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Study on Sensory Analysis of Gulabjamun Prepared by Utilization of Sweet Potato (*Ipomoea batatas*) Pulp

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

Present investigation was carried out at Dairy Science Laboratory of Department of Animal Husbandry and Dairy Science, College of Agriculture, Dr. BSKKV., Dapoli (M.S.) to study the Utilization of sweet potato (*Ipomoea batatas*) pulp for the preparation of gulabjamun. In present

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study, Khoa prepared from buffalo milk and sweet potato pulp was used in preparation of Gulabjamun. Sweet potato pulp was used at five levels i.e., 0,5,10,15,20 whereas khoa was used at 90,85,80,75 and 70 %. Maida was added 10 % at the five-treatment combination. Studied for its sensory properties such as colour and appearance, body and texture, flavour, overall acceptability was carried out by trained panelist using 9-point hedonic scale. It was found that Gulabjamun made from utilization of sweet potato pulp at 15% was best in present investigation and it may conclude that sweet potato pulp can be successfully utilized for preparation of gulabjamun.

Keywords: Gulabjamun; sweet potato pulp; sensory analysis; milk product.

1. INTRODUCTION

Milk is a complex diet that provides essential nutrients for young mammals. From a nutritional standpoint, milk is regarded as nature's practically perfect diet. Other foods may include more of a specific vitamin, but milk is thought to be the best-balanced food. Milk output in India has increased steadily during the previous two decades. India is now the world's leading producer of liquid milk. India is the world largest milk producer, with an average annual production of 230.58 MT in 2022-23 [1]. India is the world largest producer of milk and value-added dairy products, accounting for more than 16 per cent of total milk consumption. Gulabjamun is a popular khoa-based sweet that was initially prepared using khoa and maida. Gulabjamun is a khoa-based dessert that is popular in India. Though the sensory quality of gulabjamun prepared in different regions varies, the most popular product should be brown in color, smooth and spherical to oval in shape, soft and slightly spongy body, free of lumps and hard central core, uniform granular texture, mild oily flavor, fully succulent with sugar syrup, and have the optimum sweetness [2]. The growing population, increasing household incomes, and shifting consumer lifestyles [3,4], along with health concerns such as malnutrition, drive changes in consumer demand for innovative food products. Due to nutritionists' recognition of the health benefits of dairy products, attributed to their high digestibility and nutritional value (García-Pérez et al., 2005; Sadeghi, 2016) [5] [6]. Many of the developing countries depend on roots and tubers as an important source of food and nutrition [7]. Sweet potato (*Ipomoea batatas*) is one of the most significant and oldest fiber crops, produced practically everywhere in the globe. It is a significant tropical root and tuber crop, ranking second to cassava among tropical tuber crop. The crop has the potential to improve nutritional security, particularly in agriculturally backward areas. Mohammad [8] investigated the background sweet potatoes (*Ipomoea batatas*) are a popular research topic in recent years due to their unique nutritional and functional qualities. Sweet potato leaves and roots contain a variety of nutrients, including bioactive carbohydrates, proteins, carotenoids, flavonoids, anthocyanins, phenolic acids, and minerals. Sweet potato (convoluvlaceae family) is a major and valued staple crop worldwide. It is a nutritious and abundant food source for both humans and animals, as well as a raw material for the production of starch, sugar, alcohol, and other products. It is one of the most important crops in terms of yield, economic worth, and calorie and protein content [9].

2. MATERIALS AND METHODS

Following material were used in laboratory for analytical purpose during the entire research work.

2.1 Raw materials

1. Milk

Fresh Buffalo milk required for research was obtained from the Instructional Dairy farm of College of Agriculture, Dapoli.

2. Sugar

Good quality sugar was procured from the local market.

3. Sweet Potato

Sweet Potato was procured from AICRP on Tuber Crops, CES, Wakawli, DBSKKV, Dapoli.

2.2 Sensory Analysis

Sensory evaluation were performed in the laboratory under environmental conditions. The product was evaluated for sensory characteristics, viz. colour and appearance, body and texture, flavour and Overall acceptability using 9 points hedonic scale as per IS: 6273 (Part-II), 1971. A total of ten

panelists were chosen with no medical conditions.

Treatments

In the present investigation maida was used 10 per cent for all treatment. Whereas khoa was used in different proportion & sweet potato pulp was used at the rate 5 per cent, 10 per cent, 15 per cent, 20 per cent as stated below.

