Evaluation of Nutritional and Sensory Quality Characteristics of Pumpkin Pies

Authors

Monirul Islam[1], Jakia Sultana Jothi[2], Md. Rowshon Habib[3], Abdullah Iqbal[3*]

[1]Rural Development Academy (RDA), Bogra, Bangladesh
[2]Department of Food Processing and Engineering, Chittagong Veterinary and Animal Science University (CVASU), Chittagong-4225, Bangladesh
[3]Department of Food Technology & Rural Industries, Bangladesh Agricultural University, Mymensingh-2202, Bangladesh
*Corresponding Author Email: *iqbal21155@bau.edu.bd*

Abstract

The present study was conducted to develop and investigate pumpkin pies to assess its prospect in marketability and study their shelf-life. Fresh pumpkin was used to produce pumpkin puree. The pumpkin pies were prepared by incorporating different levels of pumpkin puree, wheat flour, sugar, milk and egg. The pumpkin pies were investigated for their nutritional and sensory properties. The sensory results showed that overall acceptability, flavor, texture and color scores differed significantly (p<0.05). The pumpkin pies containing pumpkin puree (40%), wheat flour (12%), sugar (20%), milk powder (15%) and egg (13%) was the favorite sample of the sensory evaluation with the highest overall acceptability among all types of pumpkin pies samples. The nutritional compositions of the best sample were moisture 38.05%, ash 1.15%, protein 10.24%, fat 7.33% and total carbohydrate 43.24% which energy value was 279.88kcal/100g.

Keywords: *Pampkin pies, nutritional composition, organoleptic attributes and storage studies*

1. Introduction

Consumption of fruits and vegetables has been increased rapidly by people due to awareness regarding their health benefits. However, the perishable nature of fruits and vegetables and over dependency of human on fewer plant species created extreme pressure on the fresh produce industries to supply bulk of fresh fruits and vegetables to the burgeoning population. Such increased demand can only be fulfilled by either using the technology to prevent the deterioration of commodity after harvest and/or to introduce underutilized fruits or vegetables for their commercial utilization [1].

Pumpkin is a member of the Cucurbitaceous family and has received considerable attention in recent years because of the nutritional and health protective values such as anti-tumor, anti-bacterial, anti-hypertensive [2]. In Bangladesh pumpkin is cultivated in about 14,000 ha of land with the production of 20-25 m tons/ha per year [3]. About 90% of the total pumpkin is produced within six months (January-June) only. For the lack of proper processing and preservation knowledge, the farmers have to sell all their produces with lower price at the harvesting season. So, they do not get economic benefit from vegetable production. If proper processing and preservation technology is applied to preserve this vegetable and it is ensured

to supply this vegetable throughout the year, farmers can be benefitted financially as well as the nation may get rid from malnutrition [4].

Pumpkin pulp has large amounts of carotenoids, which are pigments that derive from isoprene and that give flowers, leaves, and fruits a coloration that ranges from yellow to red [5],[6]. Besides the pro-vitamin A activity of some carotenoids, such as b-carotene, b-cryptoxanthin and a-carotene, studies have also indicated that consumption of carotenoids lowers the risk of degenerative and cardiovascular diseases, cataracts, macular degeneration as well as certain types of carcinomas [6],[7].

With increasing urbanization, rise in middle class purchasing power, change in food habits, there is increasing demand for factory-made cakes, biscuits, bread, pickles, chutney, squash, beverages, jam-jelly, juice, candy, pie etc. in the domestic market as well as in foreign markets [8]. Various products has been processed and preserved from Pumpkin. But so far it is known to the authors, no research has been carried out for the preparation and quality evaluation of pie from pumpkin. Therefore, the study has been taken with the following objectives: i) to develop pies from pumpkin puree; ii) to investigate nutritive value and sensory properties for consumer acceptance of the pumpkin pies and iii) to observe the shelf-life of the developed pumpkin pies.

2. Materials and Methods

The study was conducted in the laboratory of the Department of Food Technology & Rural Industries, Bangladesh Agricultural University, Mymensingh-2202, Bangladesh. Fresh fully mature pumpkin, sugar, spices (ground cinnamon, ground cloves and ground ginger), vanilla extract, eggs, milk powder, oil, wheat flour were collected from the local market were used in the study. Other ingredients were used from laboratory stocks. All of them were at analytical grade (purity $\geq$ 98%).

