Bioscene

Bioscene
Volume- 21 Number- 03
ISSN: 1539-2422 (P) 2055-1583 (O)
www.explorebioscene.com

Storage Stability and Sensory Evaluation of Guava-Strawberry Cheese and Toffee: Impact on Nutritional Quality and Consumer Acceptability

Mohammed Misab[1], Stuti Pathak[2]*, Kanchan Ainch[3] & Vishal Johar[4]

[1]Department of Food Science, School of Agriculture, Lovely Professional University, Phagwara, Jalandhar, Punjab, India,

[2]Department of Agriculture, Maharishi Markandeshwar University , Mullana, Ambala, Haryana, India,

[3]Amity School of Hospitality. Amity University Rajasthan, Kant Kalwar, Industrial Area, Rajasthan, India,

[4]Department of Horticulture, School of Agriculture, Lovely Professional University, Phagwara, Jalandhar, Punjab, India,

Corresponding Author: **Stuti Pathak**

Abstract: Guava-strawberry cheese and toffee were developed and evaluated for changes in its nutritional constituents and sensory quality at monthly interval for two months storage period. Ascorbic acid and anthocyanins decreased significantly in guava-strawberry cheese and toffee during two months of storage. The color and appearance, taste, flavor, mouthfeel, and overall acceptability of guava-strawberry cheese and toffee decreased significantly with the advancement in storage period, however, their overall rating remained above the acceptable level even after two months of storage. Cheese prepared with 20 Guava: 80 strawberry pulp was found most acceptable (8.32), while toffee prepared with 65 Guava: 35strawberry pulp was found most acceptable (8.07).

Keywords: Guava, strawberry, cheese, toffee, nutritional, sensory

Introduction

Guava (Psidium guajava) is a tropical fruit that originated in the Americas and is now widely cultivated in many parts of the world, including Asia, Africa, and the Caribbean. The fruit is round or oval, with a green or yellowish-green skin that turns yellow or reddish-pink when ripe. The flesh of the guava fruit is white, pink, or reddish, depending on the variety, and has a unique, slightly tangy flavor with notes of strawberry and citrus (Rashid et al., 2016). Guava is a rich source of various nutrients, including vitamin C, vitamin A, potassium, and dietary fiber. It also contains many antioxidants, such as carotenoids and flavonoids, which are believed to have various health benefits, including reducing inflammation and protecting against chronic diseases (Gutiérrez et al., 2008).Guavais primarily composed of water, ranging from 77-88%. Carbohydrates make up 9-11% of the fruit, with fructose, glucose, and sucrose being the main sugar components (Sogi et al., 2013). Guava is a good source of dietary fiber, containing 3.5-6.4% soluble and insoluble fiber from pectin, cellulose, and hemicellulose. It is an excellent source of vitamin C, providing 77-468 mg per 100g, which can be up to five times the recommended daily intake (Gull et al., 2012).

The strawberry (Fragaria x ananassa) is a highly prized fruit cultivated worldwide for its distinctive aroma, bright red color, juicy texture, and sweet flavour. It is an accessory fruit that develops from a single ovary of the strawberry plant, which is a low-growing perennial in the rose family (Rosaceae)(Giampieri et al., 2012**)**. Strawberries are rich in nutrients, including vitamin C, folate, potassium, and antioxidants such as pelargonidin, which give the fruit its vibrant red hue (Basu et al., 2014). They are an excellent source of dietary fiber and phytochemicals like ellagitannins and procyanidins, which have been associated with various health benefits (Gasperotti et al., 2015).Strawberries are widely consumed fresh, frozen, or processed into jams, jellies, juices, and other products. They are a valuable crop with significant economic importance, particularly in temperate regions, where they are grown commercially on a large scale (Hancock et al., 2008).