Thus, there was five treatments as stated below:

T_0G_0:- 90 per cent Khoa + 10 per cent maida + without sweet potato pulp.

T_1G_1:- 85 per cent khoa + 10 per cent maida + 5 per cent sweet potato pulp.

T_2G_2:- 80 per cent khoa +10 per cent maida + 10 per cent sweet potato pulp.

T_3G_3:- 75 per cent khoa + 10 per cent maida + 15 per cent sweet potato pulp.

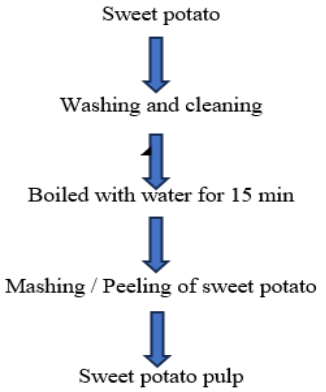
T_4G_4:- 70 per cent khoa + 10 per cent maida + 20 per cent sweet potato pulp.

Replications:

The research project was conducted with six replications.

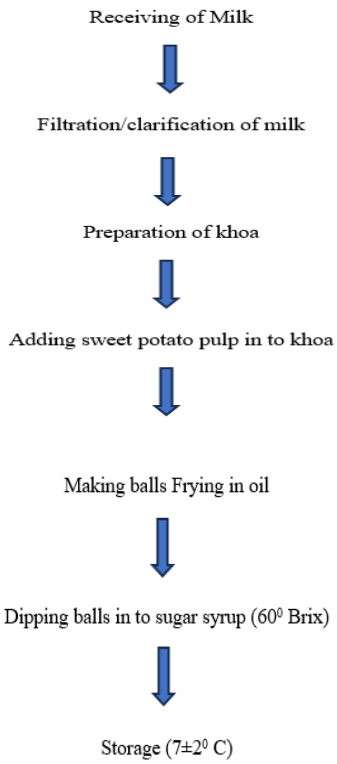
Preparation of sweet potato pulp:-

Flow Diagram 1



Gulabjamun preparation:

Flow Diagram 2



Preparation of sugar syrup:-

Syrup was prepared by dissolving 50 g of sugar in 125 ml of water and boiling till final volume become 100 ml to the required concentration (60˚B) with constant heating and stirring.

3. RESULTS AND DISCUSSION

3.1 Colour and Appearance

It is an important property for any food material that increases the consumer acceptance. Customer's acceptance of any milk product was mostly determined by its colour and look.

The data pertaining to sensory score for general appearance at different treatments are given in Table 1 and illustrated in Fig. 1.

The variation in colour and appearance score due to treatments was observed to be significant.

The perusal of data from Table 4 showed that the highest score (8.15) was obtained by the treatment T_3G_3 i.e. Gulabjamuns content with 15 per cent Sweet Potato pulp and this highest score may be due to its slightly darker brown colour and smooth surface which was liked most by the judges. Lowest score (7.03) was observed for treatment T_2G_2.

This indicates that the Sweet Potato pulp had an effect on acceptability of Gulabjamun, when judges on basis of colour and appearance quality.

Vasava et al. [10] observed that there is a marginal variation of 0.2 score and the colour and appearance score of the gulabjamun was lower than that of faraali gulabjamun 8.40 in faraali gulabjamun compared to 8.20 in gulabjamun thus the finding were slightly higher than present investigation.

3.2 Flavour

All milk products must meet certain basic requirements. It must taste just like it is intended to and not odd. It is best if the product has no trace of the natural flavouring ingredient. The merging of taste and scent produces flavour. A food item's flavour is a crucial requirement for acceptance. Each milk product has a unique flavour. The flavour of Gulabjamun ought to be characteristic oily and slightly cooked flavour and optimum sweetness and succulent taste.

The average flavour score of Gulabjamun after varying per cent of Sweet Potato pulp were added is shown in Table 2. It was determined that the flavour score was statistically significant. The Gulabjamun prepared with 15 per cent Sweet Potato pulp in T_3G_3 (8.26) had the best score, whereas the Gulabjamun prepared without Sweet Potato pulp in T_0G_0 received the lowest score (7.16). When Sweet Potato pulp was added at an increasing rate, the flavour score marginally increasing up to the T_3G_3.