2.1 Preparation of pumpkin puree

Firstly, fresh fully mature pumpkins were taken and washed thoroughly. The unwanted portions including the seeds and skin were removed after slicing. Then cut into mall pieces. After boiling at 140^0C for 20-30 minutes, the pulp was obtained from pumpkin. Finally, pulp was blended to obtain the pumpkin puree and stored in refrigerator temperature. The puree was then used for preparation of pumpkin pie.
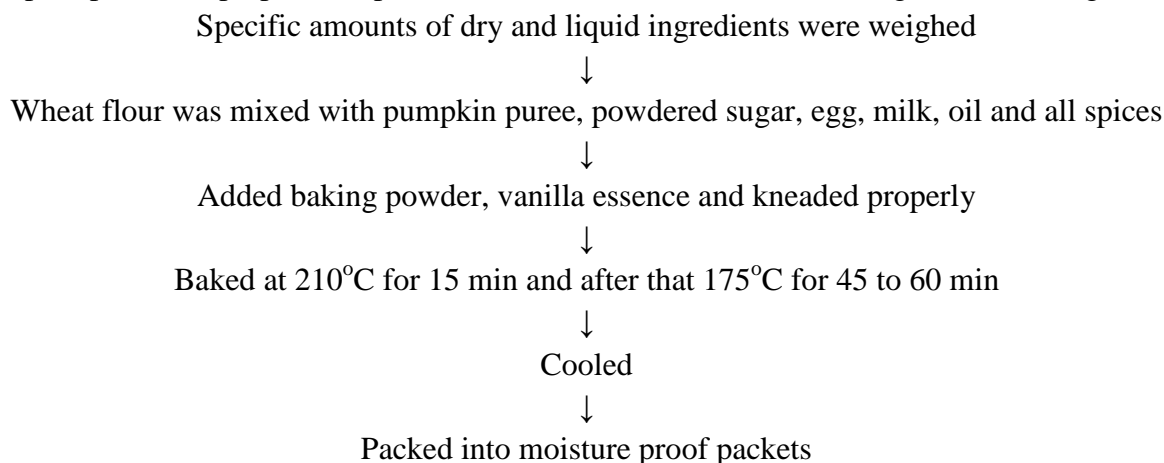
2.2 Preparation of pumpkin pies

The formulations used for preparation of pumpkin pies are outlined in Table 1.

Table 1: Formulations of pumpkin pies

Ingredients	Sample code of pumpkin pies		
	P_1	P_2	P_3
Pumpkin puree (g)	40	50	60
Wheat flour (g)	12	10	8
Sugar (g)	20	15	10
Milk powder (g)	15	13	12
Egg (g)	13	12	10
Oil (ml)	5	5	5
Baking Powder (g)	0.5	0.5	0.5
Cinnamon (g)	0.4	0.4	0.4
Cloves (g)	0.2	0.2	0.2
Ginger (g)	0.2	0.2	0.2
Vanilla flavor (ml)	2	2	2

The pumpkin pies were prepared as per the method described in the following flowchart (Figure 1).

Specific amounts of dry and liquid ingredients were weighed

↓

Wheat flour was mixed with pumpkin puree, powdered sugar, egg, milk, oil and all spices

↓

Added baking powder, vanilla essence and kneaded properly

↓

Baked at 210°C for 15 min and after that 175°C for 45 to 60 min

↓

Cooled

↓

Packed into moisture proof packets

Figure 1: Flow diagram for the preparation of pumpkin pies

2.3 Nutritional analysis

The fresh pumpkin and pumpkin pies were analyzed for their moisture, ash, protein and fat contents by appropriate AOAC methods [9]. The total carbohydrate content was determined by difference [10]. All the determinations were done in triplicate and the results were expressed as average value. Energy value was calculated using modified Atwater general factors by multiplying the portions of protein, fat and carbohydrate by their physiological fuel value of 4.0, 9.0 and 4.0 Kcal/g respectively and taking the sum of the products [11].

2.4 Sensory evaluation

The consumer's acceptability of developed pumpkin pies were evaluated through a taste testing panel of 30 testers. All the panelists were briefed before evaluation. Sensory attributes like color, texture, flavor and overall acceptability for all samples were assessed using nine point hedonic scales. Hedonic scale was in the following sequence: 9 = Like extremely, 8 = Like very much, 7 = Like moderately, 6 = Like slightly, 5 = Neither like nor dislike, 4 = Dislike slightly, 3 = Dislike moderately, 2= Dislike very much and 1= Dislike extremely [12]. The samples were coded with letters and served to the panelists at random to guard against any bias.