Fruit toffee, also known as fruit candy or fruit leather, is a confectionery made by dehydrating puréed fruit into a chewy, pliable sheet. This unique treat has been enjoyed for centuries and remains a popular snack or dessert around the world. The process of making fruit toffee involves cooking fruit pulp or purée with sugar and other ingredients until thickened, then spreading the mixture evenly and allowing it to slowly dry into a pliable, leathery texture.The origins of fruit toffee can be traced back to ancient civilizations in the Middle East and Asia, where fruits like dates, figs, apricots and grapes were dried and preserved as a way to extend their shelf life. Over time, techniques were developed to enhance the natural sweetness by adding sugars like honey or cane syrup during the drying process (Alkhiali et al., 2022). Toffees are chewy confectioneries primarily composed of sugar, milk solids, and either butter or vegetable fat (Bhokre et al., 2010). Fruit toffees are made from dried fruit pulp combined with a precise mixture of sugar and acid. These products typically contain 20% moisture, 75% total soluble solids (TSS), and 25% fruit content.

Fruit cheese is a chewable confectionery item containing sugar and butter as the major ingredients.The basic process involves cooking down fruit pulp or puree with sugar until it reaches a thick, spreadable texture. Pectin from the fruit or added pectin helps create the gel-like consistency. Some recipes may also include spices, citrus juices, or other flavorings. The cooked fruit mixture is then poured into molds and allowed to set into its firm, sliceable form Popular fruits used for fruit cheeses include apples, pears, plums, quince, oranges, and other citrus. The concentrated fruit flavors and soft, paste-like texture make them a versatile ingredient to be enjoyed on toast, baked goods, cheese plates, or even as a dessert on their own (Mertens et al., 2006).

Materials and methods

Uniformly ripe strawberry and guava fruits were selected for extraction of pulp to make cheese and toffee from strawberry-guava blends. Guava fruits were thoroughly washed under running water and then sliced thinly using a stainless-steel knife. The slices were combined with an equal amount of water and heated to 75°C for 2 to 3 minutes to soften them. The softened slices were subsequently processed through a fruit pulper to produce a homogenized, seedless pulp.

The extracted guava pulp was blended with strawberry pulp in varying proportions of 100:0, 80:20, 60:40, 40:60, 20:80, and 0:100. Cheese variants were then prepared using 100g of the blended pulp, 50g of cottage cheese (paneer), 10g of sugar, 20g of butter, 1g of citric acid, 2g of black salt, 1g of black pepper, 0.5g of kasuri methi, and 2g of red chili. Based on sensory evaluations, the blend with a 20:80 ratio of guava to strawberry was selected, along with blends of 100% guava and 100% strawberry, for storage studies at room temperature.The cheese was prepared using the selected guava-strawberry blends with the same ingredients as listed. Additionally, 2% pectin was added to the mixture to ensure proper setting. The mixture was cooked until it reached the desired consistency, then spread on butter-smeared trays to a thickness of 0.60 cm and left to cool and set for 5 to 6 hours. Once set, the product was wrapped in butter paper and packed in LDPE bags.The cheese was analyzed for changes in chemical composition over two months, with evaluations conducted at monthly intervals. Each treatment was replicated three times in a completely randomized design.Among these blends, one optimal blend (20% guava: 80% strawberry) was selected, along with the 100% guava and 100% strawberry controls, based on sensory evaluation for a storage study.

Guava – strawberry blends

↓

Addition of cottage cheese (paneer) 50g

↓

Mixing with sugar, butter, red chili, black pepper

↓

Addition of citric acid, salt

↓

Mixing of KMS (0.07%)

↓

Rolling into sheets on a smeared tray (0.6 cm thick)

↓

Cooling and cutting

↓

Wrapping in butter paper

↓

Packing in polyethylene sheets

↓

Storage

Fig 1: Flow sheet for the preparation of guava–strawberry cheese

Five varieties of toffees were created using optimal levels of guava pulp, combined in the following proportions with strawberry pulp: 100:00 (guava control), 00:100 (strawberry control), 75:25, 70:30, and 65:35 w/w. Other ingredients, including 500 g of sugar, 100 g of butterfat, 50 g of skim milk powder, and 2 g of salt per kg of pulp, remained constant across all formulations. The homogenized pulps were placed in a stainless-steel container and thoroughly mixed with the other ingredients. The mixture was heated until the TSS content reached 80° Brix. Salt, dissolved in a small amount of water, was then added to the mixture, which was heated again until the TSS content reached 82–83° Brix. The heated mass was spread into a thin sheet, 1 to 2 cm thick, on a stainless-steel plate coated with fat. This was allowed to cool and set for 2 to 3 hours before being cut into 1.5 to 2.5 cm cubes with a stainless-steel knife. All of these combinations were selected for sensory evaluation.

