Effect of dehydrated pumpkin powder and seeds on physicochemical, nutritional and sensory properties of weaning flakes

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Introduction

Sri Lankan economy is primarily based on agriculture. Pumpkin production of Sri Lanka was in the range of 15000-25000 kg in 2017. Annual loss of pumpkin during post-harvest operation represents as 30–40% [1]. Pumpkin (*Cucurbita maxima*) which belongs to *Cucurbitaceae* family are grown widely in tropical and sub-tropical regions where they are rich with β carotene, vitamins, minerals and fibres. Pumpkin seeds have great nutritional profile that benefits variety of human health factors. Protein, vitamins, fat and minerals are high in seeds which help to reduce the risk of chronic diseases and heart diseases. Because of their high moisture content, fresh pumpkins are very susceptible to attack by pathogenic microorganisms during the period between harvest and consumption [2]. Therefore, modified value-added products can be a solution to post-harvest loss of pumpkin.

Malnutrition has become one of the major health problems in Sri Lanka which lowers the resistance to disease of children. For instance, Sri Lankan Demographic and Health Survey highlighted that 18% of Sri Lankan children are stunt, 15% are wasted, 22% are underweight [3]. Introducing weaning flakes as a supplementary food prepared from regular weaning mixtures incorporated with pumpkin flour and pumpkin seeds flour can be consume with milk in order to protect the nutritional values as well as to feed infants who are consuming liquid or semisolid food. Weaning is a period of transition for infants which the diet changes in terms of consistency and source. From a milk-based diet, the child is gradually introduced to semi-solid foods [4].

According to commercially available cereal flake products, their nutrition composition has been shown with the product as 7.90 g/100 g of protein, 13.94 g/100 g of dietary fiber, 10.9 g/100 g of crude-fat, 76.40 g/100 g of carbohydrates and 216.11 µg /100 g vitamin A. The main objective of this study was to determine the effect of Pumpkin flour (*Cucurbita maxima*) and pumpkin seeds flour on physicochemical, nutritional and sensory properties of weaning flakes. Other specific objectives are to enhance the nutrient uptake by commercializing this product with high nutritional profile to children in Sri Lanka and to reduce post-harvest loss of pumpkin in Sri Lanka.

Methodology

Preparation of weaning flour. Hybrid variety of pumpkin (*Cucurbita maxima*), pumpkin seeds, Rice (*Oryza sativa*), maize (*Zea mays*) and green gram (*Vigna radiata*) were collected from the local market. Those raw materials were washed with distilled water and subjected to pretreatments such as blanching (60°C for 4mins) continued with drying at 55-60°C by oven dry method. Dried ingredients were grinded and sieved through 0.25 mesh to obtain flour separately [5].

Preparation of weaning formulations. Formulations were prepared by combining regular flour types (rice, maize and green gram) and three ratios of pumpkin flour (10, 20, 30%). Three variations were prepared with incorporating pumpkin seed flour while another three were prepared without pumpkin seeds flour and obtained six weaning mixture samples [5].

Preparation of Cereal flakes. Sugar syrup was prepared by adding 40 g sugar, 10 g of kithul treacle and 30 g of water heated up to 80 °C until it thickens. Later that mixture was added to each sample and kneaded until it become a soft dough. Then the dough was attenuate to a thin layer and cut into pieces. After that the pieces were spread on a tray and baked in an oven at 120 °C for 40 minutes. Finally, the samples were cooled to room temperature and stored in airtight containers for further analysis.

Proximate analysis, phytochemical analysis, microbial evaluations, sensory attribute evaluation of the selected final products were analysed during the storage of seven days.

Results and Discussion

Microbial analysis was done with total viable plate count and yeast and mould count where both (S2 and S5) samples have recorded colony forming units per gram which are less than stipulated limits by WHO and FAO regards to flaked cereal for infant and children. As per low colony forming units per gram less than stipulated limits during the shelf life of 7 days for the product, it is recommended to consume until 07 days after preparation.

Following with microbial analysis sensory, phytochemical and proximate analysis were done. Results of the sensory analysis of six samples from each formulation were estimated according to 9-point hedonic scale by using 30 untrained panellists. With Minitab 17 Statistical software and Freidman test sensory properties were evaluated (Figure 1). From ranking test, one sample from each formulation was selected as the highest preference: 20% of pumpkin flour with seed flour (S2) and 20% of pumpkin flour without seed flour (S5). Selected two samples were subjected to physicochemical and nutritional analysis (Table 1).

According to results, there is a significant difference ($p<0.05$) between crude fiber, crude fat, moisture, ash, protein and calorific value of sample S2 and S5 while there is no significant difference in Antioxidant activity, β-carotene content, carbohydrate content and phenolic content of two samples ($p<0.05$).

Moisture content of sample S5 shows higher value (6.1%) than sample S2 (4.6%). Moisture content influences physical, chemical properties and shelf life of food product. Fat content of sample S2 (7.9%) is higher than sample S5 (4.6%). As pumpkin seeds contain high amount of fat content there is a possibility of increasing fat content in S2. Commercially available product contains 10.9 g of crude fat which is a quite high value.

