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Nutritional Cookies Fortified with Guava (Psidium guajava L.) Pomace

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Abstract:
This study investigates the development and evaluation of cookies fortified with guava (*Psidiumguajava* L.) pomace. Cookies were formulated substituting wheat flour (variety – Lokwan) with guava pomace at six levels (0%, 10%, 20%, 30%, 40%, and 50%) respectively. Physical, chemical, and sensory analysis was performed. Cookies containing up to 30% guava pomace showed acceptable sensory attributes and improved nutritional profile, demonstrating the potential to valorize fruit processing waste.

Keywords: Cookies, Guava pomace, Wheat flour, Fortification, Sensory analysis.

Introduction:-

Cookies have now become loved fast food product for every age group. They are easy to carry, tasty to eat, cholesterol-free, and reasonable at cost. In India, about 25 percent of the wheat is used in the preparation of baked goods (Kamaljit et al., 2010).Pomace is a good phytochemical source for food enrichment (Nakanem et al., 2019). Guava pulp is considered a rich source of fiber, ash, polyphenols and sugar. Fruits play an important role in human diet because they are dynamic bases of minerals, vitamins, and dietary fiber. They are rich source of iron, phosphorus, calcium and magnesium and contribute 90% dietary vitamin C.Yellow and green fruits are rich in vitamin A (beta-carotene), folic acid, niacin, and thiamine, which are vital for the normal functioning of the human body.

Guava (*Psidiumguajava* L.) being a climacteric and highly perishable fruit has rapid post-harvest ripening. It is called the “common man’s fruit” and is also referred to as the apple of the tropics and“apple of the poor man”. Guava has the priority over other fruits due to its high nutritional and commercial value. Guava is used in various food products to enhance the shelf life and to increase the nutritional value of the product.

Guava contributes significantly to health improvement and has become increasingly popular among consumers because of its rich nutrient content and pleasant flavor. According to Aquino(2019), guava-based food products have great potential for consumer acceptance due to their unique taste, natural sweetness, and nutritional

advantages. During current study different ratio using guava pulp and wheat flour cookies was made. It can increase the nutritional value of cookies and introduce a new flavor to the customer.

Materials and methods:-

Raw materials:-

The raw materials required for the preparation of cookies i.e. Wheat flour, Guava pomace, Baking powder, Baking soda, Brown sugar, Ghee, Salt, Milk and packing material were purchase from local market of Chalisgaon, District Jalgaon, and Maharashtra State, India.

Preparation of Cookies:-

Composite flour consisting of wheat flour (variety- Lokwan) and guava fruitpomace was used according to the treatment plan. Brown sugar and ghee wascreamed until the mixture became light and fluffy. Guava pomace was then added, followed by wheat flour, baking powder, baking soda, salt, and milk. The dough was molded into the desired shapes and baked at 180°C for 15 minutes. After baking, the cookies were cooled and packed in polythene (LDPE) pouches. The packed cookies were stored at ambient temperature (28:32°C) for stability observation. The prepared cookies were then evaluated for Physical, Chemical and Sensory analysis.

Proportions for Cookie Formulations:-

Treatment	Wheat Flour : Guava Pomace ratio
C_0	100:00
G_1	90:10
G_2	80:20
G_3	70:30
G_4	60:40
G_5	50:50

Physical analysis of cookies:-

The physical properties of the cookies such as weight, diameter, thickness, density and volume were measured as per the method reported by Pawar(2016). The diameter and thickness of cookies were determined using a Verniercaliper. Diameter and thickness was measured using a vernier caliper. Volume and density were measured by the procedure suggested by S. Srivastava et al.,(2012).The volume of biscuits was obtained as the area of the biscuit cookies multiplied by thickness.

$$\text{Volume } (cm^3) = \frac{d^2 \pi T}{4}$$

T = Average thickness of cookies (cm)

d = Average diameter of cookies (cm)

After calculating volume, density of biscuits was acquired as the ratio of weight to volume.

$$\text{Density } (g/cm^3) = \frac{\text{Mass of the sample (g)}}{\text{Volume of sample } (cm^3)}$$

Chemical Analysis of Cookies:-

The chemical composition of the cookies was analyzed for Energy, Protein content, Carbohydrates, Fat content, Moisture, Ash, Total sugar, Added sugar and Mineral composition (Potassium, Sodium, and Calcium).These parameters were used to evaluate the nutritional quality of the guava fruit pomace–fortified cookies. Content of cookies were tested at Shhlok Food Laboratories Pvt. Ltd., Chhatrapati Sambhajinagar, Maharashtra, India.