Guava-strawberry blends

↓

Concentration of pulp to 1/3 of its original volume

↓

Addition of sugar, butter

↓

Cooking (till sufficiently solid)

↓

Addition of skim milk powder and dissolved in little water

↓

Cooking (4 – 5 minutes)

↓

Removing from fire

↓

Mixing of KMS (0.07%)

↓

Rolling into sheets on a smeared tray (0.50 to 0.75cm thick)

↓

cooling and cutting

↓

wrapping in butter paper

↓

packing in polyethylene sheets

Fig 2: Flow chart for the preparation of guava-strawberry toffee

Toffee and cheese were analyzed monthly over a two-month storage period to monitor changes in their nutritional components. Anthocyanin and ascorbic acid were analyzed using the methods outlined by Ranganna (2014).Guava-Strawberry cheese and toffee were also evaluated organoleptically at monthly intervals during a month's storage period.The SPSS statistical software (Version 23.0, IBM Corporation, Somers, NY, USA) was utilized to perform variance analysis (ANOVA) and Tukey multiple range tests. Data are presented as mean values with standard deviations, with significant differences indicated at $p<0.05$. Each attribute was measured in triplicate (n=3). The critical difference value at the 5 percent level was applied to compare different treatments over the two-month storage period.

Color analysis of toffee

The color of the toffee (guava-strawberry) was measured using a colorimeter (MiniScan XE Plus, CIPHET, Ludhiana, India) under conditions (Illuminant: *C, D65; space: LAB). For color analysis, the instrument was calibrated with a white reference tile before measurements The color was determined in CIE- L*, a*, b*, z* system, where L* indicates lightness (100: white, 0: black). The redness

(+)/greenness (−) and the yellowness (+)/blueness (−) are denoted by a* and b* values, respectively (Huq et al. 2021).

$\Delta E = \sqrt{(\Delta L)^2 + (\Delta a)^2 + (\Delta b)^2}$

Texture analysis of toffee

Texture Analyzer Model TMS-Pro from Food Technology Corporation, U.S.A. Having a load cell of 250 N was used for measuring texture of cheese toffee. A 4 mm cylindrical probe was used for both cheese and toffee in conjunction with a texture analyser. A2.5mm penetration was done for cheese and toffee. The hardness of products was noted in Newton (N)

Sensory Evaluation of toffee and cheese

A sensory evaluation was conducted on the developed guava-strawberry toffee and cheese, assessing parameters such as color, flavor, texture, taste, and overall acceptability. This evaluation involved a taste panel consisting of 15 semi-trained panelists. A 1- to 9-point hedonic rating test, as described by Amerine et al. (1965), was utilized to gauge the level of acceptability of the donuts.The hedonic rating scale was arranged such that: 9 = like extremely, 8 = like very much, 7 = like moderately, 6 = like slightly, 5 = neither like or dislike, 4 = dislike slightly, 3 = dislike moderately, 2 = dislike very much, and 1 = dislike extremely.

Result and discussion

Treatment	Moisture (%)	TSS (Brix)	Acidity (%)	Reducing sugar (%)	Total sugar (%)	Ascorbic acid (mg/100g)
T1	7.14 ± 0.023	83.27±0.014	0.19 ± 0.011	34.92 ±0.014	72.02 ± 0.039	86.51 ± 0.017
T2	7.64 ± 0.088	82.52 ± 0.263	0.32 ± 0.011	32.21 ± 0.008	69.24 ±0.020	43.64 ± 0.014
T3	7.63 ± 0.014	83.89 ± 0.008	0.27 ± 0.008	33.04 ± 0.012	70.34 ± 0.012	68.85 ± 0.008
T4	7.75±0.056	82.62 ± 0.031	0.29 ± 0.017	33.45 ± 0.046	70.50 ± 0.044	64.38 ± 0.033
T5	7.76 ± 0.052	82.95 ± 0.014	0.28 ± 0.013	31.78 ± 0.040	69.44 ± 0.029	61.33 ± 0.040

Table 1: Chemical constituents of guava-strawberry toffee

Table 2: Change in chemical constituents of guava-strawberry toffee during storage

