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ORIGINAL ARTICLE

Development and quality evaluation of honey based carrot candy

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Abstract Candy was prepared with 3 different combinations of honey and carrot by using 750 g honey+1,000 g carrot (T1), 1,000 g honey+1,000 g carrot (T2) and 1,250 g honey+1,000 g carrot (T3). To establish the best product, sensory evaluation was done on 9-point Hedonic scale. T1 was found to be most preferred candy. Further the T1 candy was assessed for overall quality during storage at room temperature (25–30 °C) for 6 months. Candy can be preserved safely for 6 months in both glass and LDPE packaging materials.

Keywords Honey · Carrot candy · Shelf-life · Sensory quality

Introduction

Candy is a sweet food prepared from fruits or vegetables by impregnating them with sugar syrup followed by draining of excessive syrup and then drying the product to a shelf stable state. Fruits and vegetables like apples, ginger, mangoes, guava, carrots and citrus peels have been used to prepare candies (Mehta and Bajaj 1984; Sharma et al. 1998; Ribeiro and Sabaa-Srur 1999; Chandu and Prasad 2006). Caronda, ber and Aonla candies have also been developed (Kaikadi et al. 2006).

White sugar is the usual sweetening agent used in preparation of candies. Such sugar contains sucrose (99.7%). Excessive consumption of sucrose quite often leads to variety of health problems viz. heart problems and coronary thrombosis (Alam 1999). Keeping in view the disadvantages associated with excessive sugar consumption, considerable interest is being taken to explore the possibilities of replacing sugar with alternate natural and artificial sweeteners. Srivastava et al. (2006) have recently developed jaggery based petha (Ash gourd) candy, which could be stored for 45 days under refrigerated condition.

Honey is a natural sweetener which is valued as food due to its high energy carbohydrate content, considered to be the best source of heat and energy and preferred as vehicle of medicine because of its freedom from any adverse effect and easy assimilation. Honey has antimicrobial and antifungal properties also (Molen 1992). Growth of bacterial species such as *Escherichia coli, Staphylococus aureus Salmonella typhimurium* and *Shigella* sp. are controlled by honey while its antimicrobial characteristics are due to osmotic effect, acidity, H_2O_2, flavonoids and aromatic acidic substances. Honey also has antioxidant properties (Shamala and Jyothi 1999). Addition of honey can improve the quality of a variety of food products. Honey cakes, honey cookies and biscuits made with honey have pleasant flavour and are much more nutritious than many of sugar based products (Singh et al. 1988). It has been used in formulation of bakery products like bread (Candert 1971; Voll 1974), ready-to-eat cereal products (Fast et al. 1971; Colangelo 1980), cookies (Schmidt 1978), honey fruit spread (Berthold and Benton 1968), sweetened peanut butter spread (Billerback et al. 1976), microwave cooked chiken patties with honey (Naveena et al. 2007) and

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honey based icecreams (Saxena and Jaiswal 2005). Verma et al. (2006) have developed Amla murabba (preserve) by using honey and found both the fresh and preserved honey based murabba had pleasant flavour, taste, colour, texture and overall acceptability and could be safely preserved for 6 months at room temperature (25–30 °C) in glass and pet jars.

Efforts were made to explore the possibility of utilizing honey in place of sugar as sweetening material for production of carrot candies. Carrot was preferred for candy preparation as it is a highly valued indigenous root vegetable containing high amounts of nutrients like carotenoids which are precursors of vitamin A. Besides, carrot also contains good amount of dietary fibre having laxative effect (Manay and Shadaksharaswamy 1997). Cooking increases carrot's nutritional value as it breaks down the tough cellular walls that encase beta carotene. Carrots were processed to make carrot powder and grits by pressure cooking and drying at 50 °C for 18 h. These were incorporated into traditional food products at different levels to increase vitamin A precursor levels (Singh and Kulshrestha 2008). Owing to its seasonal character and perishable nature, a large quantity of carrots goes waste due to inadequate handling and storage practices. Though it is used as salad, vegetable and in development of sweet meats like *Gajar halva* and *Gazrila,* its use as candies may prove to be a shelf stable delicious addition in the list of carrot products. Madan and Dhawan (2005) have developed carrot candies by using sugar and jaggery syrups. Fresh coconut powder was used for enrolling sugar candies. Such candies, even on 60th day of storage at room temperature when packed in polyethylene bags scored above 7 on a 9-point Hedonic scale for sensory attributes. The carrot candy prepared in sugar syrup scored the highest for all sensory parameters in comparison to jaggery based candies, though liking for this product too was still above moderate. The fresh carrot candies prepared respectively in sugar, sugar and coconut powder and jaggery syrups had β- carotene contents of 13.3, 13.2 and 11.2 mg/100 g which decreased to respectively to 11.2, 11.3 and 8.0 mg/100 g on 2 months storage (Madan and Dhawan 2005).

