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Effect of storage on chemical parameters of protein rich banana-guava cheese

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Abstract
The protein rich banana-guava cheese was developed using soya protein isolate and whey protein isolate powder (2, 4 and 6%). Cheese variants supplemented with 2% soya protein isolate powder and 4% whey protein isolate powder were found most acceptable and selected for preparation and evaluation of protein rich banana-guava cheese. The product was evaluated for changes in chemical parameters at monthly interval for three months storage period. Total sugars, acidity, non-enzymatic browning and peroxide value increased significantly, while ascorbic acid, protein content, total carotenoids, total phenols and water activity decreased significantly in protein rich banana-guava cheese variants during three months storage.

Keywords: Banana, guava, protein rich, cheese, chemical, parameter, storage

Introduction
Banana (*Musa paradisiaca* L.) belongs to family Musaceae. Banana pulp contains 18% sugar and is also rich in vitamin A and B (Aurore *et al.*, 2009) [5]. According to Adamu *et al.* (2017) [2], it contains moisture (58.24 g/100 g), carbohydrates (30.33 g/100 g), protein (3.5 g/100 g), fat (1.30 g/100 g), crude fibre (3.53 g/100 g) and ash (3.10 g/100 g). Ripe banana is rich in carotenoids (735 mg/100 g), ascorbic acid (12.7 mg/100 g), citric acid and malic acid (Kumar *et al*., 2012) [10]. The products like chips, ready-to-serve drink, flour, jam, confections, dehydrated slices, pickles and purees can be prepared from this fruit.
Guava (*Psidium guajava* L.) is a tropical fruit and belongs to family Myrtaceae. The fruit has about 83% moisture and is an excellent source of ascorbic acid. The guava fruits are available in surplus quantity during certain period of the year and can be processed into acceptable products so that the growers may get the remunerative price of their produce. The guava fruits are used in the formation of products such as jam, jelly, cheese, toffee, nectar, squash, vinegar, canned guava, etc. Blending of pulp from two fruits in cheese preparation contributes towards improving the vitamins and minerals of cheese (Adhau & Salvi, 2014**)** [3].
Protein sources like soy protein and whey protein isolates have been used as nutritional and functional food ingredients in many food categories. These could be used in form of protein isolates and protein concentrates. Protein concentrates are concentrated form of protein containing 65-70% protein, while protein isolates contain even above 90% protein. The nutritional quality of fruit products is usually inferior in terms of protein content. Therefore, protein isolates or concentrates can be added to fruit products for increasing total protein content and improving the essential amino acids profile.
Keeping the above aspects in view, the efforts were made to standardize processing technology of protein rich banana-guava cheese using soya and whey protein isolates (2, 4 and 6%) and to evaluate the chemical parameters of the most acceptable protein rich banana-guava cheese variants during storage.

Materials and Methods
The present investigation was carried out in CFST, CCSHAU, Hisar during 2017-18. Banana and guava fruits were washed thoroughly before collection of pulp (Fig. 1 and 2).

Banana fruit
↓
Peeling off
↓
Slicing
↓
Mixing potassium metabisulphite (0.1%)
↓
Blending
↓
Packing in polypropylene jars
↓
Storing in deep freezer (-20°C)

Fig 1: Flow sheet for collection and storage of banana pulp

Guava fruits
↓
Washing and cutting into thin slices
↓
Passing through pulper
↓
Guava pulp
↓
Mixing sodium benzoate
(1g/kg pulp)
↓
Packing in polypropylene jars
↓
Storing in deep freezer (-20°C)

Fig 2: Flow sheet for collection and storage of guava pulp

Banana-Guava cheese (control) was prepared by using 1 kg blended pulp (40 banana:60 guava), 860 g sugar, 4 g citric acid, 70 g butter, 5 g salt and 20 g pectin (Fig. 3). The mixture of pulp, sugar, butter and citric acid was cooked with constant stirring with a ladle to obtain desired consistency. Pectin (20 g) dissolved in lukewarm water was mixed with the cooking mass. Protein rich banana-guava cheese variants were developed by mixing soya protein isolates and whey protein isolates powder (2, 4 and 6%) after dissolving in little quantity of lukewarm water at the end point of cooking mass. Salt was mixed when it started leaving sides of the pan. End point was judged by sheet test and total soluble solids (68%) were measured using hand refractometer (58-92%). The product was finally spread on trays smeared with butter and left for cooling and setting. After setting, cheese was cut into uniform size pieces, wrapped in butter paper and packed in LDPE bags.

Banana-Guava pulp
↓
Mixing sugar, butter and citric acid
(as per recipes)
↓
Cooking with continuous stirring
↓
Mixing pectin dissolved in lukewarm water
↓
Mixing soya protein and whey protein isolates (2, 4 and 6%) after dissolving in lukewarm water
↓
Mixing salt
↓
Removing from fire
(68% TSS)
↓
Spreading cheese on butter smeared trays
↓
Cooling and setting
↓
Cutting and wrapping in butter paper
↓
Packing in LDPE bags
↓
Storing at room temperature
(18.6-38.6°C)

Fig 3: Flow sheet for preparation of protein rich banana-guava cheese

On the basis of sensory evaluation, cheese variants supplemented with 2% soya protein isolates and 4% whey protein isolates were selected for preparation and evaluation of protein rich banana-guava cheese during three months storage. The product was analyzed for changes in chemical parameters at monthly interval for three months. Total sugars were estimated by titration method as suggested by Hulme & Narain (1931) [7]. Acidity, ascorbic acid and non-enzymatic browning were determined according to methods described by Ranganna (2014) [16]. Protein content and peroxide value was estimated using micro-Kjeldhal method (AOAC, 2005) [1] with KELPLUS nitrogen estimation system. Total carotenoids were analyzed by Rodriguez-Amaya method (2004) [17] and total phenols were estimated by the method suggested by Amorium *et al*. (1997) [4]. The water activity of cheese samples was assessed with the help of water activity meter (Rotronic Hydro Lab.).

