sub>3</sub> | T <sub>4</sub> | T <sub>5</sub> | T <sub>6</sub> |
|--------------------------------|----------------|----------------|----------------|----------------|----------------|----------------|
| Wheat flour (g)                | 100            | 90             | 80             | 70             | 60             | 50             |
| Pumpkin seed kernel powder (g) | -              | 10             | 20             | 30             | 40             | 50             |
| Sugar powder (g)               | 20             | 20             | 20             | 20             | 20             | 20             |
| Milk powder (g)                | 40             | 40             | 40             | 40             | 40             | 40             |

The weaning mixes prepared from different treatments were subjected to sensory evaluation and the best four were selected for further studies.

**Development of recipe for preparation of cookies supplemented with pumpkin flour:** The recipe for cookies was developed by using different ingredients such as wheat flour, sugar, salt, glucose solution, distilled water etc. Four different recipes were prepared by using different proportions of salt, sugar, sodium bicarbonate, fats. The proportion of wheat flour, distilled water and glucose solution was kept constant (Table 5). The method for preparation of cookies was standardized for the development of cookies (Fig. 2). Cookies developed by using four different recipes were subjected to organoleptic evaluation by a panel of ten judges in order to select the best one to be used as base for further studies to be supplemented with pumpkin powder (Table 6) and pumpkin seed kernel powder (Table 7).

**Table 5:** Development and standardization of recipe for cookies

| Ingredients                        | Recipe I | Recipe II | Recipe III | Recipe IV |
|------------------------------------|----------|-----------|------------|-----------|
| Wheat flour (g)                    | 100      | 100       | 100        | 100       |
| Sugar powder (g)                   | 58       | 60        | 62         | 64        |
| Salt (g)                           | 0.65     | 0.70      | 0.75       | 0.80      |
| Sodium bicarbonate (g)             | 0.90     | 0.95      | 1          | 1.5       |
| Fat (g)                            | 28       | 30        | 32         | 34        |
| Distilled water (ml)               | 10       | 10        | 10         | 10        |
| Glucose solution (8.9 g in 150 ml) | 20       | 20        | 20         | 20        |

**Fig 2:** Flow sheet for the preparation of cookies**Table 6:** Standardization of recipe for the preparation of cookies supplemented with pumpkin flour

| Ingredients            | T <sub>1</sub> | T <sub>2</sub> | T <sub>3</sub> | T <sub>4</sub> | T <sub>5</sub> | T <sub>6</sub> |
|------------------------|----------------|----------------|----------------|----------------|----------------|----------------|
| Wheat flour (g)        | 100            | 90             | 80             | 70             | 60             | 50             |
| Pumpkin powder (g)     | -              | 10             | 20             | 30             | 40             | 50             |
| Sugar powder (g)       | 62             | 62             | 62             | 62             | 62             | 62             |
| Salt (g)               | 0.75           | 0.75           | 0.75           | 0.75           | 0.75           | 0.75           |
| Sodium bicarbonate (g) | 1              | 1              | 1              | 1              | 1              | 1              |
| Fat (g)                | 32             | 32             | 32             | 32             | 32             | 32             |
| Distilled water (ml)   | 10             | 10             | 10             | 10             | 10             | 10             |
| Glucose solution (ml)  | 20             | 20             | 20             | 20             | 20             | 20             |

The cookies prepared from different treatments were subjected to sensory evaluation by a panel of judges in order to select best four for further studies.

**Table 7:** Standardization of recipe for the preparation of cookies supplemented with pumpkin seed flour

| Ingredients                    | T <sub>1</sub> | T <sub>2</sub> | T <sub>3</sub> | T <sub>4</sub> | T <sub>5</sub> | T <sub>6</sub> |
|--------------------------------|----------------|----------------|----------------|----------------|----------------|----------------|
| Wheat flour (g)                | 100            | 90             | 80             | 70             | 60             | 50             |
| Pumpkin seed kernel powder (g) | -              | 10             | 20             | 30             | 40             | 50             |
| Sugar powder (g)               | 62             | 62             | 62             | 62             | 62             | 62             |
| Salt (g)                       | 0.75           | 0.75           | 0.75           | 0.75           | 0.75           | 0.75           |
| Sodium bicarbonate (g)         | 1              | 1              | 1              | 1              | 1              | 1              |
| Fat (g)                        | 32             | 32             | 32             | 32             | 32             | 32             |
| Distilled water (ml)           | 10             | 10             | 10             | 10             | 10             | 10             |
| Glucose solution (ml)          | 20             | 20             | 20             | 20             | 20             | 20             |

The cookies prepared from different treatments were subjected to sensory evaluation by a panel of ten judges in order to select the best four for further studies.

