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Research Article

FORMULATION AND DEVELOPMENT OF FUNCTIONAL CONFECTIONERY BY INCORPORATING PUMPKIN JUICE

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ABSRACT
A candy is composed mainly of sucrose, fructose, glucose, glucose (corn) or maltose syrups. The candies developed with these ingredients are energy dense and poor source for nutrient values as well as functional properties. Fruit candies are becoming more and more popular because of high acceptability, minimum volume, higher nutritionally value and longer storage life, which make it a potential food supplement for children and adults. For current study pumpkin was selected for addition into candies, because to utilize the underutilized fruit which is having functional properties. Pumpkin is very rich in carotenoids, which is known for keeping the immune system of an individual strong and healthy. The candies developed with pumpkin were subjected to sensory, chemical and microbial analysis. Results showed that the candies developed with pumpkin juice had significant increases in acceptability of sensory parameters i.e., appearance, colour, taste and flavor than control candies. There is no significant difference in the texture of both pumpkin and control candies. Candy developed with addition of pumpkin juice was rich in nutrient composition compared with control candy. Protein, fiber, minerals like calcium, iron and phosphorus were significantly increased in pumpkin candy at 5% level. Antioxidant composition was also more in pumpkin candies. Fat content was equal for both pumpkin candies and control candies. Carbohydrates were more in control candies. Hence the candies developed with pumpkin juice are rich in nutrient composition compared with control candies. It also showed that pumpkin juice is suitable for making candies.

Keywords: *Candy, Pumpkin, Functional Food, Antioxidant.*

INTRODUCTION
India is the world's second largest producer of food next to china, and has the potential of being the biggest with the food and agricultural sector. The Indian food industry is a largest manufacturing unit for chocolates and confectionery products in India. The chocolate market is estimated at around 33,000 tons valued at approximately Rs 8.0 billion at present. The Indian confectionery market includes sugar boiled confectionery, hard boiled candies, toffees and other sugar-based candies. Sugar boiled confectionery had penetrated an estimated 15% of the households only, suggesting a large potential for growth. Candies are a liquid mixture of sucrose, fructose, glucose, glucose (corn) or maltose syrups, which are kept in amorphous or glassy state. Sucrose and glucose syrups are the basic components of the hard candies formulation. There are different types of candies that are produced today in the world. the range of candies available in today's market include such treats as soft and tender golden caramels, elegant truffles and fudges, chewy licorice, sumptuous chocolates, mouth watering toffee and hard candy, as well as nougats, rolls, jelly beans and gum drops. The list is almost endless. Each of these candy delights has their own special quality about them, which makes them unique in their own way.
Today, with modern technology and continued growing interest in sweets, large candy companies are competing to come up the most interesting and new products on the market, thus complicating these simple procedures of the past candies in the shape of baby's facifiers, leggo building blocks, candy hair that grows on top of plastic head as well as rocket ships and nuggets have appeared in candy stores in the past few years, in addition to the old favorites. In order to produce some of these sugary creations, ingredients of a non-kosher source can often be used. Some of these problematic ingredients may include, flavor (such as grape), release agents, gelating, glycerin, food coloring, monosterates, as well as

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emulsifiers and oils. Some of these "new-age" ingredients service to extend the shelf life of candies, while other artificially enhances colour or flavor. Consumers of all age groups prefer chocolate and confectionery products because of their attractive appearance and colour. Now-a-days varieties of products have gained importance due to their delicious taste and better keeping quality making a direct impact on demand.

Confectionery has a major future role to play in the fast food market, as the benefits of its 'portability', long shelf life without refrigeration and its ability to provide control of calorie intake and balance nutrition, together with beneficial additives are promoted. Confectionery products with specific additives etc. with health benefits, added to conventional confections – often called neutraceuticals or functional foods. Hence to improve the functional properties of sugar candies, the current study was carried out by developing functional candies with addition of fruit pulp.

Fruit candies are becoming more and more popular because of high acceptability, minimum volume, higher nutritionally value and longer storage life. These have additional advantage of being least thirst provoking and ready to eat snacks. In the present study pumpkin was selected for addition, because to utilize the underutilized fruit which is having functional properties. Pumpkins are very versatile in their uses for cooking. Most parts of the pumpkin are edible, including the flesh, seeds, the leaves and even the flowers. It is a very important, traditional part of the autumn harvest, eaten mashed and making its way into soups and purees.

