Physical and sensory characteristics of cookies prepared with guava and chia seed flours

ABSTRACT

Guavas are frequently referred to be super fruits due to their abundance in dietary fibre, omega-3 and 6 polyunsaturated fatty acids in the seeds, and vitamins A and C in the pericarp. Chia seeds are also one of the foods with excellent nutritional value, outstanding omega-3 fatty acid quality, gluten-free protein, and a high level of antioxidants that protect the seeds from microbial and chemical deterioration. An experimental study was carried out to study the effect of different incorporation ratio of wheat, guava and chia seed flours on physical and sensory attributes of cookies. Mass, diameter, volume and spread ratio increased whereas thickness decreased by substituting wheat flour with guava flour. As per composition of flours, the T4 composition (incorporated with 20% wheat flour, 70% guava flour and 10% chia flour) in cookies had highest overall acceptability score and were more acceptable by the panel. Findings showed that on the basis of sensorial analysis, storage period had slight effect on the overall acceptability of cookies.

Keywords: *Superfruits, chia seeds, antioxidants, omega-3 & 6 fatty acids, overall acceptability.*

1. INTRODUCTION

The tropical fruits drying can be an excellent alternative to make their shelf-life longer and utilization easier. It allows conversion of perishable materials into stabilized products by lowering water activity to appropriate levels, thus preventing microbial spoilage and quality deterioration due to undesirable biochemical reactions **[1,2].**

The guava has various varieties such as Allahabad Safeda (roundish), Lucknow 49 (roundish Ovate), and seedless fruits, while Chitridar (sub-globose), Banarsi (round), Safed jam (roundish), Apple colour (spherical), Behat coconut (round), Hafshi (spherical), etc. are also considered to be very good varieties **[3]**. Allahabad Safeda, Chittidar, Lucknow-49, Bangalore, Nagpur Seedless, Dharwar, Arka Amulya, Akra Mridula, Harijha, Allahabad Surkha CISHG -1, CISHG-2, CISHG-3., etc. are the popular varieties grown in India **[4,5].**

The use of chia may be in the form of whole seeds, mucilage, flour and oil seed **[6].** Chia seed is an excellent source of omega-3/omega-6 fatty acids, soluble dietary fiber and contains appreciable amount of proteins and phytochemicals. Thus it has nutritional attributes which support

the prevention of several non-communicable diseases such as hypertension, obesity, cardio-vascular disease (CVD's), cancer and diabetes **[7,8]**.

Consumption of snack foods has been on the increase as a result of urbanization and increase in the number of working people. Cookies have become one of the most desirable snacks for both youth and elderly people due to their low manufacturing cost, convenience, long shelf life and ability to serve as a vehicle for important nutrients **[9,10].** It represents the largest category of snack items among baked food products throughout the word **[11].** This study aims to find the effect of different compositions of wheat, guava and chia seed flours on the physical properties and sensory characteristics of cookies produced having good acceptability.

2. MATERIALS AND METHODS

2.1 Preparation

Guava and chia seed flours were prepared by method **[12]**. Raw materials i.e., wheat flour, guava flour, chia seed flour, milk powder and baking powder were weighed in predetermined proportions and sieved together so that all the ingredients get thoroughly mixed. Fat and jaggery powder was creamed together using a whipping machine and added to the dry flours mix. Kneading was done with water to make dough. Dough was rolled and desired shape was cut using a cookie cutter and baked in the oven at 180°C for 18 minutes. Cookies were then cooled and packed in aluminium laminated pouches at room temperature. Wheat flour, guava flour and chia seed flour were mixed as per the following treatments.