### Physico-chemical analysis

Pumpkin fruit and pulp was analyzed for different parameters. The weight of fruit was taken on top pan balance while length and width of ripe pumpkin were measured by using thread and scale. Recovery of pulp was calculated by subtracting the weight of peel/seed/core/fluffy portions from the fruit. The colour of the flesh of pumpkin was evaluated visually. Moisture content was determined by measuring the weight loss due to evaporation of water (AOAC, 2012) [4]. Titrable acidity was estimated by titrating known volume of sample against standard 0.1 N NaOH using phenolphthalein as an indicator (Ranganna, 2009). Total Soluble solids (TSS) of the samples were measured by hand refractometer of 0-32 °Brix (AOAC, 2012) [4]. The pH was determined by using a digital pH meter (CRISON Instrument, Ltd Spain). The method as described by Ranganna (2009) [25] was followed for the estimation of pectin. Ascorbic acid content was determined by using 2-6 dichlorophenol indophenols dye (AOAC, 2012) [4]. Sugars, ash content and  $\beta$ -carotene were estimated by as per the method described by Ranganna (2009) [25].

### Sensory evaluation

Nine point hedonic scale method given by Amerine *et al.* (1965) [2] was followed for conducting the sensory evaluation of pumpkin pulp. The panel of ten judges comprising of faculty members and post graduate students were selected with care to evaluate the products for various sensory parameters such as colour, body, texture, flavour and overall acceptability depending upon the type of product. Efforts were made to keep the same panel for sensory evaluation throughout the entire period of study. Plain water was given to the judges to rinse their mouth in between the evaluation of samples.

## Results and Discussions

### Physical characteristics of pumpkin fruit and its seed

The results obtained for physical characteristics of ripe

pumpkin revealed that ten randomly selected fruits have an average weight, length and diameter of  $3295 \pm 70.84$  g,  $30.95 \pm 0.84$  and  $67.95 \pm 1.78$  cm, respectively. These findings are almost in line with the results of Noelia *et al.* (2011). The pulp recovery was found to be  $64.98 \pm 0.65$  per cent, whereas, pulp: skin: seed ratio was recorded to be 20: 08: 01. The average value for firmness of ripe pumpkin was  $19.7 \pm 0.46$  lbs/ inch<sup>2</sup>, while the colour of ripe pumpkin fruit vary from pale yellow to golden yellow which is in conformity with the results of Anju (2000) [3].

The physical analysis of pumpkin seed kernels indicated that ten randomly selected samples have an average weight, length and width of  $0.124 \pm 0.005$  g,  $1.2 \pm 0.208$  and  $0.7 \pm 0.145$  cm, respectively which are in the range of values recorded by Joshi *et al.* (1993) [18] and Altuntas (2008) [1]. The oil recovery from seeds was  $34.98 \pm 0.376$  per cent. The colour of pumpkin seed kernels was observed to be light green.

### Chemical characteristics of ripe pumpkin and pumpkin seed kernels

The data on chemical characteristics of pumpkin flesh and pumpkin seed kernels are shown in Table 8.