Present study was not in agreement with Vasava et al. [10] where she reported flavour score of gulabjamun was significantly higher than the faraali gulabjamun. which was natural as the panelists did not find the typical flavour of gulabjamun when maida is used as a binder. The flavour of potato starch and sago was masked with the help of cardamom and caramel flavour.

Table 1. Score for colour and appearance of gulabjamun

Treatment	R-I	R-II	R-III	R-IV	R-V	R-VI	Mean
T_0G_0	7.25	7.56	7.54	8.21	7.21	6.95	7.45^{ab}
T_1G_1	7.15	8.12	6.87	7.88	7.56	7.89	7.58^{ab}
T_2G_2	6.21	7.01	6.29	7.28	7.54	7.84	7.03^{b}
T_3G_3	8.32	8.10	8.14	7.89	8.21	8.21	8.15^{a}
T_4G_4	7.89	8.12	8.12	7.52	7.85	7.21	7.79^{ab}
Mean	7.23	7.78	7.39	7.75	7.67	7.62	7.60

Anova Table

S.V.	DF	SS	MSS	Fcal	F tab 5%	F tab 1%	RESULT
Treatments	4	4.08008	1.02002	5.041418	2.75871	4.17742	SIG
Error	25	5.0582	0.202328				
Total	29	9.13828					

S. E.	CD at 1%	CD at 5%
0.2597	0.72389	0.53486

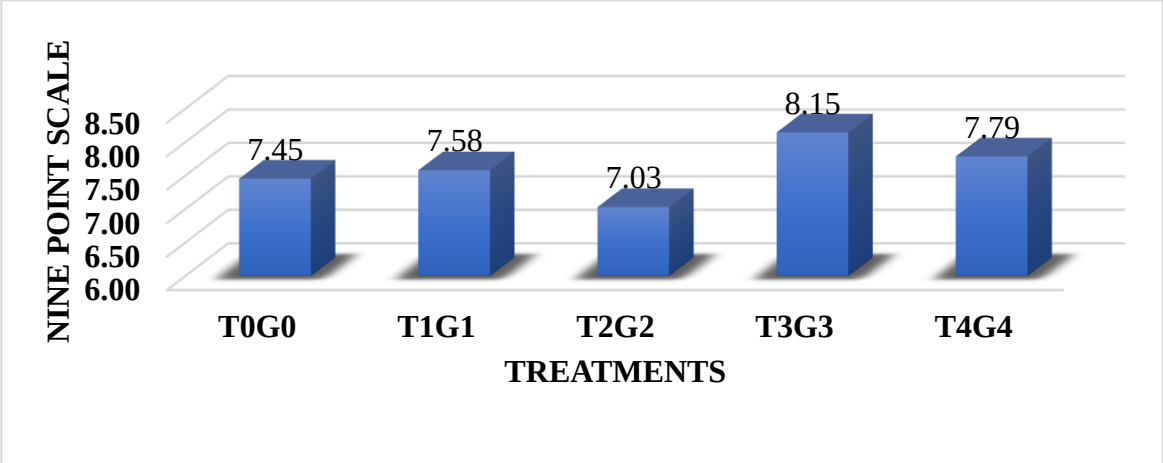


Fig. 1. Score for Colour and appearance of Gulabjamun

Table 2. Score for flavour of utilization of gulabjamun

Treatment	R-I	R-II	R-III	R-IV	R-V	R-VI	Mean
T_0G_0	6.54	7.56	7.11	7.21	7.41	7.14	7.16^{b}
T_1G_1	7.21	8.02	8.12	7.05	7.54	7.25	7.53^{ab}
T_2G_2	8.54	6.87	8.33	8.59	8.29	8.21	8.14^{ab}
T_3G_3	8.54	6.87	8.33	8.59	9.01	8.21	8.26^{a}
T_4G_4	8.01	7.99	8.41	8.34	7.10	7.41	7.88^{ab}
Mean	7.70	7.46	8.06	7.95	7.87	7.64	7.79

Anova Table

S.V.	DF	SS	MSS	Fcal	F tab 5%	F tab 1%	RESULT
Treatments	4	4.858	1.2145	3.947967	2.75871	4.17742	SIG
error	25	7.690667	0.307627				
Total	29	12.54867					

