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Shelf life analysis of ghee residue candy incorporated with orange peel

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Abstract

Ghee residue candy was prepared by incorporating dried orange peel powder and aqueous extract at various levels of 5, 10, 15 per cent (T₁, T₂, T₃). Nutritional, textural and sensory qualities of the ghee residue candy incorporated with various levels of orange peel was carried out. This study was carried out to develop a candy utilizing the waste products of juice and dairy industry viz. orange peel and the ghee residue. The vitamin C analysis in ghee residue candy (T₂) had a decreasing trend which was observed on storage at refrigerated temperature. On sensory evaluation by using 9-point hedonic scale T₂ was found to be the best among the various levels tried. The texture, sweetness and overall acceptability for T₂ were found to decrease during storage for a period of 60 days. The nutritional quality of T₂ was analyzed for 60 days period and it was found that moisture, ether extract and NFE was found to decrease with increase in storage period. Texture analysis of ghee residue candy for T₂ was carried out for the parameters hardness and stickiness and it was found to increase considerably after 30 days of storage at refrigerated temperature indicating its acceptability up to 30 days.

Keywords: Ghee residue candy, Orange peel, Nutritional quality, Sensory evaluation, Textural analysis, Storage studies, Vitamin C.

Introduction

Candy is consumed globally by all age group people and has remained popular, especially among children and has a high demand in global market for value added candies of functional importance. Developing an innovative candy with enhanced nutrients may add a new variety of the candy to the existing array of candies available in global market. Fruits and vegetables like apples, ginger, mangoes, guava, carrot and citrus peels have been used to prepare candies (Mehta and Bajaj, 1984) [6].

Ghee residue is the by-product of ghee making process, and the solids not fat (SNF) present in cream or butter appear in the form of small particles known as 'ghee residue'. It is obtained as moist brownish sediment after molten ghee has been strained out.

The ghee residue is rich in phospholipids, sulphhydryl compounds, poly unsaturated fatty acids (PUFA), lipid, non-lipid constituents, flavour concentrates like FFA, carbonyls, and lactones (Serunjogi *et al.*, 1988) [9]. Antioxidant property of ghee residue is due to the mixture of its constituents.

Orange constitutes about 60 per cent of the total citrus production (Lucia and Calogera, 2008) [5]. Peel represents between 50 to 65 per cent of total weight of the fruits and is the primary by-product (Ashbell and Donahaye, 1984) [3]. Orange peels are rich in flavonones, powerful antioxidants that help to reduce oxidative damage and fight free radicals. Citrus peels contain principal dietary fibre sources such as cellulose, hemicelluloses, lignin, pectin, gums and bioactive compounds.

Orange peels are also loaded with natural histamine suppressing compounds.

The vitamin C in orange peel is 136 mg/100 g whereas in the pulp it is about 50 mg/100 g (Zamantha *et al.*, 2014) [13]. It also contains considerable amounts of calcium, copper, magnesium, vitamin A, folate, other B complex vitamins. The present study was undertaken to develop ghee residue candy by incorporating orange peel to effectively utilize the nutrients in the orange peel.

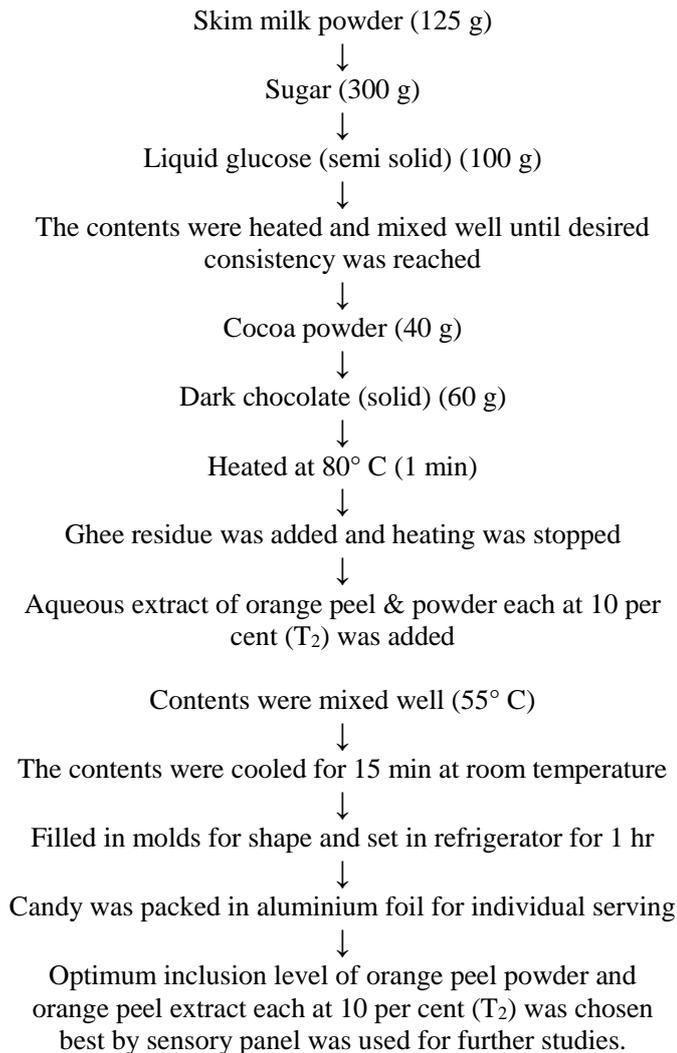
Materials and methods**Ingredients for ghee residue candy**