2.5 Statistical analysis

The data obtained from the experiments were statistically analyzed for analysis of variance (ANOVA) and consequently Duncan's Multiple Range Test (DMRT) was used to determine significant difference among the various samples in triplicate. Data were analyzed using the software, IBM SPSS Statistics, version 20 at the 0.05 level [13].

2.6 Storage studies

The pumpkin pies samples were packed in aluminum laminate polyethylene pouches and stored at ambient temperature (25-30^{0}C) for a period of 21 days. The stored pies were analyzed at an interval of 7 days. During storage studies the change in color, texture, flavor, overall acceptability and visual fungal were observed.

3. Results and discussions
3.1 Proximate Composition of Fresh Pumpkin

The fresh pumpkin was analyzed for moisture, ash, protein, fat and total carbohydrate content are presented in Table 2.

Table 2: Composition of Fresh Pumpkin*

Components	Fresh Pumpkin
Moisture (%)	87.7±0.49
Ash (%)	1.14±0.07
Fat (%)	0.71±0.07
Protein (%)	0.82±0.06
Total Carbohydrate (by difference) (%)	9.41±0.01

*Values are mean ± standard error of triplet determinations

The fresh pumpkin contained 87.7% moisture, 1.14% ash, 0.82% protein, 0.71% fat and 9.41% carbohydrate content. Pongjanta *et al.* (2006) reported that fresh pumpkin consisted of 84.32% moisture, 1.26% ash, 1.29% protein, 1.45% fat and 10.51% carbohydrate [14]. A small difference was found in composition of fresh pumpkin due to varietal difference, stage of maturity, climatic condition of cultivation, types of fertilizer used during cultivation and as well as post harvest storage and transportation etc.

3.2 Nutritional Composition of Pumpkin pies

The composition of developed pumpkin pies was determined and the results are presented in Table 3.

The range of moisture content of pumpkin pies was 38.05-47.57% with maximum value in P_3 samples of pumpkin pies (47.57%). The variation of moisture content among pumpkin pies samples due to increase of percentage of pumpkin puree. P_1 sample (10.24%) had higher protein content and differs significantly with 5% significant level from the P_2 sample (9.55%) and P_1 sample (8.44%). The variation of protein content among pies samples due to use of high amount of milk powder and egg were used in sample P_1. The ash content of pumpkin pies varies from 1.15% to 1.85% where sample P_1 had highest ash and sample P_3 had lowest ash content. The variation of ash content among samples due to various amount of ingredients used during the preparation of pies.

Table 3: Nutritional composition of pumpkin pies

Parameters	Sample code of pumpkin pies[1,2]		
	P_1	P_2	P_3
Moisture (%)	38.05±0.20[c]	43.81±0.20[b]	47.57±0.41[a]
Protein (%)	10.24±0.05[a]	9.55±0.16[b]	8.44±0.26[c]
Ash (%)	1.15±0.04[c]	1.51±0.06[b]	1.85±0.03[a]
Fat (%)	7.33±0.01[c]	7.44±0.02[b]	8.10±0.01[a]
Total Carbohydrate (%)	43.24±0.21[a]	38.69±0.40[b]	34.07±0.15[c]
Energy content (kcal/100g)	279.88±0.72[a]	259.93±0.86[b]	242.94±1.73[c]

[1]Values are mean ± standard error of triplet determinations.
[2]Means with different superscript within the same row differ significantly ($p < 0.05$) using Duncan multiple range test.

The P_1 pumpkin pies sample had the highest total carbohydrate (43.24%) and energy content (279.88kcal/100g) but lowest fat content (7.33%). Whereas P_3 pumpkin pies sample had the lowest total carbohydrate (34.07%) and energy content (242.94kcal/100g) but highest fat content (8.10%). The variation of composition among pumpkin pies samples might be due to the varietal differences of

pumpkins as well as ingredients used during the preparation of pies.

3.3 Sensory attributes of pumpkin pies

The mean score for color, flavor, texture and overall acceptability of the pumpkin pies are illustrated in figure 2. The one way analysis of variance reveled that all these sensory attributes of

different pumpkin pies were significantly (p<0.05) different and thus the pumpkin pies samples showed varied degree of acceptability in terms of color, flavor, texture and overall acceptability .

The range of mean scores for color was (6.45-7.75) where the color of P_1 was preferred to all other samples while P_3 was the least. P_1 sample scored highest for flavor (8.03) followed by P_2 (7.25) and P_3 (6.32). The score for texture of P_3 (6.28) had least while majority preferred the texture of P_1 (8.14). The mean score for overall acceptability of pumpkin pies varied from 6.37-8.06 where maximum value was obtained for P_1 sample.