Results and Discussion
The data (Table 1) show significant increase in total sugars of protein enriched banana-guava cheese variants during three months storage. The increase in total sugars of the products during storage might be due to hydrolysis of some carbohydrates like pectin, cellulose, starch, etc. and conversion of non-reducing to reducing sugars. Similar increase in total sugars of cheese during storage has also been reported by Sinha *et al*. (2017) [19] in guava cheese prepared by value addition of 1.5% ashwagandha powder.

The acidity in banana-guava cheese variants also increased significantly during storage. The increase in acidity of the product might be due to degradation of polysaccharides, pectic substances and uric acid during storage. Similar finding was reported by Shabi *et al.* (2018) [18] in guava cheese.

The ascorbic acid content in protein rich banana-guava cheese variants decreased significantly during three months storage. The decrease in ascorbic acid of protein rich cheese variants could be due to oxidation of ascorbic acid to dehydro-ascorbic acid with passage of time. Similar findings have been confirmed by Souad *et al.* (2012) [20] in jam prepared from watermelon waste

There was significant decrease in protein content of cheese variants over control. Similar decrease during storage has been reported by Khapre & Kulthe (2017) [9] in guava toffee enriched with soybean slurry. The decrease in protein content during storage of fruit products was attributed due to denaturation and degradation of protein into amino acid (Parimita & Arora, 2015) [15].

There was significant decrease in total carotenoids of protein rich banana-guava cheese during storage. It might be due to thermo-labile, thermo-sensitive and epoxide forming nature of carotene compounds. The results are in conformity with those of Deepika *et al*. (2016) [6] in aonla based fruit bars.

Total phenols in protein rich banana-guava cheese variants also decreased significantly during three months. The decrease in phenolic compounds of cheese during storage could be due to oxidation of phenols and its polymerization with proteins (Liu *et al.*, 2014) [11]. Due to this reason, the protein rich cheese variants containing soya protein and whey protein isolates had lowest total phenols. The results of the present investigation are in accordance with the findings of Nayak *et al*. (2011) [12] in aonla segments.

The non-enzymatic browning in protein rich banana-guava cheese variants increased significantly during three months storage. The increase in non-enzymatic browning might be due to formation of furfural and hydroxyl furfural by aerobic and anaerobic degradation of ascorbic acid, sugars and organic acids during storage. The results are also confirmed with the findings of Nayak *et al*. (2012) [13] in aonla candies.

A significant increase in peroxide value of protein rich banana-guava cheese variants was observed three months storage. The reason for increase in peroxide value of cheese variants during storage is due to the fact that phenolic compounds, carotenoids and ascorbic acid in fruits that helps in improving antioxidant activity and controlling peroxide value of fruit products got decreased during storage. The increase in peroxide value of products during storage was also reported by Khalil *et al*. (2019) [8] in cheese fortified with pomegranate and lemon peels extract.

The water activity in protein rich banana-guava cheese variants decreased significantly during storage. It might be due to loss of moisture content in cheese variants during storage. Similar decrease in water activity during storage was reported by Panwar (2014) [14] in IMF aonla segments during six months storage.

Table 1: Changes in chemical parameters of protein rich banana-guava cheese variants during storage

Treatments* Banana:Guava (40:60)	Storage period (months)	Total Sugars (%)	Acidity (%)	Ascorbic acid (mg/100g)	Protein content (%)	Total carotenoids (mg/100 g)	Total phenols (mg/100 g)	Non-enzymatic browning (440 nm)	Peroxide value (meq./kg)	Water activity (a_w)
Control sample (40 Banana: 60 Guava)	0	57.30	0.80	30.96	1.62	0.52	17.63	0.219	0.13	0.75
	1	58.20	0.84	27.92	1.60	0.49	16.58	0.225	0.15	0.73
	2	58.90	0.86	24.86	1.58	0.47	15.51	0.230	0.17	0.71
	3	59.70	0.89	21.80	1.57	0.45	14.45	0.242	0.20	0.70
Cheese prepared with 2% soy protein	0	56.40	0.76	27.76	3.44	0.45	17.52	0.198	0.15	0.72
	1	57.20	0.78	24.71	3.43	0.44	16.45	0.208	0.16	0.69
	2	57.70	0.81	21.68	3.41	0.42	15.38	0.215	0.18	0.66
	3	58.40	0.85	18.62	3.39	0.40	14.30	0.223	0.22	0.62
Cheese prepared with 4% whey protein	0	56.50	0.74	27.11	5.12	0.43	17.55	0.206	0.18	0.67
	1	57.40	0.76	24.05	5.10	0.42	16.48	0.214	0.20	0.65
	2	57.90	0.80	21.96	5.09	0.40	15.40	0.219	0.22	0.64
	3	58.70	0.84	18.92	5.07	0.38	14.30	0.226	0.25	0.62
CD at 5%	Treatment	0.09	0.03	0.05	0.07	0.09	0.02	0.026	0.02	0.22
	Storage	0.07	0.02	0.06	0.05	0.12	0.04	0.020	0.03	0.15
Treatment x Storage		0.17	NS	0.10	0.10	0.22	0.13	0.400	NS	0.40

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