Treatments Guava-strawberry	Storage periods (months)	Moisture Content (%)	TSS (Brix)	Acidity (%)	Reducing sugar (%)	Total sugar (%)	Ascorbic acid (%)
100:0	0	7.14	83.27	0.195	34.92	72.45	86.51
	1	6.77	83.14	0.198	34.68	72.01	82.66
	2	6.58	84.23	0.207	34.10	71.45	78.33
0:100	0	7.64	85.52	0.329	32.21	70.01	43.64
	1	7.02	82.91	0.335	33.24	70.11	40.27
	2	6.73	83.75	0.326	32.51	70.17	37.77
75:25	0	7.63	83.89	0.272	33.04	71.59	68.85
	1	7.11	84.77	0.269	32.31	70.49	65.49
	2	6.33	85.32	0.270	32.02	70.22	62.78
70:30	0	7.75	82.62	0.294	33.45	70.48	64.38
	1	7.08	83.68	0.284	32.58	70.37	61.54
	2	6.03	84.32	0.291	33.20	70.10	59.89
65:35	0	7.76	82.95	0.288	31.78	71.31	61.33
	1	6.94	83.78	0.270	33.56	71.01	59.23
	2	6.47	84.77	0.283	33.05	70.91	57.60
C.D at 5%	-	N/A	N/A	0.011	1.099	N/A	0.030
S.E(m)	-	0.337	0.435	0.031	0.540	0.577	1.701
S.E(d)	-	0.476	0.615	0.044	0.764	0.816	2.406
C.V.	-	2.319	0.899	19.33	2.827	1.404	4.752

NA - Not applicable

Table 3: Chemical constituents of guava-strawberry cheese

Treatment (Guava-strawberry)	TSS (Brix)	Acidity (%)	Total phenols (mg/100)	Total flavonoids (mg GAE/100g)	Ascorbic acid (mg/100g)	Anthocyanins (mg/100 g)	Antitoxin - dent Activity (%)
T1 (100:0)	65.09 ± 0.050	0.73 ± 0.014	233.24 ± 0.090	0.331 ± 0.006	59.43±0.064	ND	63.45±0.043
T2 (20:80)	65.68 ± 0.044	0.67 ± 0.017	217.80 ± 0.066	0.156 ± 0.007	48.40±0.047	37.46±0.049	65.86±0.027
T3 (0:100)	66.16 ± 0.032	0.58 ± 0.024	206.67 ± 0.076	0.083 ± 0.002	43.64±0.040	44.60±0.049	75.34±0.043

Table 4: Change in chemical constituents of guava-strawberry cheese during storage

Treatment Guava-strawberry	Storage periods (months)	TSS (Brix)	Acidity (%)	Total phenols (mg/100g)	Total flavonoids (mg GAE/100 g)	Ascorbic acid (mg/100g)	Anthocyanin (mg/100g)	Antioxidant activity (%)
100:0	0	65.09	0.737	233.24	0.331	59.43	ND	63.45
	1	66.23	0.698	232.97	0.297	53.21	ND	59.22
	2	68.32	0.729	232.82	0.277	50.21	ND	53.34
20:80	0	65.68	0.670	217.80	0.156	48.40	37.46	65.86
	1	67.78	0.617	217.58	0.125	45.94	36.04	66.27
	2	68.77	0.612	218.34	0.111	41.73	35.77	62.89
100:0	0	66.16	0.585	206.67	0.081	43.64	44.60	75.34
	1	67.07	0.574	203.23	0.066	40.21	43.31	72.56
	2	69.45	0.612	215.26	0.051	38.02	41.97	69.02
C.D at 5%	-	N/A	0.046	0.306	0.046	0.057	0.630	0.364
S.E(m)	-	0.946	0.032	2.071	0.013	2.148	0.652	2.087
S.E(d)	-	1.338	0.046	2.929	0.018	3.037	0.923	2.952
C.V.	-	2.440	2.567	1.632	3.464	2.957	2.835	2.534