The DMRT tests revealed that among all pumpkin pies samples, the P_1 sample containing pumpkin puree (40%), wheat flour (12%), sugar (20%), milk powder (15%) and egg (13%) was the most preferred sample concerning sensory evaluation with the highest overall acceptability followed by P_2 and P_3.
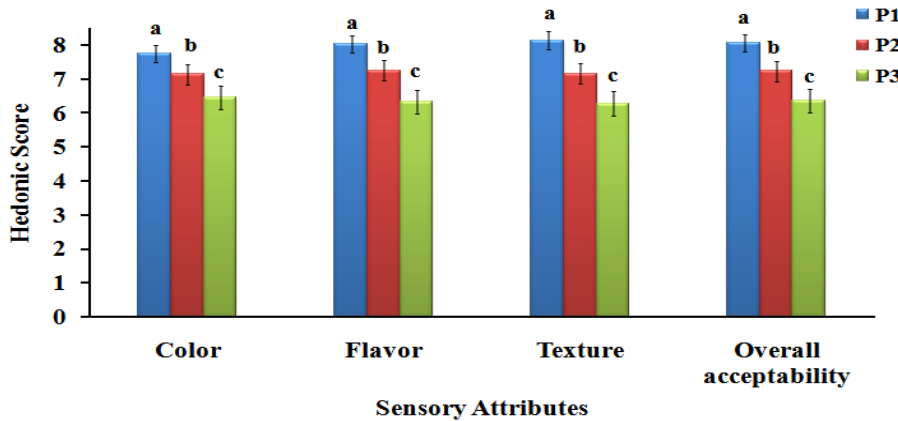
Figure 2: The mean score of acceptability of pumpkin pies

3.4 Storage studies of pumpkin pies

The shelf-life of processed pumpkin pies (packed in aluminum laminate polyethylene pouches) was studies for the period of 21 days at room temperature (25-30^{0}C). No remarkable change in color, texture, flavor and overall acceptability were observed up to 14 days of storage. After 14 days of storage greater change in color, texture, flavor and overall acceptability were noticed for samples P_2 and P_3, but no changes were observed for sample P_1. From the storage studies of the pumpkin pies (Table 4), it may be predicted that the processed pies (sample P_1) may be considered as shelf-stable for 21 days at ambient temperature (25-30^{0}C). The effects of storage time on physical properties of pumpkin pies are shown in Table 4.

Table 4. Storage studies of pumpkin pies

Period of Storage (Days)	Observation						Remarks
	Sample	Color	Flavor	Texture	Overall acceptability	Visual Fungal	
0	P_1	Deep Brown	Good	Firm	Acceptable	No Growth	Good
	P_2	Deep Brown	Good	Firm	Acceptable	No Growth	Good
	P_3	Deep Brown	Good	Firm	Acceptable	No Growth	Good
7	P_1	Deep Brown	Good	Firm	Acceptable	No Growth	Good
	P_2	Brown	Good	Slightly Soft	Acceptable	No Growth	Good
	P_3	Brown	Good	Slightly Soft	Acceptable	No Growth	Good

14	S$_1$	Deep Brown	Good	Firm	Acceptable	No Growth	Good
	S$_2$	Slightly Brown	Slightly Rancid	Soft	Not Acceptable	No Growth	Freshness Declined
	S$_3$	Slightly Brown	Slightly Rancid	Soft	Not Acceptable	No Growth	Freshness Declined
21	S$_1$	Brown	Good	Firm	Acceptable	No Growth	Good
	S$_2$	Discolored	Rancid	Very soft	Not Acceptable	Growth	Not Acceptable
	S$_3$	Discolored	Rancid	Very soft	Not Acceptable	Growth	Not Acceptable

4. Conclusion

Use of pumpkin puree had considerable effects on physical-chemical and organoleptic properties of pies. From the above investigation it can be concluded that the pies containing pumpkin puree (40%), wheat flour (12%), sugar (20%), milk powder (15%) and egg (13%) were more acceptable when compared with other formulated pumpkin pies. No remarkable change in color, texture, flavor and overall acceptability were observed up to 21 days of storage at ambient temperature (25-30^{0}C). The study indicates that pumpkin can be used in bakery and confectionary industries. Through processing of pumpkin pies, the market value of pumpkin may be increased and post harvest losses can be minimized. Thus farmers would be benefited and encouraged to expand production. Further investigation is necessary to study economic and safety aspects of the pumpkin pies before commercial exploitation.