Sensory Analysis of Cookies:-

The sensory evaluation of cookies was conducted to assess their acceptability among consumers. A total of ten untrained panelists were selected from different faculties related to the field of education, considering their familiarity with food products. The evaluation was performed using the Nine-Point Hedonic Scale (Larmond,1977), where a score of 9 represented "extremely like" and 1 represented "extremely dislike." The panelists evaluated various sensory attributes such as color, flavor, texture, taste, and overall acceptability. The resulting data were analyzed using standard deviation (S.D.) and other statistical tools to determine significant differences among all treatments.

Observations:-

Analysis of Raw Materials:-

Table 1. Chemical Composition of Guava Pomace and Wheat Flour (Variety: Lokwan)

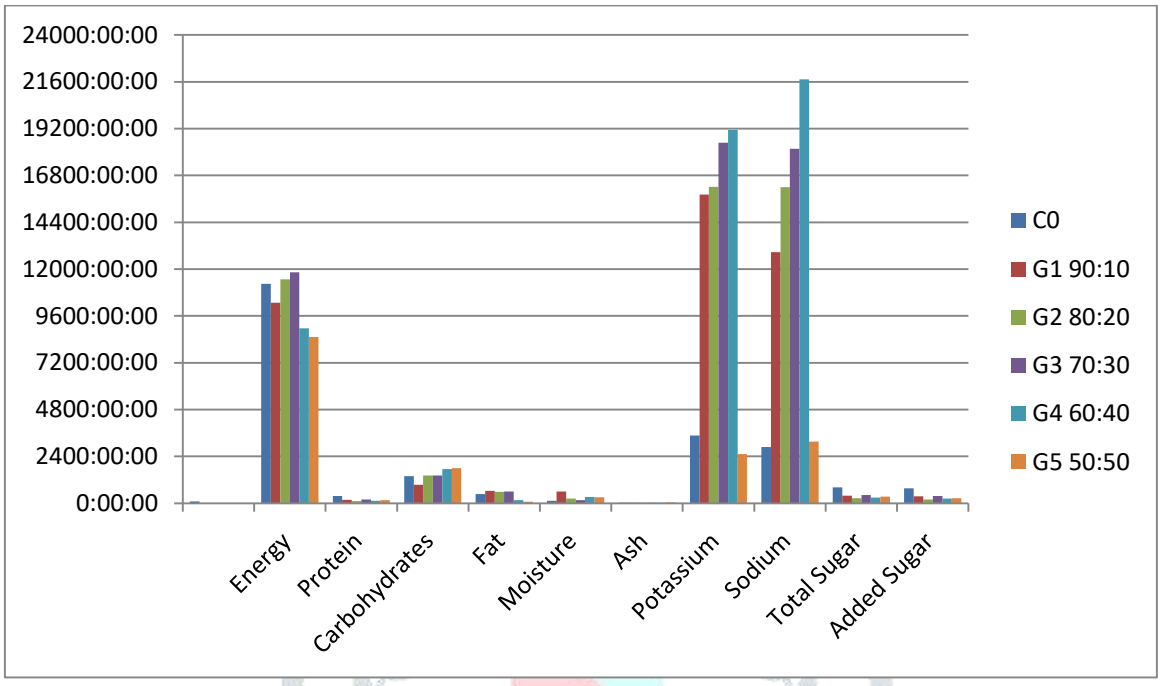
Sr. No.	Parameters	Guava Pomace	Wheat Flour (Variety:Lokwan)
1	Energy (kcal/100g)	47.44	390.8
2	Protein (g/100g)	2.23	12.4
3	Carbohydrates (g/100g)	7.38	80.71
4	Fat (g/100g)	1.0	2.0
5	Moisture (g/100g)	88.13	6.41
6	Ash (g/100g)	2.73	0.39
7	Potassium (mg/100g)	285	125
8	Sodium (mg/100g)	344	567
9	Total Sugar (g/100g)	8.8	0.0
10	Added Sugar (g/100g)	0.0	0.0
11	Calcium (mg/100g)	112	408