**Table 8:** Chemical characteristics of ripe pumpkin

| Characteristics              | Pumpkin Mean $\pm$ S.E | Pumpkin seed kernels Mean $\pm$ S.E |
|------------------------------|------------------------|-------------------------------------|
| Moisture (%)                 | $88 \pm 1.15$          | $5.2 \pm 0.0577$                    |
| Protein (%)                  | $4.08 \pm 0.154$       | $35.22 \pm 0.25$                    |
| Fat (%)                      | $0.46 \pm 0.029$       | $48.13 \pm 0.57$                    |
| $\beta$ -carotene (mg/100 g) | $15.27 \pm 0.577$      | $8.94 \pm 1.154$                    |
| Ascorbic acid (mg/100 g)     | $14.49 \pm 0.318$      | $14.60 \pm 0.11$                    |
| Pectin (%)                   | $1.018 \pm 0.003$      | N/D*                                |
| Fibre (%)                    | $0.62 \pm 0.011$       | $0.95 \pm 0.011$                    |
| Total soluble solids (°B)    | $8.3 \pm 0.05$         | $8 \pm 0.176$                       |
| Total sugars (%)             | $3.76 \pm 0.01$        | $1.25 \pm 0.005$                    |
| Reducing sugars (%)          | $1.83 \pm 0.01$        | $0.21 \pm 0.0145$                   |
| Ash (%)                      | $0.54 \pm 0.15$        | $4.55 \pm 0.04$                     |
| pH                           | $4.4 \pm 0.05$         | $6.73 \pm 0.05$                     |
| Acidity (%)                  | $0.064 \pm 0.001$      | $0.096 \pm 0.0037$                  |
| Mineral Elements (g/kg)      |                        |                                     |
| Calcium (Ca)                 | $0.038 \pm 0.0005$     | $0.0149 \pm 0.086$                  |
| Potassium (K)                | $0.789 \pm 0.16$       | $4.3 \pm 0.216$                     |
| Sodium (Na)                  | $0.007 \pm 0.0008$     | $0.061 \pm 0.0163$                  |
| Copper (Cu)                  | $0.152 \pm 0.0006$     | $0.950 \pm 0.0013$                  |
| Iron (Fe)                    | $2.2 \pm 0.787$        | $1.676 \pm 0.462$                   |
| Magnesium (Mg)               | $0.099 \pm 0.137$      | $2.385 \pm 0.122$                   |
| Manganese (Mn)               | $0.307 \pm 0.0244$     | $3.277 \pm 0.0523$                  |
| Selenium (Se)                | $0.071 \pm 0.021$      | $0.533 \pm 0.08$                    |

N/D\* = Not Determined

### Chemical characteristics of different flour/powder

The different flours (pumpkin powder, pumpkin seed kernel powder and wheat flour) used in the study for development of value added products were analyzed for different chemical characteristics and the data are depicted in Table 9.

**Table 9:** Chemical characteristics of different flours

| Characteristics              | Pumpkin powder Mean $\pm$ S.E | Defatted pumpkin seed powder Mean $\pm$ S.E | Wheat flour Mean $\pm$ S.E | CD <sub>0.05</sub> |
|------------------------------|-------------------------------|---|----------------------------|--------------------|
| Moisture (%)                 | $6.28 \pm 0.049$              | $5.1 \pm 0.05$                              | $10.6 \pm 0.088$           | 0.24               |
| Protein (%)                  | $6.12 \pm 0.101$              | $37.33 \pm 0.51$                            | $10.5 \pm 0.202$           | 0.50               |
| Fat (%)                      | $1.5 \pm 0.049$               | $2.12 \pm 0.031$                            | $2.1 \pm 0.0328$           | 0.14               |
| Fibre (%)                    | $2.96 \pm 0.002$              | $1.85 \pm 0.0002$                           | $0.046 \pm 0.0005$         | 0.03               |
| $\beta$ -carotene (mg/100 g) | $18.13 \pm 0.577$             | $10.96 \pm 1.54$                            | $1.89 \pm 0.577$           | 2.88               |

|                           |                |                |               |      |
|---------------------------|----------------|----------------|---------------|------|
| Ascorbic acid (mg/100 g)  | 10.27 ± 0.702  | 12.26 ± 0.145  | 3 ± 0.2886    | 1.50 |
| Total soluble solids (°B) | 50.4 ± 0.317   | 20.33 ± 0.11   | 3.7 ± 0.11    | 0.73 |
| Total sugars (%)          | 41.09 ± 0.297  | 3.19 ± 0.042   | 13.91 ± 0.032 | 0.61 |
| Reducing sugars (%)       | 21.48 ± 0.795  | 0.35 ± 0.008   | 2.03 ± 0.033  | 1.62 |
| pH                        | 6.04 ± 0.003   | 6.85 ± 0.005   | 5.03 ± 0.0577 | 0.12 |
| Acidity (%)               | 1.03 ± 0.011   | 0.351 ± 0.017  | 0.12 ± 0.0037 | 0.04 |
| Ash (%)                   | 4.61 ± 0.2577  | 4.21 ± 0.058   | 0.57 ± 0.136  | 0.54 |
| Yield of flour (%)        | 3.5            | 67.45          | N/D*          | N/D* |
| Mineral Elements (g/kg)   |                |                |               |      |
| Calcium (Ca)              | 0.438 ± 0.252  | 0.233 ± 0.0188 | 0.110 ± 0.010 | 0.04 |
| Potassium (K)             | 11.142 ± 0.142 | 5.967 ± 0.691  | 2.525 ± 0.123 | 0.04 |
| Sodium (Na)               | 0.0752 ± 0.007 | 0.077 ± 0.014  | 0.060 ± 0.010 | 1.46 |
| Copper (Cu)               | 1.706 ± 0.1011 | 0.309 ± 0.005  | Nil           | 0.03 |
| Iron (Fe)                 | 10.242 ± 0.27  | 11.197 ± 0.123 | 5.737 ± 0.02  | 0.62 |
| Magnesium (Mg)            | 1.163 ± 0.413  | 3.270 ± 0.174  | 0.736 ± 0.315 | 1.12 |
| Manganese (Mn)            | 2.925 ± 0.023  | 2.983 ± 0.415  | 2.771 ± 0.101 | NS   |
| Selenium (Se)             | 0.559 ± 0.053  | 1.111 ± 0.134  | 0.496 ± 0.185 | 0.48 |