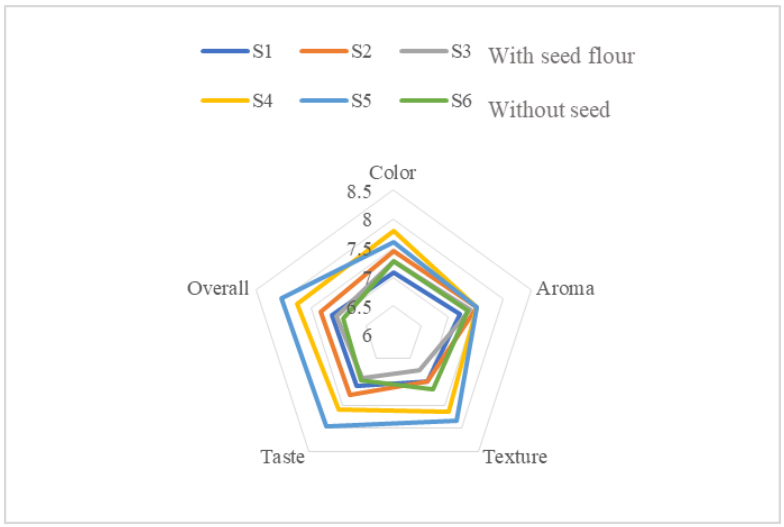

Figure 1. Radar diagram for sensory evaluation of samples

Table 1. Comparison of proximate analysis and phytochemical properties of two developed, preferred samples and commercially available product

Parameter	Sample with seed flour (S2)	Sample without seed flour (S5)	Commercially available cereal flakes (per 100g)
Moisture (%)	4.6 ± 0.1	6.05 ± 0.1	-
Crude fat (%)	7.9 ± 2.8	4.63 ± 2.4	10.90 g
Ash (%)	3.5 ± 0.1	4.15 ± 0.2	-
Crude fiber (%)	8.1 ± 0.4	7.17 ± 0.2	13.94 g
Protein (%)	8.4 ± 0.5	10.5 ± 0.2	7.90 g
Carbohydrate (%)	67.4 ± 0.1	67.5 ± 0.1	76.40 g
Antioxidant capacity (mg GAE/100 g)	23.5 ± 10.8	22.2 ± 9.4	-
Total phenolic content (%)	6.1 ± 0.1	5.73 ± 0.3	-
β-carotene content (µg/100 g)	14400 ± 0.2	14500 ± 0.2	216.11 µg
Calorific value (Kcal/ kg)	361.5 ± 0.1	339.3 ± 0.3	130 kcal /kg

Mean value from triplicate (n=3), Mean ± standard deviation.

Ash content is a significant metric that can be used to determine minerals in a product and to inhibit microbial growth. Ash content of sample S2 is 3.5% and 4.1% in S5. As a vegetable, pumpkin contains higher fiber content than other grains. Crude fiber composed with digestible (dietary) and non-digestible fiber. Dietary fiber is important to keep the digestive system of infants healthy and to reduce diabetes. Results predict fiber content of sample S2 is 8.12% which was a higher value than sample S5 (7.2%). However, the dietary fiber level of commercially available cereal flakes has been observed as 13.94 g which is a higher amount than the prepared products.

Protein content obtained as 8.4% in S2 and 10.5% in S5. Commercially available product has 7.90 g of protein content. Protein high diet for infants increase bone growth. Also, keratin protein helps to influence hair and nail growth. Carbohydrate content of samples are 67.4% in S2 and 67.5% in S5 and 76.4 g in commercial product. Carbohydrates converted into glucose, which provides the energy to growth of the body of infants. Also, the brain consumes more glucose during the growth which is more significant. Calorific value indicates the total amount of energy an infant could generate during metabolism. Antioxidant activity of cereal flakes helps to scavenge and neutralize oxidation, which lowers chronic and cardiovascular diseases. Antioxidant activity of sample S2 resulted as 23.50%, while it is 22.2% in sample S5.

β-carotene content in S2 is 14400 µg /100 g and in S5, 14500 µg /100 g. β-carotene or pro-vitamin A is a precursor to Vit.A in the food product which is an essential vitamin for cellular health and vision of infants. Since Vit.A deficiency is a main factor for malnutrition, β-carotene content has a higher possibility to reduce malnutrition. Also, phenolic content of a food product helps to reduce the risk of developing several diseases due to their antioxidant power among other factors. Pumpkin seeds contain individual phenolics tyrosol, vanillic acid, vanillin, luteolin etc. Highest value of phenolic content was found in sample S2 (6.1%) which is produced with incorporation of pumpkin seed flour.

Conclusion

Fat content of sample with seed flour (S2) is greater, implying that pumpkin seeds might have influenced the fat content of final product. Pumpkin has a high β-carotene content thus helps to influence the β-carotene content of final product. Since β-carotene converts into vitamin A there is a possibility to increases Vit A uptake by allowing infants to consume S2 and S5 products which have nearly 67 times higher β-carotene content than commercially available cereal flakes in order to minimize Vitamin A deficiency disorder among infants and children. Once you introduce these products with higher protein content during weaning, regulates growth development of infants which affect their life stages physically.

Weaning flakes also can be consumed as a breakfast cereal which is also suitable for children as an energy dense product with 361.5 ± 0.1 kcal/100 g of calorific value.

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