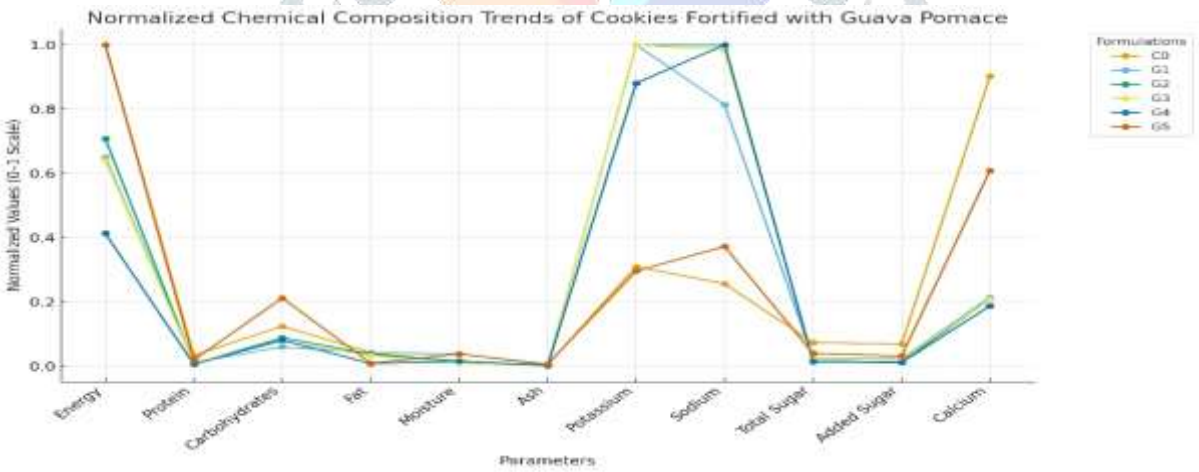
Chemical Composition of cookies:-

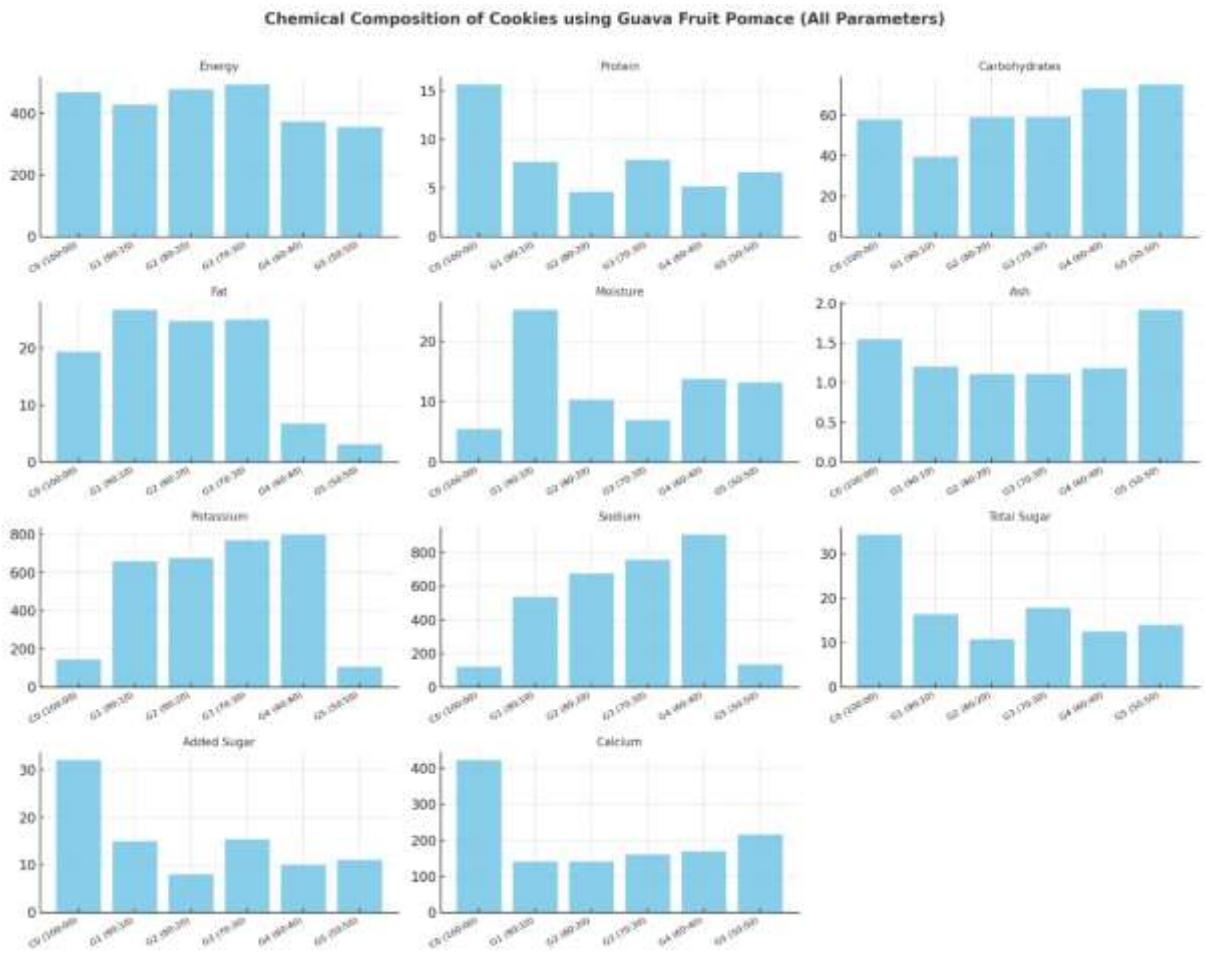
Table 2.Chemical Composition of cookies using Guava fruit Pomace