N/D\* = Not Determined

### Development, standardization and nutritional evaluation of value added products from pumpkin and its seed Weaning mix supplemented with pumpkin powder

#### Development and standardization of recipe for preparation of weaning mix

Four different recipes were prepared by using various proportions of sugar and milk powder, while wheat flour was kept as constant (Table 1). The weaning mixes were subjected to sensory evaluation by a panel of ten judges. The results pertaining to the sensory evaluation of weaning mixes prepared from four recipes are presented in Table 10. The data showed that significantly higher score of 8.61 was awarded to Recipe III followed by 7.61 (Recipe II), 7.36 (Recipe I) and 7.33 (Recipe IV). However, the scores for all the quality parameters of different recipes were well above the acceptable limits but as significantly higher scores were received by Recipe III, therefore, was selected for further studies.

**Standardization of recipe for preparation of weaning mix supplemented with pumpkin powder:** Six different weaning mixes were developed by replacing wheat flour with pumpkin

flour in different proportions (Table 2). Weaning mixes were subjected to a panel of ten judges for sensory evaluation for the selection of treatments for further studies. The data of sensory evaluation (Table 11) showed that the score for overall acceptability was highest for treatment T<sub>3</sub> and T<sub>4</sub> which attained an identical score of 7.88. T<sub>1</sub> and T<sub>2</sub> were found to be at par, while T<sub>5</sub> and T<sub>6</sub> received the lowest scores. Highly significant differences were observed among the treatments as far as various sensory parameters are concerned. Based upon sensory evaluation four treatments (T<sub>1</sub>, T<sub>2</sub>, T<sub>3</sub>, T<sub>4</sub>) which received the highest scores were evaluated for nutritional composition.

**Table 10:** Sensory evaluation for development and standardization of recipe for preparation of weaning mix (on 9 point hedonic scale)

| Recipe             | Colour | Texture | Flavour | Taste | Overall acceptability |
|--------------------|--------|---------|---------|-------|-----------------------|
| Recipe 1           | 7.30   | 7.58    | 7.31    | 7.25  | 7.36                  |
| Recipe 2           | 7.80   | 7.60    | 7.62    | 7.43  | 7.61                  |
| Recipe 3           | 8.15   | 8.70    | 8.80    | 8.80  | 8.61                  |
| Recipe 4           | 7.68   | 7.56    | 6.90    | 7.40  | 7.33                  |
| CD <sub>0.05</sub> | 0.54   | 0.45    | 0.46    | 0.59  | 0.36                  |

**Table 11:** Sensory evaluation of standardization of recipe for preparation of weaning mix supplemented with pumpkin flour (on 9 point hedonic scale)

| Treatments         | Colour | Texture | Flavour | Taste | Overall acceptability |
|--------------------|--------|---------|---------|-------|-----------------------|
| T <sub>1</sub>     | 7.59   | 7.56    | 7.86    | 8.01  | 7.78                  |
| T <sub>2</sub>     | 7.72   | 7.76    | 7.65    | 7.96  | 7.85                  |
| T <sub>3</sub>     | 7.87   | 7.66    | 7.85    | 8.11  | 7.88                  |
| T <sub>4</sub>     | 8.07   | 7.79    | 7.62    | 7.97  | 7.88                  |
| T <sub>5</sub>     | 6.90   | 6.99    | 6.60    | 7.19  | 6.94                  |
| T <sub>6</sub>     | 7.08   | 6.71    | 6.68    | 6.85  | 6.84                  |
| CD <sub>0.05</sub> | 0.61   | 0.52    | 0.53    | 0.63  | 0.40                  |

### Nutritional composition of selected weaning mix supplemented with pumpkin powder

The nutritional composition of best weaning mix supplemented with pumpkin powder based on sensory evaluation is presented in Table 12.