ND – Not detected, NA – Not applicable

The data (Table 2 and Table 4) reveal that there was an increasing trend in total soluble solids of guava-strawberry toffee and cheese during two two-month storage period. The increase in total soluble solids might be due to acid hydrolysis of insoluble polysaccharides, especially gums and pectin, and its conversion into soluble sugar. Similar increase was observed in papaya toffee by Attri et al. (2014). Ascorbic acid is sensitive to heat and light and is oxidized quickly in the presence of oxygen. hence, it might have been destroyed during processing and subsequently during storage period. Similar reduction in ascorbic acid content was also recorded in guava-papaya toffee by Mewada et al. (2013) and guava toffee by Chavan et al. (2016). The acidityof guava-strawberry toffee and cheese decreased significantly during two months of storage. Similar results of a decrease in acidity werefound by Attri et al. (2014) in papaya toffee and leather.Flavonoids are a group of polyphenolic compounds found in fruits, vegetables, and other plant-based foods. They are known for their antioxidant properties and potential health benefits, including anti-inflammatory, anti-cancer, and cardioprotective effects. The total flavonoid content decreased with increasing storage time for all treatments, which could be attributed to the degradation or oxidation of flavonoids during storage.It is worth noting that the total flavonoid content can vary depending on factors such as fruit variety, growing conditions, processing methods, and extraction techniques (Haminiuk et al., 2012).During a two-month storage period, there was a significant decrease in the antioxidant activity observed in guava-strawberry cheese. The antioxidant activity of cheese fortified with fruit-based ingredients. The incorporating pomegranate rind powder into cheese significantly increased its antioxidant capacity and total phenolic content. Similarly, Ozcan et al. (2015) observed enhanced antioxidant activity in cheese supplemented with grape seed extract.The antioxidant activity of the cheese samples could be attributed to the presence of bioactive compounds from strawberries and guavas, such as vitamin C, phenolic acids, flavonoids, and anthocyanins (Vieira et al., 2011).Anthocyanins are phenolic compounds known for their high volatility and susceptibility to oxidation. Their levels might also diminish during storage due to condensation into brown pigments. Similar result was reported by Kannan and thirumaran (2001) in Jamun products.

Color Analysis of Toffee

The color parameters (L*, a*, b*, and Z) of the toffee formulations made from different ratios of strawberry and guava pulps are presented in Table 5 The lightness (L*) values ranged from 26.64 ± 0.234 (T1: 100% guava pulp) to 32.19 ± 0.048 (T2: 100% strawberry pulp), indicating that the toffee made from 100% strawberry pulp was lighter in color. The redness (a*) values were highest for T2 (15.79 ± 0.104) and lowest for T1 (6.80 ± 0.357), with the blended formulations (T3, T4, and T5) exhibiting intermediate values. The yellowness (b*) values were highest for T1 (9.22 ± 0.301) and lowest for T4 (5.84 ± 0.208). The browning index (Z) values ranged from 4.13 ± 0.546 (T3) to 5.99 ± 0.064 (T4), suggesting varying degrees of browning among the formulation. The color parameters of the toffee formulations were influenced by the ratios of strawberry and guava pulps used. The control T1 (100% guava pulp) exhibited a darker, more yellowish hue, while the control T2 (100% strawberry pulp) displayed a lighter, more reddish hue. These differences can be attributed to the natural pigments present in the respective fruit pulps. Guava pulp contains carotenoids and chlorophylls, which contribute to its yellowish hue, while strawberry pulp is rich in anthocyanins and carotenoids, imparting a reddish color (Zapata et al., 2020; Türker & Tatlısu, 2019).

The blended formulations (T3, T4, and T5) exhibited color characteristics that were intermediate between the control samples, with higher strawberry content resulting in a lighter, more reddish hue, and higher guava content contributing to a darker, more yellowish hue. These observations are consistent with previous studies that have reported color changes in fruit-based products due to the blending of different fruit sources (Mahdavi et al., 2021; Kumar & Srivastav, 2016). The browning index (Z) values also varied among the formulations, with T4 (75% guava, 25% strawberry) exhibiting the highest value, suggesting a higher degree of browning. This could be attributed to the Maillard reaction, which occurs between reducing sugars and amino acids during thermal processing, leading to the formation of brown pigments (Tamanna & Mahmood, 2015).