References

1. S. Sharma and R. Rao, "Nutritional quality characteristics of pumpkin fruit as revealed by its biochemical analysis", International Food Research Journal, 20(5), pp. 2309-2316, 2013.
2. F. Caili, T. Haijun, C. Tongyi, L. Yi, and L. Quanhong, "Some properties of an acidic protein-bound polysaccharide from the fruit of pumpkin", Food Chemistry, 100, pp. 944-947. 2007.
3. BBS, "Statistical Year Book of Bangladesh", Bangladesh Bureau of Statistics, Statistic Division, Ministry of Planning, Govt. of the people's Republic of Bangladesh, Dhaka, 2008.
4. K. G. Shanmugavelu, Production Technology of Vegetable Crops. 2nd ed.,Oxford and IBH publishing Co. Pvt. Ltd, New Delhi, India, p. 716, 1989.
5. J. Oliver and A. Palou, "Chromatographic determination of carotenoids in foods". Journal of Chromatography, 881, pp. 543–555, 2000.
6. J. G. Provesi, C. O. Dias and E. R. Amante, "Changes in carotenoids during processing and storage of pumpkin puree", Food Chemistry, 128, pp.195–202, 2011.
7. V. Rao and L. G. Rao, "Carotenoids and human health", Pharmacological Research, 55, pp. 207–216, 2007.
8. R. P. Srivastava and S. Kumar, Fruit and Vegetable Preservation Principles and Practices, 3rd ed. International Book Distributing Co., Charbagh, India. p. 6-7, 1997.
9. AOAC, Official Methods of Analysis, Fourteenth Edition, Association of Official Analytical Chemists, 15th Edn. , Washington, D. C., 2005.
10. D. Pearson, The chemical analysis of foods, 7th Edn., Churchill Lavingstone, New York, 1970.
11. FAO food and nutrition paper, Food energy – methods of analysis and conversion factors, Food and Agriculture Organization of The United Nations, Rome, p. 37, 2003.

12. E. Larmond, Laboratory Methods for Sensory Evaluation of Foods, Department of Agriculture Publication Ottawa, Canada, 1977.
13. IBM SPSS Statistics, IBM SPSS Statistics for Windows, Version 20.0. IBM Corp., Armonk, New York, 2011.
14. J. Pongjanta, A. Naulbunrang, S. Kawngdang, T. Manon and T.Thepjaikat, "Utilization of pumpkin powder in bakery products", Songklanakarin J. Sci. Technol., 28(1), pp. 71-79, 2006,

Author Profile

Monirul Islam has been serving as **Assistant Director** under the division of Food Technology, Irrigation and Water Resources Management at Rural Development Academy (RDA), Bogra, Bangladesh. He is graduated from Bangladesh Agricultural University (BAU), Mymensingh in the faculty of Agricultural Engineering and Technology major in Food Technology & Rural Industries. He is basically a **Food Engineer**.

Jakia Sultana Jothi has been serving as a **Lecturer** in the department of Food Processing and Engineering at Chittagong Veterinary and Animal Sciences University (CVASU), Chittagong, Bangladesh. She successfully completed her graduation and post graduation in **Food Engineering** under the department of Food Technology and Rural Industries from Bangladesh Agricultural University (BAU), Mymensingh, Bangladesh. She has extensive experience with engineering aspects of food production in order to improve the quality standards and ensure food safety through introducing better management in the sector. Her role is to support and maintain the University's national and international reputation for excellence in teaching and research activities. She has worked widely in development and innovation, lecturing, student support, conducting seminars, curriculum development and teaching practices.

Md. Rowshon Habib successfully completed B.Sc. and M.S. in **Food Engineering** degrees from the department of Food Technology and Rural Industries, Bangladesh Agricultural University (BAU), Mymensingh, Bangladesh.

Abdullah Iqbal is Associate Professor of Department of Food Technology & Rural Industries at Bangladesh Agricultural University (BAU), Mymensingh, Bangladesh. He received a **B.Sc. Agricultural Engineering** and an **M.S. in Food Technology** from BAU and **Ph.D.** from University College Dublin (UCD), Ireland. His current research concerns include processing and preservation of food and biological matter (especially drying and fermentation), nutrient degradation during processing of food, quality evaluation of food by non-destructive techniques using Computer Vision System (CVS) and Hyperspectral Imaging (HSI).