Pumpkin is very rich in carotenoids, which is known for keeping the immune system of an individual strong and healthy. Beta carotene, found in pumpkin, is an anti-inflammatory agent. It helps to prevent build up of cholesterol on the critical walls, thus reducing changes of strokes. Being rich in alpha-carotene, pumpkin is believed to slow the process of aging and also prevent cataract formation. Pumpkin contains lots of antioxidant vitamins a and c, as well as zinc and alpha-hydroxy-acids which help to reduce the signs of aging. Pumpkin is a valuable source of functional components mainly carotenoids, lutein, zanthin, ascorbic acid, phytosterols, selenium and linoleic acid, which acts as antioxidants in human nutrition.

MATERIALS AND METHODS

Round shaped pumpkins with vertical stripes and yellow skin with sweet flesh were procured from the local markets of Tirupati. Corn syrup was brought from confectionary stores of Vijayawada. The other ingredients, sugar and food colours were procured from the local stores of Tirupati.

Processing of pumpkin juice

After proper selection and weighting, pumpkins were cleaned under running tap water to remove adhered dust, peeled off to remove the outer skin. The pumpkin was cut into small pieces and seeds were removed by using stainless steel knife. The pumpkin which made into small pieces was passed through electronic mixer, without any addition of water up to uniform consistency was obtained. Then extract the juice with the help of muslin cloth.

Development of Pumpkin Candies

Various trails were carried out to standardize the ingredient composition and methodology for development of pumpkin candy. Sugar syrup was prepared with 20gms of sugar by adding 100ml of water until thread stage appeared. 30gms of corn syrup was added to the sugar syrup. Then pumpkin juice was added to the above mixer. It was heated till it reaches the temperature of 140^0c and a pinch of permitted food colour was added. Finally it was poured into molds and cooled. The pumpkin candies developed in each trial were subjected to sensory evaluation with the selected panel members. The candy developed with 50% pumpkin juice was most acceptable in all sensory parameters than the candy developed with 40% and 60% pumpkin juice. Hence the candies developed with 50% of pumpkin juice were considered as standard trail. Control candies were also developed without any addition of fruit juice. Comparative study was conducted by sensory evaluation for both standardized pumpkin candies and control candies to assess the quality attributes such as appearance, taste, color, flavor, texture and overall acceptability.

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Chemical analysis

The chemical analysis like moisture, protein, fat, carbohydrates and the mineral content i.e. calcium, iron and phosphorus and antioxidant and β-carotene content were analyzed by AOAC and ISI methods.

Microbial Analysis

Microbial analysis of fruit candies was carried for total plate count and yeast /mould by ISI methods.

RESULTS AND DISCUSSION

The results obtained during the analysis of candies are illustrated as follows

The mean scores obtained during the sensory evaluation of pumpkin and control candies were presented in table 1.

Table 1: Shows sensory evaluation of pumpkin candies

S.No.	Parameter	Mean rank for pumpkin candies	Mean rank for control candies	Z value	p-value
1.	Appearance	4.95	3.70	4.0000	0.0001*
2.	Colour	5.0	3.80	12.0000	0.0020*
3.	Taste	5.0	4.0	13.5000	0.0010*
4.	Texture	5.0	3.75	32.0000	0.1310NS
5.	Flavor	5.0	3.50	9.0000	0.0001*
6.	Overall acceptance	5.0	4.0	9.0000	0.0001*

P value <0.5 –significant at 5% level
**-significant at 5% level*
NS – Non-significant

The data in table revealed that the mean rank for overall acceptability of pumpkin and control candies were 5.0 and 4.0 respectively. It shows that the difference between the pumpkin and control candy was significant at 5% level, where overall acceptability was more in pumpkin candies compared with control candies. The statistical results showed that the candies developed with pumpkin juice had significant increases in acceptability of sensory parameters i.e., appearance, colour, taste and flavor than control candies. There is no significant difference in the texture of both pumpkin and control candies. Thus the above results showed that the candies developed with pumpkin was most acceptable than the control candies. It also shows that pumpkin juice was suitable for development of candies.