Treatments	**Color analysis of toffee**			
	L*	**a***	**b***	**Z***
100:0	26.64 ± 0.234	6.80 ± 0.357	9.22 ± 0.301	4.21 ± 0.084
0:100	32.19 ± 0.048	15.79 ± 0.104	8.11 ± 0.427	5.19 ± 0 .068
75:25	27.66 ± 0.422	10.58 ± 0.422	5.84 ± 0.208	5.99 ± 0.064
70:30	29.34 ± 0.342	14.04 ± 0.169	7.56 ± 0.288	4.13 ± 0.546
65:35	31.26 ± 0.286	14.20 ± 0.882	7.29 ± 0.602	4.89 ± 0.109

Table 5: colour analysis of toffee

Texture Analysis of Toffee

The texture analysis revealed that the toffee samples made from different combinations of guava and strawberry pulps exhibited varying textural properties. The sample T2 (100% strawberry pulp) was the hardest and most adhesive but had low springiness, cohesiveness, and resilience. T1 (100% guava pulp) was relatively softer, less adhesive, and springier and more resilient compared to T2. The blend T5 (65% guava pulp and 35% strawberry pulp) exhibited intermediate hardness, high adhesiveness, low springiness, and the highest cohesiveness, gumminess, and chewiness values among the three samples (Table 6).

Treatments	**Texture analysis of toffee**						
	Hardness	Adhesiveness	springiness	Cohesiveness	Gumminess	Chewiness	Resilience
T1(100:0)	76.16±61.19	-59.60±29.20	0.143±0.029	0.054±0.010	9.41±0.251	0.64±0.131	0.083±0.058
T2(0:100)	436.6±20.02	-144.3±37.49	0.04±0.003	0.03±0.003	13.3±1.256	0.60±0.047	0.01±0.002
T5(65:35)	120.9±11.61	-116 ± 30.65	0.014±0.006	0.07±0.018	16.07±1.427	1.02±0.275	0.048±0.015

Table 6: Texture analysis of toffee

The hardness of toffee T2 (100% strawberry pulp) exhibited the highest hardness value (436.6 ± 20.02), indicating that the toffee made from pure strawberry pulp was the hardest among the samples. T1 (100% guava pulp) had a relatively lower hardness value (76.16 ± 61.19), while T5 (65% guava pulp and 35% strawberry pulp) had an intermediate hardness value (120.9 ± 11.61) between T1 and T2.All samples exhibited negative adhesiveness values, indicating that some force was required to remove the toffee samples from the probe surface. T2 (100% strawberry pulp) had the highest adhesiveness value (-144.3 ± 37.49), implying that it was the most adhesive sample among the three. T1 (100% guava pulp) and T5 (65% guava pulp and 35% strawberry pulp) had lower adhesiveness values of -59.60 ± 29.20 and -116 ± 30.65, respectively.In this the T5 (65% guava pulp and 35% strawberry pulp) had the highest cohesiveness value (0.07 ± 0.018), indicating that it was the most cohesive sample among the three. T1 (100% guava pulp) and T2 (100% strawberry pulp) had lower cohesiveness values of 0.054 ± 0.010 and 0.03 ± 0.003, respectively.Springiness: T1 (100% guava pulp) exhibited the highest springiness value (0.143 ± 0.029), indicating its ability to recover its original shape after deformation. T2 (100% strawberry pulp) had the lowest springiness value (0.04 ± 0.003), suggesting that it was the least elastic sample. T5 (65% guava pulp and 35% strawberry pulp) had a very low springiness value (0.014 ± 0.006), similar to T2.T5 (65% guava pulp and 35% strawberry pulp) exhibited the highest gumminess value (16.07 ± 1.427), followed by T2 (100% strawberry pulp) with a gumminess value of 13.3 ± 1.256, and T1 (100% guava pulp) with the lowest gumminess value (9.41 ± 0.251).In this the T1 (100% guava pulp) exhibited the highest resilience value (0.083 ± 0.058), followed by T5 (65% guava pulp and 35% strawberry pulp) with a resilience value of 0.048 ± 0.015, and T2 (100% strawberry pulp) with the lowest resilience value (0.01 ± 0.002).