Sr.No.	Parameters	$C_0$100:00	$G_1$90:10	G_2 80:20	G_3 70:30	G_4 60:40	G_5 50:50
1	Energy	468.9	428.1	478.5	493.1	373.9	354.9
2	Protein	15.65	7.7	4.63	7.90	5.17	6.65
3	Carbohydrates	57.97	39.42	59.13	59.01	73.11	75.17
4	Fat	19.38	26.78	24.81	25.06	6.76	3.07
5	Moisture	5.45	25.23	10.27	6.92	13.78	13.19
6	Ash	1.55	1.20	1.11	1.11	1.18	1.92

7	Potassium	145	659	676	770	797	105
8	Sodium	120	536	675	757	905	132
9	Total Sugar	34.22	16.39	10.69	17.79	12.46	14.03
10	Added Sugar	32.05	14.97	7.99	15.39	9.96	11.03
11	Calcium	423	141	141	160	169	216







1) Energy values increased due to higher sugar and carbohydrate levels. Highest energy content was found in G_3 (70:30), i.e., 493.1 kcal.

2)Energy and carbohydrate content increased with guava pomace, while protein decreased due to dilution.

3) Protein (g)-The control sample (CO) had the highest protein (15.65 g).Guava pomace, being low in protein, caused this decrease.