Treatments:

T_0: Wheat flour (90%) and chia seed flour (10%) (control)
T_1: Wheat flour (80%), guava flour (10%) and chia seed flour (10%)
T_2: Wheat flour (60%), guava flour (30%) and chia seed flour (10%)
T_3: Wheat flour (40%), guava flour (50%) and chia seed flour (10%)
T_4: Wheat flour (20%), guava flour (70%) and chia seed flour (10%)
T_5: Guava flour (90%) and chia seed flour (10%)

2.2 Physical Properties

Cookies diameter (D) and thickness (T) were determined using vernier callipers, while cookies mass were measured as average of values of five individual cookies with the help of electronic balance. Volume of cookie was measured as the area of cookies multiplied by its thickness **[13]**. Spread ratio was expressed as diameter/thickness (D/T). The average values of 3 replicate determinations were reported.

2.3 Sensory Test

The sensory test was carried out just after the preparation and on interval of 1 month up to 90 days. A panel consisting of both genders 10 panelists of different age group having different eating habits was constituted to evaluate the color, taste, appearance, texture and overall acceptability. A hedonic scale 1–9 was used to evaluate the samples **[14]** in which a score of 1 represents the attributes most disliked while a score of 9 represents the attributes most liked. Scores above 5 are considered acceptable **[2]**.

2.4 Statistical Analysis

To test the significance of the effect of treatment and storage period on quality parameters, analysis of variance (ANOVA) of the collected data for different properties was carried out as applicable to experiments of randomized design of the data record. Data was analyzed with the help of MS Excel Spreadsheet and SPSS software. The analysis of samples was carried out at 5% level of significance.

3. RESULTS AND DISCUSSION

3.1 Physical Properties of Cookies

The result of physical properties of cookies produced from wheat, guava and chia seed flour blends is presented in **Table 1**. The mass and diameter of the cookies significantly ($p < 0.01$) increased with addition of guava flour from the control samples of 90% wheat flour and 10% chia flour. The lowest mass and diameter of 5.03 g and 3.22 cm were recorded for control cookies (T_0) whereas T_5 cookies measured highest values 5.40 g and 3.67 cm respectively. The increase in weight possibly could be due to the higher bulk density of the blend **[15]**. Similar findings were found by **Igbabul *et al.* [16]** in which they observed increasing mass and diameter of cookies on addition of cocoyam and African yam bean flours in wheat flour due to their higher bulk densities. The high diameter of the cookies made using fibrous flours in the blend are likely due to the high fibre content of the guava compared to that made using wheat flour. This finding is in agreement with the observation of **[17]**, who reported increase in cookie diameter with addition of sorghum flour to wheat flour. The thickness of the cookies varied from 0.83-1.03 cm and significantly decreased ($p < 0.01$) with increase in the incorporation ratio of guava flour. The high water absorption capacity of fibre can draw in more water, causing the viscosity of the dough to decrease and thus the thickness to decrease **[18]**.

Table 1. Physical properties of cookies

Samples	Physical Properties of Cookies (Mean ± SEm)					
	N	Mass (g)	Diameter (cm)	Thickness (cm)	Volume (cm^3)	Spread Ratio
T_0	**3**	$5.03^{a} \pm 0.012$	$3.22^{a} \pm 0.007$	$1.03^{e} \pm 0.006$	$8.38^{a} \pm 0.009$	$3.12^{a} \pm 0.006$
T_1	**3**	$5.09^{b} \pm 0.009$	$3.34^{b} \pm 0.012$	$0.97^{d} \pm 0.012$	$8.54^{b} \pm 0.024$	$3.45^{b} \pm 0.015$
T_2	**3**	$5.15^{c} \pm 0.009$	$3.45^{c} \pm 0.018$	$0.92^{c} \pm 0.012$	$8.60^{bc} \pm 0.024$	$3.75^{c} \pm 0.015$
T_3	**3**	$5.22^{d} \pm 0.012$	$3.52^{d} \pm 0.019$	$0.89^{b} \pm 0.015$	$8.66^{cd} \pm 0.020$	$3.96^{d} \pm 0.015$
T_4	**3**	$5.29^{e} \pm 0.013$	$3.61^{e} \pm 0.012$	$0.85^{ab} \pm 0.007$	$8.70^{d} \pm 0.019$	$4.24^{e} \pm 0.012$
T_5	**3**	$5.40^{f} \pm 0.006$	$3.67^{f} \pm 0.015$	$0.83^{a} \pm 0.012$	$8.78^{e} \pm 0.026$	$4.42^{f} \pm 0.017$
Overall	**18**	5.20 ± 0.030	3.47 ± 0.038	0.92 ± 0.017	8.61 ± 0.032	3.82 ± 0.108
F Value		165.305**	140.611**	46.903**	43.977**	1273.251**