**Table 12:** Nutritional composition of weaning mix supplemented with pumpkin powder

| Nutritional parameters    | Treatments     |                |                |                |
|---------------------------|----------------|----------------|----------------|----------------|
|                           | T <sub>1</sub> | T <sub>2</sub> | T <sub>3</sub> | T <sub>4</sub> |
| Moisture (%)              | 4.06           | 4.13           | 4.19           | 4.24           |
| Crude protein (%)         | 11.26          | 11.68          | 12.08          | 12.57          |
| Crude fat (%)             | 8.22           | 8.26           | 8.30           | 8.36           |
| β-carotene (mg/100 g)     | 4.51           | 5.22           | 6.90           | 8.06           |
| Crude fiber (%)           | 0.07           | 0.36           | 0.62           | 0.93           |
| Total soluble solids (°B) | 25.30          | 27.40          | 28.57          | 29.90          |
| Total sugars (%)          | 13.16          | 13.72          | 14.22          | 15.97          |

|                                  |       |       |       |       |
|----------------------------------|-------|-------|-------|-------|
| Reducing sugars (%)              | 7.13  | 7.99  | 8.25  | 8.88  |
| Ash (%)                          | 1.84  | 1.90  | 1.93  | 1.97  |
| Water activity (a <sub>w</sub> ) | 0.128 | 0.154 | 0.202 | 0.207 |

|                |   |                                       |
|----------------|---|---------------------------------------|
| T <sub>1</sub> | = | 100% Wheat flour                      |
| T <sub>2</sub> | = | 90:10(Wheat flour : Pumpkin powder)   |
| T <sub>3</sub> | = | 80: 20 (Wheat flour: Pumpkin powder ) |
| T <sub>4</sub> | = | 70:30 (Wheat flour: Pumpkin powder )  |

### Weaning mix supplemented with pumpkin seed kernel powder

**Standardization of recipe for preparation of weaning mix supplemented with pumpkin seed flour:** The weaning mixes of six different treatments were subjected to a panel of ten judges for sensory evaluation and the data is presented in Table 13. The results indicated that the highest mean score was awarded to treatment T<sub>4</sub> (8.00) followed by T<sub>1</sub> (7.99), T<sub>3</sub> (7.96), T<sub>2</sub> (7.95), T<sub>5</sub> (6.73) and T<sub>6</sub> (6.66) for overall acceptability. Though, significant differences were observed in all the treatments for various parameters, yet T<sub>1</sub> and T<sub>4</sub> were found to be at par for overall acceptability. On the basis of result of sensory parameters, the treatments (T<sub>1</sub>, T<sub>2</sub>, T<sub>3</sub>, T<sub>4</sub>), which received the higher scores were selected for nutritional studies.

**Table 13:** Sensory evaluation of standardization of recipe for preparation of weaning mix supplemented with pumpkin seed flour (on 9 point hedonic scale)

| Treatments         | Colour | Texture | Flavour | Taste | Overall acceptability |
|--------------------|--------|---------|---------|-------|-----------------------|
| T <sub>1</sub>     | 7.94   | 7.95    | 7.92    | 8.15  | 7.99                  |
| T <sub>2</sub>     | 7.80   | 7.73    | 8.18    | 8.08  | 7.95                  |
| T <sub>3</sub>     | 7.84   | 7.80    | 7.97    | 8.22  | 7.96                  |
| T <sub>4</sub>     | 8.16   | 7.79    | 7.89    | 7.98  | 8.00                  |
| T <sub>5</sub>     | 6.72   | 7.00    | 6.50    | 6.70  | 6.73                  |
| T <sub>6</sub>     | 6.50   | 6.75    | 6.48    | 6.94  | 6.66                  |
| CD <sub>0.05</sub> | 0.52   | 0.47    | 0.46    | 0.52  | 0.37                  |

### Nutritional composition of selected weaning mix supplemented with pumpkin seed kernel powder

The nutritional composition of best weaning mix supplemented with pumpkin seed kernel powder based on sensory evaluation is presented in Table 14.