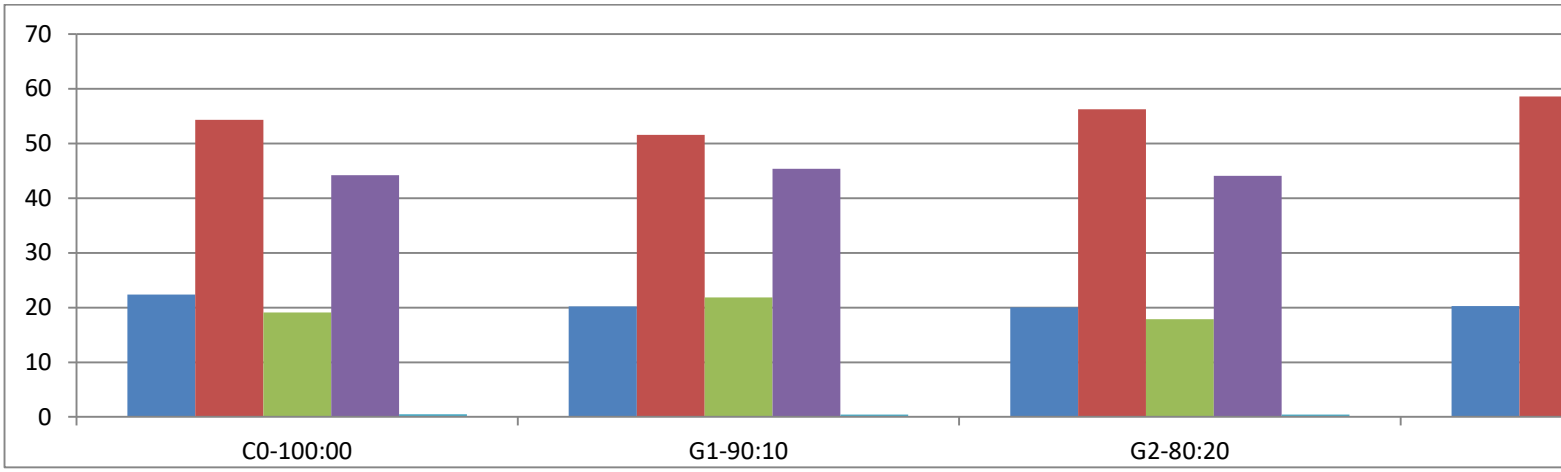
4) Fat (g)-Fat content was highest in G1 (26.78 g) and G3 (25.06 g).

5) Moisture (%)-G1 (25.23%) showed maximum moisture, while CO (5.45%) had the least.

Physical analysis cookies:-

Table 3. Physical analysis of cookies using Guava fruit Pomace

Sr.No	Treatment	Weight (g)	Diameter (mm)	Thickness (mm)	Volume (cm3)	Density (g/cm3)
1	C_0-100:00	22.35	54.32	19.11	44.20	0.49
2	G_1-90:10	20.19	51.60	21.87	45.38	0.42
3	G_2-80:20	20.04	56.27	17.85	44.12	0.44
4	G_3-70:30	20.26	58.62	17.59	47.42	0.43
5	G_4-60:40	19.30	57.80	17.01	44.58	0.42
6	G_5-50:50	17.42	59.33	17.37	47.73	0.35



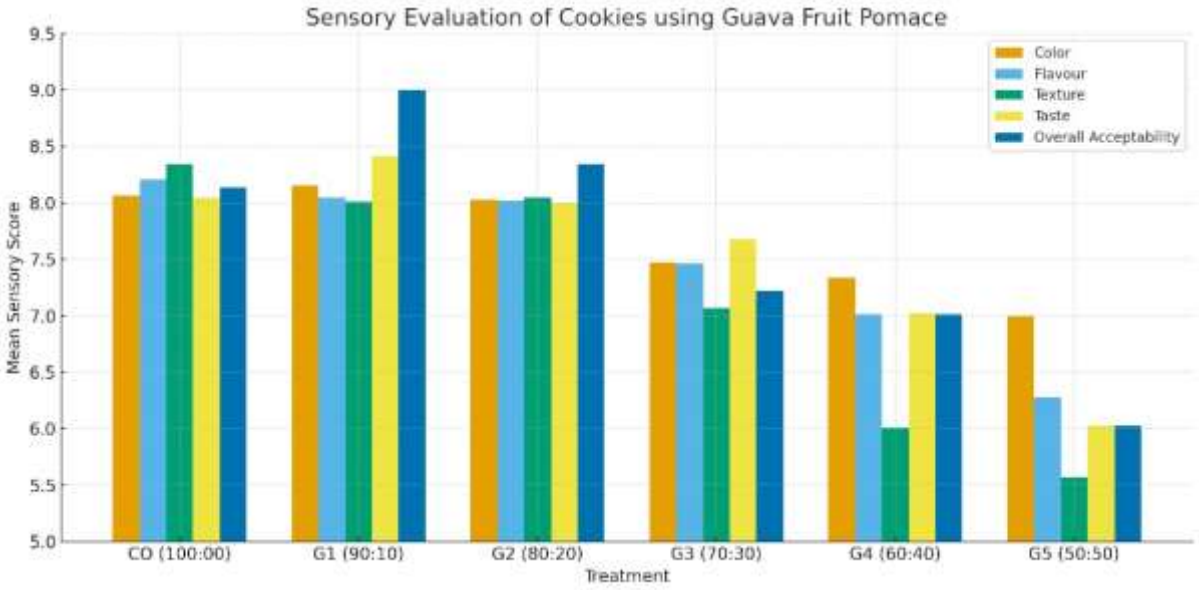
1)The control sample (G_0–100% wheat flour) had the highest weight (22.3 g).As guava pomace increased, the weight gradually decreased (lowest in G_5–50:50, i.e., 17.3 g).
2) Weight (g)-The control sample (C0–100:00) had the highest weight (22.35 g).
As guava pomace increased, the weight gradually decreased (lowest in G5–50:50 = 17.42 g).
3) Diameter (mm)-Diameter increased slightly with more guava pomace, from 54.32 mm (C0) to 59.33 mm (G5).
4) Thickness (mm)-The highest thickness was observed in G1–90:10 (21.87 mm) and lowest in G3–70:30 (17.59 mm).
5) Volume (cm^3)-The cookie volume showed mild fluctuations between 44–48 cm^3.
6)Density (g/cm^3)-Density decreased as guava pomace increased.
As pomace level increased, weight increased by approximately 9–10%.