Sensor analysis of toffee

Consumer food choice motivation is strongly influenced by sensory parameters such as smell, taste, texture, appearance, and color. A study was conducted to evaluate the sensory attributes of different toffee formulations (Table 7). Among the five-toffee tested, the treatments T5 (65:35) and control T2(0:100) generally scored higher in appearance and smell compared to other treatments, indicating these formulations might have better visual appeal. Texture ratings varied across treatments, with T3 receiving the highest score. However, control T1 and T3 also received relatively high scores in this texture aspect. Aroma and taste are crucial sensory attributes in food acceptance. T2 and T5 received high scores in aroma, while T1, T3, and T4 scored well in taste. Both controls (T1,T2) scored decently in both aroma and taste. The aftertaste is an important aspect influencing overall food perception. T2 and T5 received higher scores in the aftertaste. Overall acceptability scores were generally higher for T1, T2 (control) and T5 indicating these formulations were more favoured by the panellists.

Evaluation parameters	Treatment's guava% and strawberry%				
	Control (T1) Guava (100%)	**Control (T2) strawberry (100%)**	**T3 (75%+25%)**	**T4 (70%+30%)**	**T5 (65%35%)**
Appearance	7.10	7.98	7.22	7.63	7.98
Smell	7.67	8.12	6.56	7.34	7.87
Colour	7.80	8.43	7.55	6.78	8.12
Texture	8.1	7.02	7.77	7.32	7.77
Taste	8.17	7.87	6.87	7.99	8.56
Mouth feel	7.09	7.22	6.98	6.66	7.54
Overall acceptability	7.52	7.85	7.03	7.22	8.07

Table 7: sensory analysis of toffee

Sensory analysis of cheese

Research project was undertaken to assess the sensory characteristics of three different cheese formulations: one with a ratio of 0:100, another with 100:0, and a third with 80:20 (Table 8). Among these cheese tested, the treatments T2 (0:100) and T3 (80:20) generally scored higher in colour and taste compared to other T1(100;0), indicating these formulations might have better visual appeal. Texture ratings varied across treatments, with T3(80:20) receiving the highest score. However, control T1 and T2 also received relatively high scores in this texture aspect. Aroma and taste are crucial sensory attributes in food acceptance.T2 and T5 received high scores in aroma, while those three scored well in taste(T1,T2,T3). Both controls (T1,T2) scored decently in both aroma and taste. The aftertaste is an important aspect influencing overall food perception.T2 received higher scores in the aftertaste. Overall acceptability scores were generally higher for T2 (control) and T3 indicating these formulations were more favored by the panelists.

Table 8: sensory analysis of cheese

Evaluation parameters	Treatments		
	Control Guava (100%)	**Control strawberry (100%)**	**Sample 1 (80%:20%)**
Appearance	7.23	7.67	7.43
Smell	6.78	8.32	8.01
Colour	7.21	8.21	7.45
Texture	6.56	6.87	7.78
Taste	7.77	8.11	7.45
Mouth feel	7.40	7.45	7.31
Overall acceptability	7.43	7.89	8.32

Conclusion

The present study concluded that cheese made from a blend of 20% guava and 80% strawberry received the highest overall acceptability rating (8.32), followed by cheese made from pure strawberry pulp with a rating of 7.89. Similarly, toffee made from a blend of 65% guava and 35% strawberry achieved the highest overall acceptability score (8.07), with toffee made from pure strawberry pulp close behind at 7.85. Although the overall acceptability of guava-strawberry cheese and toffee decreased significantly over two months of storage, both products remained acceptable after this period. During storage, total sugars and reducing sugars in the products increased significantly, while levels of anthocyanins, ascorbic acid, total phenols, total flavonoids, and antioxidant activity decreased significantly. The texture of guava-strawberry cheese softened, whereas the texture of guava-strawberry toffee hardened over the two-month storage period.