Ghee residue, skim milk powder, orange peel, liquid glucose, sugar, cocoa powder and dark chocolate were used for preparation of candy.

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Flow chart for the preparation of ghee residue candy incorporated with orange peel (modified technique of Wadhwa, 1997) ^[12]



Proximate analysis of ghee residue candy incorporated with orange peel (T₂) during storage

The developed product was analyzed for moisture, crude protein, crude fibre, ether extract, nitrogen free extract and total ash as per the procedure described in AOAC (1997) ^[2].

Sensory evaluation of developed candy (T₂) during storage at refrigerated temperature

Sensory evaluation was conducted by using the 9 point hedonic scale for the sensory attributes developed by Larmond (1997) ^[4].

Texture analysis

The ghee residue candy incorporated with orange peel was observed for textural properties, by using texture analyzer as per Afoakwa *et al.* (2007) ^[1] with a penetration probe P/5 attached to a 50 kg load cell (Stable Micro Systems; Model : TA XT Plus), connected to a computer, programmed with texture analysis software, assembled for candy analysis.

Storage studies

Nutritional and textural quality of developed candy (T₂) was assessed at regular intervals up to 60 days of storage at refrigerated temperature.

Results and Discussion

Table 1: Vitamin C concentration in ghee residue candy incorporated with orange peel (T₂) during storage at refrigerated temperature (Mean + SE) (mg/10g)@

Vitamin C concentration in ghee residue candy incorporated with orange peel (T ₂) during storage period (in days)					
0	15	30	45	60	F - value
2.82a + 0.32	2.72b + 0.21	2.32c + 0.02	1.43d + 0.20	0.27e + 0.02	9020.167**

@Average of six trials

Mean with different superscripts within a same row differ significantly from each other ($P < 0.01$)

** Highly significant ($P < 0.01$)

T₂ - Ghee residue candy incorporated with 10 per cent orange peel and extract.

Orange peels are rich in flavonones, powerful antioxidants that help to reduce oxidative damage and fight free radicals. The vitamin C in orange peel is 136 mg/100 g whereas in the pulp it is about 50 mg/100 g (Zamantha *et al.*, 2014) ^[13]. Citrus peels contain principal dietary fibre sources such as cellulose, hemicelluloses, lignin, pectin, gums and bioactive compounds.

The decreasing trend of vitamin C in T₂ was observed on storage at refrigerated temperature. The decrease was drastic after 30 days of storage which might be due to the degradation and loss of vitamin C in the ghee residue candy stored at refrigerated temperature as observed by Sethi (1980) ^[10] in anola preserve.

Table 2: Nutritional composition in per cent of ghee residue candy incorporated with orange peel (T₂) during storage at refrigerated temperature (Mean + SE)@

Storage period in days	Moisture	Crude protein	Crude fibre	Ether extract	Total ash	NFE
0	10.60a +0.11	6.75 +0.02	3.53 +0.01	10.88a +0.17	1.49 +0.04	66.75e +0.17
15	9.45b +0.14	6.70 +0.04	3.45 +0.24	9.35b +0.14	1.45 +0.03	69.60d +0.15
30	8.32c +0.09	6.69 +0.02	3.45 +0.15	7.97c +0.18	1.43 +0.07	72.14c +0.31
45	7.64d +0.08	6.66 +0.01	3.43 +0.20	6.56d +0.21	1.40 +0.16	74.31b +0.16
60	6.95e +0.02	6.65 +0.02	3.40 +0.10	5.15e +0.09	1.39 +0.11	76.46a +0.11
F - value	32.843**	1.678NS	2.321 ^{NS}	1.214**	0.54 ^{NS}	5.205**

@Average of six trials

Mean with different superscripts within a same column differ significantly from each other ($P < 0.01$)

NS – Non significant ($P > 0.05$)

** Highly significant ($P < 0.01$)

T₂ - Ghee residue candy incorporated with 10 per cent orange peel and extract.