Sensory evaluation of cookies:-

Table 4. Sensory evaluation of cookies using Guava fruit Pomace

Sr. No	Parameters	Treatment					
		C_0- 100:00	G_1- 90:10	G_2- 80:20	G_3- 70:30	G_4- 60:40	G_5- 50:50
1	Color	8.06±0.06	8.15±0.13	8.03±0.06	7.47±0.41	7.34±0.28	7.00±0.01
2	Flavour	8.21±0.02	8.05±0.04	8.02±0.05	7.46±0.40	7.01±0.02	6.28±0.03
3	Texture	8.34±0.29	8.01±0.02	8.05±0.03	7.07±0.06	6.01±0.02	5.57±0.52
4	Taste	8.05±0.04	8.41±0.33	8.00±0.01	7.68±0.55	7.02±0.02	6.03±0.03
5	Overall Acceptability	8.14±0.12	9.00±0.01	8.34±0.31	7.22±0.02	7.01±0.01	6.03±0.03

(Values are means of 3 determinations ± Standard deviation)



G_1 (90:10) as well as G_2 (80:20) both showed excellent sensory performance. The G_1 (90:10) showed the highest overall acceptability (9.9) and excellent taste score. G_2 (80:20) also showed well-balanced sensory attributes.The similar result was also reported by P.O. Pandey,et.al.,(2020).In present study control cookies were found to be satisfactory for the cookies prepared with banana flour and wheat flour(variety- Lokwan).

Result and Discussion:-

The earlier literature cited for preparation of cookies made from Guava revealed that maximum workers have tried guava flour for preparation of cookies for ex. (Monika Mahajan,et.al.,2019), (Deepali Mudgal *et.al*., 2022), (Ayo JA *et.al*., 2018)while only few like (Jeetial Verma et.al.,2019) had guava pulp. Their finding showed the fat, sugar, fiber, ash, protein and vitamin c content significantly increased due to addition of guava pulp mean while refined flour had nothing quantity of ascorbic acid, presence of ascorbic acid is very positive character of cookies.

According to Jahanzeb M.et.al.,(2016) guava pulp is considered as a rich source of fiber, ash, polyphenols and sugars and thus using this for preparation of cookies will enhance the nutritional quality of cookies. The present study as in accordance with Jahanzeb M. et.al., (2016) and Jeetlal Verma *et.al*.,(2019).While the use of guava flour does not reveal finest quality of cookies as compared to guava pulp However many workers area of opinion that guava pulp is not good as per sensory parameters are concerned. But present study suggest the use of guava pomace is best instead of guava flour .

Conclusion:-

This study demonstrates that guava pomace , a low – cost fruit by-product ,can be effectively incorporated up to 30% in wheat flour cookie. The treatment G3 (70:30) exhibited the best balance between nutritional enrichment and consumer acceptability .The cookie will qualify as nutritionally fortified bakery products, suitable for consumers seeking ,high-fiber, low fat alternatives.

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