*Significant ($p \leq 0.05$), **Highly significant ($p < 0.01$), Treatment along the columns with different superscripts (a - f) differed significantly at ($p \leq 0.05$)

Description

T_0 = Wheat Flour (90%), Chia Seed Flour (10%)
T_1 = Wheat Flour (80%), Guava Flour (10%), Chia Seed Flour (10%)
T_2 = Wheat Flour (60%), Guava Flour (30%), Chia Seed Flour (10%)
T_3 = Wheat Flour (40%), Guava Flour (50%), Chia Seed Flour (10%)
T_4 = Wheat Flour (20%), Guava Flour (70%), Chia Seed Flour (10%)
T_5 = Guava Flour (90%), Chia Seed Flour (10%)

The spread ratio varied from 3.12-4.42 and increased significantly ($p < 0.01$) with increase in guava flour ratio with control cookies from 90% wheat and 10% chia seed flours recording the lowest value of 3.12 while the cookies from 90% guava and 10% chia seed flours recorded the highest value of 4.42. The increase in the spread ratio could be attributed to the increased number of hydrophilic sites in the dough mixture leading to increased water absorption and swelling index. The rise in the spread ratio may be related to the dough mixture's enhanced hydrophilic sites, which increase water absorption and swelling index **[16]**. Similar findings were observed by **Ayo and Johnson [19]** who prepared acha-guava flour blend biscuits. The volume for different incorporation ratio of wheat flour and guava flour cookies increased were found to be significant at $p < 0.01$ level of significance.

3.2 Sensory Scores of Cookies

During the storage time sensory evaluation was done in the time interval of 30 days up to 90 days. All the sensory observations were shown in the **Table 2.** The sensory scores of developed cookies were not much affected during the storage period. Color scores of cookies slightly decreased with increasing ratio of guava flour and sample T_0 got highest average value for color 8.02 whereas sample T_5 got the least score 7.10. However changes in color development of baked products is also caused by Maillard reactions between sugars and proteins **[20]**. Sample T_4 got the highest score for taste 8.72 whereas lowest taste acceptance score was obtained by T_0 8.10. Taste scores evaluated by panelist members were in order T4>T3>T2>T1>T0>T5. In case of texture, adding guava flour affected the texture of cookies negatively. T_4 cookies got a highest score of 7.85 and lowest score was observed for T_5 with 6.90. **BERTAGNOLLI *et al.* [21]** also showed the decreasing appearance score of wheat cookies on addition of guava peel flour. The overall acceptability scores ranged from 7.35 to 7.95 before storage and after storage of three months it changed to a range of 7.02 to 7.66. T_4 having wheat flour (20%), guava flour (70%) and chia seed flour (10%) reported the highest acceptability of 7.95. After the sensory analysis it was found that all the organoleptic scores of the product samples were affected by the three months storage conditions but all were acceptable.

4. CONCLUSION

Incorporation of guava flour affected the both physical and sensory properties of the cookies. Increasing guava flour increased the mass, diameter, volume and spread ratio of the cookies which is considered to profitable for bakery industry. The cookies T_4 made with the flour blends of wheat, guava and chia seed in the ratio of (20:70:10) obtained highest overall acceptability. Using these flours to make cookies will significantly lessen reliance on wheat flour for cookie production. These crops might be used to make cookies, which would boost their production and consumption as well as reduce post harvest losses of guava in underdeveloped nations.