The moisture content of the ghee residue candy incorporated with orange peel was found to decrease with increase in storage period as per Nayak *et al.* (2011) ^[8] who noticed decrease in moisture of candy with increase in storage period. The decrease in ether extract in the candy might be due to the breakdown of fat and binding of fat to the orange peel due to the oil holding capacity of the orange peel as per Nassaret *al.* (2008) ^[7]. Highly significant difference was observed in NFE during storage which gradually increased from 30 days of storage at refrigerated temperature. This might be due to

conversion of polysaccharide into sugars due to hydrolysis during storage, the decrease in moisture content with storage

might be due to increase in total soluble sugars as per Tandon *et al.* (2003)^[11].

Table 3: Sensory attributes of ghee residue candy incorporated with orange peel (T₂) during storage at refrigerated temperature (Mean + SE)@

Storage period in days	Sensory attributes				
	Colour	Flavour	Texture	Sweetness	Overall acceptability
0	7.60+ 0.30	8.00+ 0.22	7.28a+ 0.22	7.00a+ 0.22	7.45a+ 0.25
15	7.37+ 0.30	7.82+ 0.21	6.93b+ 0.25	6.34b+ 0.27	7.11b+ 0.30
30	7.36+ 0.30	7.75+ 0.21	6.67c+ 0.16	6.30c+ 0.20	7.02c+ 0.22
45	7.15+ 0.30	7.46+ 0.30	6.59d+ 0.21	5.98d+ 0.22	6.79d+ 0.21
60	7.15+ 0.30	7.28+ 0.30	6.50e+ 0.22	4.60e+ 0.22	6.38e+ 0.16
F - value	0.440 ^{NS}	0.378 ^{NS}	7.849 ^{**}	3.786 ^{**}	4.559 ^{**}

@Average of six trials

Mean with different superscripts within a same column differ significantly from each other (P<0.01)

NS – Non significant (P > 0.05)

** Highly significant (P < 0.01)

T₂ - Ghee residue candy incorporated with 10 per cent orange peel and extract.

Highly significant difference was noticed in texture, sweetness and overall acceptability during storage which might be due to the decrease in moisture and breakdown of NFE into total soluble sugars as per Tandon *et al.* (2003)^[11] and the higher decreasing trend in the sensory scores for texture, sweetness and overall acceptability was found after 30 days of storage at refrigerated temperature. The sensory scores for overall acceptability for T₂ on storage for 30 days were found to fall moderately during storage at refrigerated temperature. Hence the ghee residue incorporated with 10 per cent candy (T₂) was considered to be acceptable up to 30 days of storage at refrigerated temperature.

Table 4: Texture analysis of ghee residue candy incorporated with orange peel (T₂) during storage at refrigerated temperature (Mean + SE)@

Storage period in days	Textural parameters	
	Hardness (g)	Stickiness (g)
0	101.38e+ 0.31	-101.93e+0.39
15	113.81d+ 0.35	-142.69d+0.21
30	162.45c+ 0.78	-196.59c+0.43
45	207.20b+ 0.61	-223.77b+0.95
60	262.20a+0.92	-247.13a+0.97
F – value	309.171 ^{**}	129.814 ^{**}

@Average of six trials

Mean with different superscripts within a same column differ significantly from each other (P<0.01)

** Highly significant (P<0.01)

T₂ - Ghee residue candy incorporated with 10 per cent orange peel and extract.

The hardness and stickiness of T₂ was found to increase considerably after 30 days of storage at refrigerated temperature which might be due to loss of moisture on storage and hydrolysis of sugar as per Tandon *et al.* (2003)^[11]. This also proves that T₂ remains acceptable up to 30 days of storage at refrigerated temperature.

Conclusion

Ghee residue candy with optimum level of orange peel developed was subjected to storage studies at refrigerated temperature. Highly significant difference in vitamin C content was noticed during storage at refrigeration temperature. The vitamin C was found to decrease drastically after 30 days of storage.

The nutritional composition of ghee residue candy incorporated with orange peel during storage for a period of 0, 15, 30, 45 and 60 days revealed a highly significant difference

(P<0.01) in moisture, ether extract and NFE, while there was no significant difference in crude protein, crude fibre and total ash. Moisture, ether extract of the ghee residue candy decreased on storage while NFE increased during storage at refrigerated temperature.

The sensory attributes of ghee residue candy incorporated with orange peel (T₂) during storage revealed no significant difference (P>0.05) for colour and flavour, but revealed a highly significant difference (P < 0.01) for texture, sweetness and overall acceptability. Higher decreasing trend in sensory scores for texture, sweetness and overall acceptability was found after 30 days of storage at refrigerated temperature.

The texture analysis of ghee residue candy incorporated with orange peel (T₂) during storage period revealed a highly significant difference (P<0.01) for both hardness and stickiness. The candy T₂ was considered to be acceptable after 30 days as hardness and stickiness increased consistently after 30 days of storage.

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