**Table 14:** Nutritional composition of weaning mix supplemented with pumpkin seed kernel powder

| Nutritional parameters           | Treatments     |   |                |                |
|----------------------------------|----------------|---|----------------|----------------|
|                                  | T <sub>1</sub> | T <sub>2</sub>                                    | T <sub>3</sub> | T <sub>4</sub> |
| Moisture (%)                     | 4.05           | 4.09  | 4.12           | 4.17           |
| Crude protein (%)                | 11.26          | 13.88   | 15.58          | 17.07          |
| Crude fat (%)                    | 8.22           | 8.32  | 8.37           | 8.43           |
| β-carotene (mg/100 g)            | 4.51           | 5.03  | 5.77           | 6.39           |
| Crude fiber (%)                  | 0.07           | 0.23  | 0.43           | 0.61           |
| Total soluble solids (°B)        | 25.30          | 25.80   | 26.40          | 26.90          |
| Total sugars (%)                 | 13.16          | 13.42   | 13.93          | 14.27          |
| Reducing sugars (%)              | 7.13           | 7.39  | 7.95           | 8.34           |
| Ash (%)                          | 1.84           | 1.86  | 1.89           | 1.92           |
| Water activity (a <sub>w</sub> ) | 0.128          | 0.144   | 0.177          | 0.188          |
| T <sub>1</sub>                   | =              | 100% Wheat flour                                  |                |                |
| T <sub>2</sub>                   | =              | 90:10(Wheat flour : Pumpkin seed kernel powder)   |                |                |
| T <sub>3</sub>                   | =              | 80: 20 (Wheat flour: Pumpkin seed kernel powder ) |                |                |
| T <sub>4</sub>                   | =              | 70:30 (Wheat flour: Pumpkin seed kernel powder )  |                |                |

### Cookies supplemented with pumpkin powder

**Development and standardization of recipe for preparation of cookies:** The cookies of four different recipes were prepared by using various proportions of sugar, salt, fat, while wheat flour, glucose solution, distilled water were kept constant (Table 4). The cookies were subjected to a panel of ten judges for sensory evaluation and the results are depicted

in Table 15. The data clearly reflected that significantly higher score of 8.01 was awarded to Recipe III followed by 7.15 (Recipe I), 7.07 (Recipe II) and 7.01 (Recipe IV) for overall acceptability. However, the score for all the sensory parameters of different recipes were well above the acceptable limits but significantly higher scores were received by Recipe III, therefore, was selected as base for further studies.

**Table 15:** Sensory evaluation of development and standardization of recipe for preparation of cookies (on 9 point hedonic scale)

| Recipe             | Colour | Texture | Flavour | Taste | Overall acceptability |
|--------------------|--------|---------|---------|-------|-----------------------|
| Recipe 1           | 7.25   | 7.05    | 7.00    | 7.32  | 7.15                  |
| Recipe 2           | 7.00   | 7.00    | 7.00    | 7.28  | 7.07                  |
| Recipe 3           | 7.79   | 8.10    | 7.80    | 8.38  | 8.01                  |
| Recipe 4           | 7.50   | 6.65    | 6.72    | 7.16  | 7.01                  |
| CD <sub>0.05</sub> | 0.42   | 0.58    | 0.58    | 0.46  | 0.34                  |

### Standardization of recipe for preparation of cookies supplemented with pumpkin powder

The cookies of six different treatments were prepared by replacing wheat flour with pumpkin flour in various proportions (Table 5). The products were subjected to sensory evaluation by a panel of ten judges for the selection of treatments for further studies.

The data (Table 16) pertaining to sensory evaluation of cookies clearly indicate that the highest mean score was awarded to treatment T<sub>1</sub> (8.41) followed by T<sub>4</sub> (7.99), T<sub>2</sub> (7.98), T<sub>3</sub> (7.87), T<sub>5</sub> (7.12) and T<sub>6</sub> (6.84) for overall acceptability. Though, significant differences were observed in all the treatments, yet T<sub>2</sub> and T<sub>4</sub> were found to be at par. On

the basis of results of sensory parameters, the treatments (T<sub>1</sub>, T<sub>2</sub>, T<sub>3</sub>, T<sub>4</sub>) which received the higher scores were selected for nutritional studies.