The present paper describes efforts made to optimize various process parameters and product quality evaluation of carrot candy containing honey.

Materials and methods

Fresh, mature and red carrots (*Daucus carota*) and honey were procured from local market. After washing, peeling and removing inedible portion, carrots were pricked with stainless steel fork and cut into pieces of 1.2–1.5 cm. These pieces were blanched in boiling water for 3 min and were placed on a dry cloth and excess water was allowed to drain off. The pricked and blanched pieces were soaked overnight in honey syrup with 3 combinations T1 (750 g honey +1,000 g carrots), T2 (1,000 g honey +1,000 g carrots) and T3 (1,250 g honey +1,000 g carrots) at room temperature (25–30 °C). Next day, the carrots were taken out from the syrup and syrup was boiled. The syrup was cooled and added again with carrots. The product was kept again for 24 h. On third day, the process was repeated with addition of carrots in hot syrup and product was kept again for 24 h. Next day, the carrots and syrup were cooked together till the candies were of 70° Brix. The pieces were dried at room temperature till they become non-sticky. The prepared candies were packed in glass jar and LDPE pouches of 500–600 μm film thickness and stored.

Moisture content, titratable acidity, reducing and total sugars were estimated as described by Ranganna (1986). Total soluble solids of candy were determined by using hand refractometer. Browning index and β-carotene of candy were determined by method recommended by Srivastava and Kumar (1994). Sensory quality was assessed by panel of 14 semi trained judges on 9-point Hedonic scale (Ranganna 1986). The statistical analysis of storage data was carried out by ANOVA and CD value was calculated (Mandal and Nambiar 2002).

Results and discussion

The average score of colour of T1 was 9.0 as compared to T2 and T3 samples which obtained the same score of 8.3 (Table 1). In case of flavour the average value for T1 was higher as compared to T2 and T3. Highest score values of 8.3 and 8.7 was awarded to sample T1 for its taste and texture respectively. So the overall acceptability score of T1 was highest over other 2 samples. The above results indicated that sample T1 prepared by incorporating 750 g

Table 1 Effect of honey composition on sensory quality of honey based carrot candy

Treatments	Colour	Flavour	Taste	Texture	O A
T1	9.0±0	8.7±0.57	8.3±0.57	8.7±0.57	8.7±0.38
T2	8.3±0.57	8.0±0	8.0±0	7.7±0.57	8.0±0.25
T3	8.3±0.57	8.0±0	7.0±0	7.0±0	7.6±0.14
$CD_{0.05}$ (n=3)	0.13	0.16	0.16	0.13	0.24

OA Overall acceptability; T_1, T_2, T_3: See text

Table 2 Effect of storage period and packaging material on physico-chemical and microbiological quality of honey based carrot candy (T1 samples)

	Storage period, months			CD 5%	
		6			
		Glass jar	LDPE pouch	P	S
Moisture,%	28.0±0.50	32.5±0.10	33.0±0.20	0.17	0.24
TSS, °Brix	72.0±0.50	84.5±0.10	84.0±0.20	0.28	0.40
Acidity,%	0.06±0	0.12±0.0	0.12±0.0	NS	NS
Browning index	0.02±0.005	0.06±0.01	0.06±0.005	NS	NS
Reducing sugars,%	30.5±0.10	38.7±0.10	39.0±0.11	0.12	0.17
Total sugars,%	78.0±0.20	83.5±0.10	83.8±0.15	0.13	0.18
β-Carotene, mg/100 g	16.2±0.25	11.2±0.10	11.0±0.10	0.09	0.13
TPC, log cfu/g	ND	4.7	4.7	0.01	0.02
Y&M, log cfu/g	ND	4.4	4.4	0.02	0.03
Coliform count	ND	ND	ND	NS	NS

ND Not detected, *NS* Not significant ($n=3$), *P* Packaging system

S Storage, *TPC* Total plate count, *Y & M* Yeast and moulds, T_1 : See text

honey in 1,000 g of carrot was the most preferred candy. Further studies were conducted with T1 sample only.