Table 2. Sensory properties of cookies

Samples	Color				Taste				Appearance				Texture				Overall Acceptability			
	0 day	30 days	60 days	90 days	0 day	30 days	60 days	90 days	0 day	30 days	60 days	90 days	0 day	30 days	60 days	90 days	0 day	30 days	60 days	90 days
T_0	8.02 ± 0.17	7.92 ± 0.38	7.78 ± 0.41	7.60 ± 0.65	7.12 ± 0.53	7.11 ± 0.61	7.11 ± 0.10	7.09 ± 0.16	7.12 ± 0.53	7.11 ± 0.61	7.11 ± 0.10	7.09 ± 0.16	7.07 ± 0.25	7.00 ± 0.10	6.88 ± 0.65	6.50 ± 0.67	7.57 ± 0.55	7.51 ± 0.13	7.43 ± 0.52	7.24 ± 0.80
T_1	7.90 ± 0.32	7.81 ± 0.40	7.79 ± 0.10	7.72 ± 0.69	7.30 ± 0.67	7.29 ± 0.45	7.29 ± 0.63	7.26 ± 0.41	7.30 ± 0.67	7.29 ± 0.45	7.29 ± 0.63	7.26 ± 0.41	7.23 ± 0.50	7.10 ± 0.16	6.95 ± 0.28	6.76 ± 0.69	7.68 ± 0.47	7.62 ± 0.65	7.53 ± 0.11	7.44 ± 0.58
T_2	7.68 ± 0.55	7.59 ± 0.50	7.42 ± 0.38	7.34 ± 0.13	7.59 ± 0.59	7.59 ± 0.57	7.59 ± 0.80	7.58 ± 0.32	7.59 ± 0.59	7.59 ± 0.57	7.59 ± 0.80	7.58 ± 0.32	7.41 ± 0.69	7.25 ± 0.65	7.08 ± 0.30	6.90 ± 0.13	7.78 ± 0.38	7.71 ± 0.45	7.61 ± 0.41	7.50 ± 0.61
T_3	7.35 ± 0.67	7.30 ± 0.45	7.23 ± 0.28	7.09 ± 0.64	7.82 ± 0.82	7.81 ± 0.82	7.80 ± 0.50	7.79 ± 0.45	7.82 ± 0.82	7.81 ± 0.82	7.80 ± 0.50	7.79 ± 0.45	7.64 ± 0.40	7.50 ± 0.92	7.32 ± 0.45	7.03 ± 0.32	7.85 ± 0.67	7.79 ± 0.64	7.71 ± 0.30	7.55 ± 0.53
T_4	7.27 ± 0.76	7.12 ± 0.16	6.96 ± 0.25	6.75 ± 0.92	7.99 ± 0.60	7.98 ± 0.53	7.97 ± 0.53	7.96 ± 0.40	7.99 ± 0.60	7.98 ± 0.53	7.97 ± 0.53	7.96 ± 0.40	7.85 ± 0.84	7.80 ± 0.17	7.61 ± 0.50	7.42 ± 0.41	7.95 ± 0.92	7.89 ± 0.43	7.78 ± 0.76	7.66 ± 0.73
T_5	7.10 ± 0.47	6.90 ± 0.76	6.72 ± 0.55	6.50 ± 0.13	6.88 ± 0.51	6.87 ± 0.63	6.86 ± 0.55	6.84 ± 0.19	6.88 ± 0.51	6.87 ± 0.63	6.86 ± 0.55	6.84 ± 0.19	6.90 ± 0.38	6.76 ± 0.25	6.55 ± 0.30	6.47 ± 0.16	7.35 ± 1.69	7.26 ± 0.92	7.14 ± 0.67	7.02 ± 0.68

Description

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T_2 = Wheat Flour (60%), Guava Flour (30%), Chia Seed Flour (10%)

T_3 = Wheat Flour (40%), Guava Flour (50%), Chia Seed Flour (10%)

T_4 = Wheat Flour (20%), Guava Flour (70%), Chia Seed Flour (10%)

T_5 = Guava Flour (90%), Chia Seed Flour (10%)

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