Nutrient composition of pumpkin candies

The nutrient analysis results obtained for the candies developed with pumpkin juice and control candies were presented differently for proximate composition, mineral composition and antioxidant activity in the following way.

Proximate composition of pumpkin candy

The results obtained for the proximate analysis of pumpkin candies with comparison of control candies are presented in table 2.

Table 2: Shows proximate composition of pumpkin candies

S.No	Nutrient	Pumpkin candies (Mean ± SD)	Control candies (Mean ± SD)	t-value	P-value
1.	Moisture (%)	1.40±0.10	0.73±0.06	-11.7007	0.0003*
2	Protein (gm)	5.37±0.06	5.04±0.06	-7.0711	0.0021*
3.	Fat (gm)	11.47±0.06	11.47±0.06	100.000	0.0000*
4.	Fiber (gm)	2.24±0.06	1.20±0.00	-31.0000	0.0000*
5.	Total ash (gm)	1.84±0.06	1.14±0.06	-14.8492	0.0001*
6.	Carbohydrates (gm)	75.70±0.10	81.17±0.16	61.9862	0.0000*
7.	Acid insoluble ash (gm)	0.30±0.00	0.10±0.00	SD = 0** No t-test;	

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P value <0.5 –significant at 5% level
**-significant at 5% level*
NS – Non-significant
*** SD is zero, hence no statistical test was done*

The data in table shows that significant levels of the pumpkin candy and control candy for proximate composition. The mean values obtained for the moisture content of the pumpkin and control candies were 1.40±0.10 and 0.73±0.06 respectively. It showed that there was significant difference between the pumpkin and control candy at 5% level, where, the moisture content of the pumpkin was more than the control sample, this might be due to the addition of pumpkin juice. The results were coincides with the study conducted by Ergun et al (2008) where moisture content of candies developed with addition of fruit juice was more in moisture content than candies developed without addition of any fruit juice. A difference in water activity, either between two domains within the candy, is the driving force for moisture migration in confections. When the difference in water activity is large, moisture migration is rapid, although the rate of moisture migration depends on the nature of resistance to water diffusion. Barrier packaging films protect the candy from air whereas edible films inhibit moisture migration between different moisture domains within a confection.

The mean value for the protein content of pumpkin and control candies were 5.37±0.06 and 5.04±0.06. The difference between the pumpkin and control sample was significant at 5% levels, where the protein percentage was more in pumpkin candies than control candies. This was due to addition of pumpkin juice, where pumpkin contain 1.4gm of protein per 100gm of pumpkins. (NIN 2004).

The mean values for the fat content of the both pumpkin and control candy was 11.47±0.06. There was no significant difference between the pumpkin and control candy, because pumpkin is not a source for fat (0.01gm/100gm).

The mean values for the fiber content of pumpkin and control candy were 2.24±0.06 and 1.20±0.00 respectively. It shows that the difference between the pumpkin and control candy was significant at 5% level, where fiber content was more in pumpkin candy than the control candy. This might be due to the addition pumpkin juice. Pumpkin contains 0.07gm/100gm of crude fiber (NIN 2004).

The mean value for the total ash of the pumpkin and control candies were 1.24±0.06 and 1.14±0.06 respectively. The mean scores were more for pumpkin candy than the control candy although there was no significant difference between them. The increased total ash content in pumpkin candy was due to addition of pumpkin juice. According to NIN,(2004) pumpkin contains 0.6gms/100gm of mineral content. The decrease ash content in control sample was due the ingredients used in control candy i.e., sugar and corn syrup were not a source for minerals.

Mean scores for the carbohydrate content for pumpkin and control candies were 75.70±0.10 and 81.17±0.16 respectively. It shows that there was a significant difference between the pumpkin and control candy at 5% level. The reduced carbohydrate content of pumpkin candy might be due to addition of pumpkin juice where the carbohydrate content in pumpkin is 4.6gm/100gm (NIN, 2004).

Mean values for the acid insoluble ash for pumpkin and control candies were 0.30±0.00 and 0.10±0.00 respectively. The data revealed that there was no standard deviation between them, because of the acid insoluble ash content was very minute. But the results showed that the mean values were more for pumpkin candy than control candy. It was due to addition of pumpkin fruit juice.