Reference

1. Alkhiali, R. et al. (2022). Nutritional and Functional Characteristics of Fruit Leathers: A Review. Food Reviews International, 38(3), 263-280.
2. Attri S, Dhiman AK, Kaushal M, Sharam R. Development and storage stability of papaya (Carica papaya L.) toffee and leather. International Journal of Farm Sciences. 2014; 4(3):117-125
3. Basu, A., et al. (2014). Strawberries decrease atherosclerotic markers in subjects with metabolic syndrome. Nutrition Research, 34(6), 462-469.
4. Bhokre CK, Rodge AB, Ghatge PU, Chilkawar PM. Preparation and evaluation of banana toffee. Beverage & Food World. 2010; 37(9):50-51.
5. Chavan UD, Shegade SL, Karma BR, Dalvi US. Studies on preparation of toffee from guava. International Journal of Advanced Research in Biological Sciences, 2016; 3(1):99-111
6. Gasperotti, M., et al. (2015). Strawberry-based cosmetic formulations protect human dermal fibroblasts against UVA-induced oxidative stress and mitochondrial dysfunction. Journal of Cosmetic Science, 66(4), 229-245.
7. Giampieri, F., et al. (2012). The strawberry: Composition, nutritional quality, and impact on human health. Nutrition, 28(1), 9-19
8. Gutiérrez, R.M.P., Mitchell, S., and Solis, R.V. (2008). Psidium guajava: A review of its traditional uses, phytochemistry, and pharmacology. Journal of Ethnopharmacology, 117(1), 1-27.
9. Haminiuk, C. W., Plata-Oviedo, M. S., de Mattos, G., Carpes, S. T., & Branco, I. G. (2012). Extraction and quantification of phenolic acids and flavonols from Eugenia pyriformis using different solvents. Journal of Food Science and Technology, 49(2), 208-212
10. Hancock, J.F., et al. (2008). Utilizing wild Fragaria virginiana in strawberry cultivar development: Inheritance of total phenolic content from the native source. HortScience, 43(5), 1384-1387.
11. Kannan S, Thirumaran AS. Studies on storage life of jamun products. Indian Food Packer. 2001; 55(6):125-127
12. Kumar, S., & Srivastav, S. (2016). Guava-strawberry blended leather: Physico-chemical, sensory and antioxidant properties. Journal of Food Science and Technology, 53(11), 3757-3767.
13. Mahdavi, R., Mohammadi, A., Feizollahi, E., & Jafari, S. M. (2021). Optimization of the formulation and processing conditions for production of functional gummy candies based on date and strawberry powders. LWT, 137, 110457.
14. Mewada H, Jain PK, Barche S. Physiological and biochemical evaluation of guava papaya mixed fruit toffee. International Journal of Horticulture. 2013; 3(3):11-15.

15. Mertens-Talcott, S.U. et al. (2006). Absorption, Metabolism, and Antioxidant Effects of Pomegranate (Punica granatum L.) Polyphenols After Ingestion of a Standardized Extract. Journal of Agricultural and Food Chemistry, 54(23), 8956-8961.
16. Ozcan, T., Bayizit, A. A., Ersan, L., & Yilmaz, B. (2015). Antioxidant properties of grape and pomace extract incorporated cheese. Journal of Food Processing and Preservation, 39(6), 2669-2677.
17. Ranganna S. Handbook of Analysis and Quality Control for Fruit and Vegetable Products. Tata McGraw Hills Publishing Co. Ltd., New Delhi, 2014
18. Rashid, M.M. (2016). Guava: An Underrated Fruit. In Breeding and Health Benefits of Fruit and Nut Crops. Intech Open, pp. 63-85.
19. Tamanna, N., & Mahmood, N. (2015). Food processing and Maillard reaction products: Effect on human health and nutrition. International Journal of Food Science, 2015, 526762.
20. Türker, N., & Tatlısu, N. B. (2019). Evaluation of color, antioxidant activity and anthocyanin content of selected strawberry cultivars. Journal of Food Measurement and Characterization, 13(3), 2039-2048.
21. Vieira, F. G. K., Borges, G. D. S. C., Copetti, C., Gonzaga, L. V., Nunes, E. D. C., & Fett, R. (2011). Physico-chemical and antioxidant properties of strawberry guava fruit (Psidium littorale Raddi). Brazilian Journal of Food Technology, 14(2), 115-123.
22. Zapata, K., Corradini, E., Aranda, P., & Galizzi, M. (2020). Guava (Psidium guajava L.) powder as an ingredient to develop novel food products: Exploring its phenolic compounds and antioxidant potential. Journal of Food Science and Technology, 57(8), 3089-3099.