**Table 16:** Sensory evaluation standardization of recipe for preparation of cookies supplemented with pumpkin flour

| Treatments         | Colour | Texture | Flavour | Taste | Overall acceptability |
|--------------------|--------|---------|---------|-------|-----------------------|
| T <sub>1</sub>     | 8.22   | 8.40    | 8.40    | 8.64  | 8.41                  |
| T <sub>2</sub>     | 7.95   | 7.85    | 7.90    | 8.25  | 7.98                  |
| T <sub>3</sub>     | 7.90   | 7.79    | 7.75    | 8.05  | 7.87                  |
| T <sub>4</sub>     | 7.80   | 7.94    | 8.01    | 8.22  | 7.99                  |
| T <sub>5</sub>     | 7.20   | 7.20    | 7.10    | 7.00  | 7.12                  |
| T <sub>6</sub>     | 6.40   | 6.83    | 6.72    | 6.92  | 6.84                  |
| CD <sub>0.05</sub> | 0.45   | 0.49    | 0.53    | 0.52  | 0.36                  |

### Nutritional composition of selected cookies supplemented with pumpkin powder

The nutritional composition of best weaning mix supplemented with pumpkin seed kernel powder based on sensory evaluation is presented in Table 17.

**Table 17:** Physical characteristic and Nutritional composition of cookies supplemented with pumpkin powder

| Physical/Nutritional parameters      | Treatments     |                                      |                |                |
|--------------------------------------|----------------|--------------------------------------|----------------|----------------|
|                                      | T <sub>1</sub> | T <sub>2</sub>                       | T <sub>3</sub> | T <sub>4</sub> |
| Weight (g)                           | 10.23          | 10.56                                | 10.61          | 10.86          |
| Width (cm)                           | 3.29           | 3.12                                 | 3.34           | 3.36           |
| Thickness (cm)                       | 1.11           | 1.14                                 | 1.18           | 1.21           |
| Spread ratio                         | 0.338          | 0.345                                | 0.352          | 0.361          |
| Moisture (%)                         | 2.14           | 2.15                                 | 2.17           | 2.17           |
| Crude protein (%)                    | 8.47           | 9.12                                 | 9.60           | 10.14          |
| Crude fat (%)                        | 17.53          | 18.01                                | 18.06          | 18.11          |
| $\beta$ -carotene (mg/100 g)         | 3.22           | 4.13                                 | 4.39           | 4.88           |
| Crude fiber (%)                      | 0.037          | 0.321                                | 0.592          | 0.904          |
| Total soluble solids ( $^{\circ}$ B) | 14.40          | 16.30                                | 17.30          | 18.50          |
| Total sugars (%)                     | 10.42          | 11.23                                | 11.86          | 12.37          |
| Reducing sugars (%)                  | 0.87           | 1.17                                 | 1.40           | 1.78           |
| Ash (%)                              | 0.65           | 0.72                                 | 0.75           | 0.78           |
| Water activity (a <sub>w</sub> )     | 0.354          | 0.370                                | 0.376          | 0.382          |
| T <sub>1</sub>                       | =              | 100% Wheat flour                     |                |                |
| T <sub>2</sub>                       | =              | 90:10(Wheat flour : Pumpkin powder)  |                |                |
| T <sub>3</sub>                       | =              | 80: 20 (Wheat flour: Pumpkin powder) |                |                |
| T <sub>4</sub>                       | =              | 70:30 (Wheat flour: Pumpkin powder)  |                |                |

**Cookies supplemented with pumpkin seed kernel powder**  
**Standardization of recipe for preparation of cookies supplemented with pumpkin seed flour:** The cookies of six different treatments were prepared by replacing wheat flour with pumpkin seed flour in various proportions. Then, these were subjected to sensory evaluation by a panel of ten judges for selection of treatments for further studies and the data pertaining to the same are presented in Table 18. The data reveal that the highest mean score was awarded to treatment T<sub>1</sub> (8.32) followed by T<sub>3</sub> (8.10), T<sub>2</sub> (8.04), T<sub>4</sub> (7.95), T<sub>5</sub> (6.73) and T<sub>6</sub> (6.38) for overall acceptability. Significant differences were observed in all the treatments for all the sensory parameters. On the basis of results of sensory evaluation, the treatments (T<sub>1</sub>, T<sub>2</sub>, T<sub>3</sub>, T<sub>4</sub>) which received the higher scores were selected for nutritional studies.