Hence the proximate result shows that the candy developed with pumpkin juice was rich in almost all nutrients except carbohydrates and fat.

Mineral composition of pumpkin candy

The results obtained during the analysis of minerals of pumpkin and control candies were presented in the table 3

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Table 3: Shows mineral composition of pumpkin candies

S. No.	Nutrient	Pumpkin candies (Mean ± SD)	Control candies (Mean ± SD)	t-value	P-value
1.	Calcium (mg/g)	45.70±0.10	25.30±0.10	-111.4518	0.0000*
2	Iron	0.38±0.01	0.29±0.01	-218.0046	0.0000*
3.	Phosphorus	29.20±0.10	11.40±0.10	74.9430	0.0000*

P value <0.5 –significant at 5% level
**-significant at 5% level*
NS – Non-significant

The data in the table revealed that the mean values for calcium, iron and phosphorus for pumpkin candy were 45.70±0.10, 0.38±0.01 and 29.20±0.10 respectively, where as for control candy the mean values were 25.30±0.10, 0.29±0.01 and 11.40±0.10 respectively. It shows that the difference between pumpkin and control candy for all mineral composition i.e., calcium, iron and phosphorus were significant at 5% level, where the pumpkin candy shows more mineral composition than the control candy. This was due to pumpkin juice addition. According to NIN, pumpkin contains 0.6gms of minerals i.e., calcium (1mg/100g), iron (0.44mg/100g) and phosphorous (30mg/100gm).

Antioxidant composition of pumpkin candy

The results obtained regarding TBARS (Thio Barbatric Reactive Substances) value for total antioxidants and beta-carotene value is presented in table 4.

Table 4: Shows antioxidant composition of pumpkin candies

S. No.	Antioxidant	Pumpkin candies (Mean ± SD)	Control candies (Mean ± SD)	t-value	P-value
1.	TBARS	200.00±1.00	244.60±0.25	-1184.3564	0.0000*
2	Beta carotene (µg)	86.85±0.11	14.92±0.11	14.913±0.006	0.0000*

P value <0.5 –significant at 5% level
**-significant at 5% level*
NS – Non-significant

The mean value for the TBARS for candies i.e. pumpkin and control were 200±00±1.00 and 244.60±0.25. The mean value for β-carotene were 86.85±0.11 and 14.92±0.11 for pumpkin candy and control candy respectively. There was a significant difference between the pumpkin and control candy for both total antioxidants (TBARS) and β-carotene at 5% level.

The antioxidants status was more in pumpkin candy than control candy. If the TBARS value is more, the antioxidant status is less and if the TBARS value is less the antioxidant status is more. The reason is due to liquid per oxidation. Hence, compared with pumpkin candy the TBARS value was more in control candy, where it clearly indicates the antioxidant status was more in pumpkin candy. Antioxidant activity is a functional property which is most significant in development of functional foods, than measuring only the specific nutrients. (Wan Bekel & Jongen 1997).

The β-carotene composition in pumpkin candy was more than control candy, because pumpkin is a rich source of β-carotene. According to USDA the β-carotene content in pumpkin is 3100µg. β-carotene is probably the most well known of the carotenoids, a phytonutrients family that represents one of the most wide spread groups of naturally occurring pigments. It is important to note, however that in most cases, prolonged cooking of vegetables decreases the availability of carotenoids by changing the shape of the carotenoid from its natural trans configuration to a cis configuration. For example, fresh carrots contain 100% all-trans beta-carotene, while canned carrots contain only 73% all-trans beta-carotene.

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Microbial quality of pumpkin candy

The microbial quality of control and pumpkin candy is presented in table 5.

Table 5: Shows microbial quality pumpkin candies

S.No	Type of microorganism	Control candies	Pumpkin candies	PFA standards
1.	SPC(cfu/g)	<100	<100	<100
2.	Yeast and moulds (cfu/g)	_	_	<500

The microbial content was absent for almost all candies. Both the control candy and pumpkin candy had <100 cfu/gm. whereas yeast and moulds were absent in all candies. Hence the results were within the limits of PFA standards.

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