The fresh candy had 28% moisture content which gradually increased to 32.5% in glass jar and up to 33.0% in LDPE pouch on 180th day (Table 2). Madan and Dhawan (2005) have reported moisture content values of 16.2, 14.2 and 21.0%, respectively in fresh carrot candies in sugar, in sugar and coconut powder and in jaggery. The TSS of candy increased from 72°Brix in fresh condition to respectively 84.5 and 84.0°Brix in case of packaging in glass jar and LDPE pouch. The fresh candy had 0.02 browning index value, which slightly increased to 0.06 in both packaging materials after 6 months storage. The increase in non-enzymatic browning may be attributed to the presence of sugars which support the formation of brown pigments. The fresh candies had acidity of 0.06%, while Madan and Dhawan (2005) reported acidity of 0.70, 0.076 and 0.73%, respectively in case of carrot candy in sugar, in sugar coconut powder and in jaggery

There was a gradual increase in acidity during storage in carrot candy as also reported by Madan and Dhawan (2005). The reducing sugar and total sugars increased from respectively 30.5 and 78.0% in fresh condition to 38.7–39.0% and 83.5–83.8% in preserved condition. Bajwa and Gupta (2007) also reported similar findings in carrot milk cake. Fresh carrot candies contained 16.2 mg/100 g of β-carotene, which gradually decreased during storage to 11.2 mg/100 g in glass jar and 11.0 mg/100 g in LDPE pouch. In comparison the β-carotene contents of carrot candies in sugar, in sugar coconut powder, and in jaggery, as reported by Madan and Dhawan (2005) were respectively 13.3, 13.2 and 11.2 mg/100 g. The variation in β-carotene content may be due to varietal difference. The decrease in β-carotene during storage may be attributed to its sensitivity to light and oxygen. Similar findings were earlier reported by Madan and Dhawan (2005) in carrot candies prepared in sugar, in sugar coconut powder and jaggery and by Premavalli and Arya (1991) in carrot *Halwa*. Microbes could not be detected in fresh carrot candy, because honey also had antimicrobial effect. Even after 6 months of storage candies were found microbiologically safe in both the packaging materials.

Sensory quality scores decreased during storage and scores in glass jar packed samples were higher than in LDPE packed samples (Table 3). Almost similar trend was observed in the sensory quality by Gupta et al. (2005) in *khoa* and milk based carrot cake and Manjunatha et al. (2003) in carrot *kheer* mix

Table 3 Effect of packaging materials and storage life on sensory qualities of honey based carrot candy (T1 sample)

	0 (Initial)	After 3 months Storage		After 6 months Storage	
		Glass jar	LDPE	Glass jar	LDPE
Colour	8.7±0.57	7.7±0.57	7.5±0.50	6.8±0.28	6.8±0.28
Flavour	8.0±0	7.5±0.50	7.2±0.28	6.8±0.28	6.8±0.28
Taste	8.7±0.57	7.8±0.28	7.7±0.57	7.0±0	6.8±0.28
Texture	8.0±1.00	8.0±0	7.7±0.57	6.7±0.57	6.7±0.57
O.A.	8.3±0.52	7.7±0.19	7.5±0	6.8±0.14	6.8±0.19

OA Overall acceptability, *LDPE* Low density polyethylene, T_1= See text

Conclusion

Honey based carrot candy of acceptable sensory, microbiological and physico- chemical characteristics can be developed and the product T1 (750 g honey+1,000 g carrot) was better, based on sensory attributes in both glass and LDPE packaging materials. The product can be safely preserved for 6 months at room temperature (25–30 °C).

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