**Table 18:** Sensory evaluation of standardization recipe for preparation of cookies supplemented with pumpkin seed flour (on 9 point hedonic scale)

| Treatments         | Colour | Texture | Flavour | Taste | Overall acceptability |
|--------------------|--------|---------|---------|-------|-----------------------|
| T <sub>1</sub>     | 7.95   | 8.10    | 8.45    | 8.75  | 8.32                  |
| T <sub>2</sub>     | 7.85   | 7.95    | 8.10    | 8.33  | 8.04                  |
| T <sub>3</sub>     | 7.98   | 8.13    | 7.90    | 8.40  | 8.10                  |
| T <sub>4</sub>     | 7.75   | 7.90    | 7.94    | 8.23  | 7.95                  |
| T <sub>5</sub>     | 6.80   | 6.93    | 6.68    | 6.50  | 6.73                  |
| T <sub>6</sub>     | 6.39   | 6.57    | 6.61    | 5.94  | 6.38                  |
| CD <sub>0.05</sub> | 0.53   | 0.54    | 0.48    | 0.39  | 0.29                  |

### Nutritional composition of selected cookies supplemented with pumpkin seed kernel powder

The nutritional composition of best weaning mix supplemented with pumpkin seed kernel powder based on sensory evaluation is presented in Table 19.

**Table 19:** Physical characteristic and Nutritional composition of cookies supplemented with pumpkin seed kernel powder

| Physical/Nutritional parameters | Treatments     |                |                |                |
|---------------------------------|----------------|----------------|----------------|----------------|
|                                 | T <sub>1</sub> | T <sub>2</sub> | T <sub>3</sub> | T <sub>4</sub> |
| Weight (g)                      | 10.231         | 10.523         | 10.545         | 10.572         |
| Width (cm)                      | 3.291          | 3.262          | 3.242          | 3.222          |
| Thickness (cm)                  | 1.102          | 1.092          | 1.062          | 1.042          |
| Spread ratio                    | 0.331          | 0.328          | 0.321          | 0.313          |
| Moisture (%)                    | 2.14           | 2.15           | 2.16           | 2.17           |
| Crude protein (%)               | 8.47           | 10.12          | 11.36          | 12.56          |

|                                      |       |   |       |       |
|--------------------------------------|-------|---|-------|-------|
| Crude fat (%)                        | 17.53 | 18.02   | 18.05 | 18.11 |
| $\beta$ -carotene (mg/100 g)         | 3.22  | 3.58  | 3.66  | 3.78  |
| Crude fiber (%)                      | 0.037 | 0.307   | 0.552 | 0.874 |
| Total soluble solids ( $^{\circ}$ B) | 14.40 | 14.90   | 15.40 | 16.20 |
| Total sugars (%)                     | 10.41 | 10.67   | 11.56 | 12.26 |
| Reducing sugars (%)                  | 0.87  | 0.90  | 0.93  | 0.95  |
| Ash (%)                              | 0.65  | 0.67  | 0.69  | 0.71  |
| Water activity ( $a_w$ )             | 0.354 | 0.365   | 0.372 | 0.379 |
| T <sub>1</sub>                       | =     | 100% Wheat flour                                  |       |       |
| T <sub>2</sub>                       | =     | 90:10(Wheat flour : Pumpkin seed kernel powder )  |       |       |
| T <sub>3</sub>                       | =     | 80: 20 (Wheat flour: Pumpkin seed kernel powder ) |       |       |
| T <sub>4</sub>                       | =     | 70:30 (Wheat flour: Pumpkin seed kernel powder )  |       |       |

## Conclusion

From the study conducted it is clear that pumpkin fruit which otherwise processed to a limited extent can be successfully utilized for supplementation of common man food such as weaning mix for infants and cookies as snacks for all age groups. The investigation revealed that the supplementation of both pumpkin flour and pumpkin seed flour enhanced the nutritional value of weaning mixes and cookies. On the basis of sensory evaluation supplementation up to a level of 90:10 and 80:20 was found to be the best for weaning mixes in which wheat flour was replaced by pumpkin flour and pumpkin seed flour, respectively. While for cookies the best ratio was found to be 80:20 in both the cases *i.e.* supplementation of wheat flour with pumpkin flour and pumpkin seed flour. Henceforth, it can be said that this nutritious crop can be successfully exploited for the preparation of good quality and nutritionally enriched processed products such as weaning mixes and cookies.

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