S. E.	CD at 1%	CD at 5%
0.32022	0.8926	0.65951

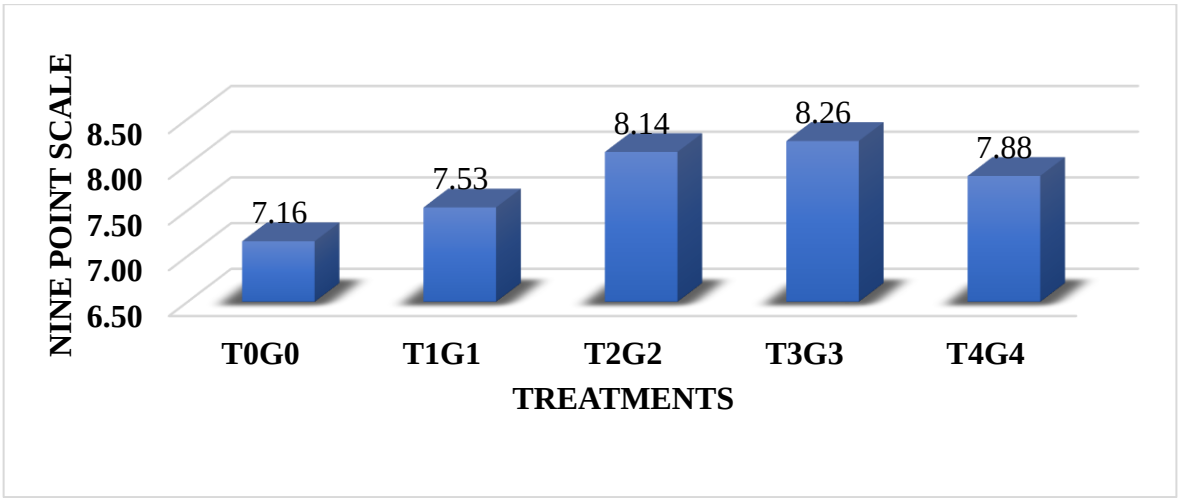


Fig. 2. Score for flavour of gulabjamun

3.3 Body and Texture

Each dairy product possesses its own characteristic properties of mouth feel, which are commonly defined in terms of body and texture. The desired body of the Gulabjamun should be soft and slightly spongy, while the texture should be uniform and slightly granular.

Table 3 represents the average score obtained for body and texture of Gulabjamun by addition of different level of Sweet Potato pulp. It was observed that the score for body and texture statistically significant.

The highest score for body and texture was obtained by treatment T_3G_3 (8.32) i.e. Gulabjamun prepared by using 15 per cent Sweet Potato pulp followed by treatment T_4G_4 (7.89) i.e. Gulabjamun prepared by using 20 per cent Sweet Potato pulp and lowest for treatment T_1G_1 (6.90) i.e. Gulabjamun prepared with 5 per cent Sweet Potato pulp.

Gulabjamun with 15 per cent Sweet Potato pulp possessed soft body with spongy and porous texture, which obtained highest score (8.32). The product with 10 and 20 per cent addition of Sweet Potato pulp did like by the judges, as these products possessed comparatively spongy and less porous texture. The porousness decreases the rate of sugar syrup absorption of Gulabjamun with 10 and 20 per cent Sweet Potato pulp.

Slightly similar results were observed by Kardule [11] he that reported the control (To) had slightly lower score for body and texture than gulabjamun blended with 0.4, 0.8 and 1.2 per cent level of rice bran.

Table 3. Score for Body and Texture of Gulabjamun

Treatment	R-I	R-II	R-III	R-IV	R-V	R-VI	Mean
T_0G_0	7.21	7.51	8.01	6.24	7.21	8.32	7.42^{ab}
T_1G_1	6.24	7.02	8.47	7.21	6.30	6.14	6.90^{b}
T_2G_2	6.23	8.21	7.25	8.25	7.94	6.89	7.46^{ab}
T_3G_3	8.21	8.54	8.41	7.58	8.21	8.96	8.32^{a}
T_4G_4	8.54	8.04	7.05	8.14	7.29	8.26	7.89^{ab}
Mean	6.97	7.86	7.83	7.48	7.39	7.71	7.60

Anova Table

S.V.	DF	SS	MSS	Fcal	F tab 5%	F tab 1%	RESULT
Treatments	4	6.873153	1.718288	3.397985	2.75871	4.17742	SIG
Error	25	12.64197	0.505679				
Total	29	19.51512					

S. E.	CD at 1%	CD at 5%
0.41056	1.14441	0.84556

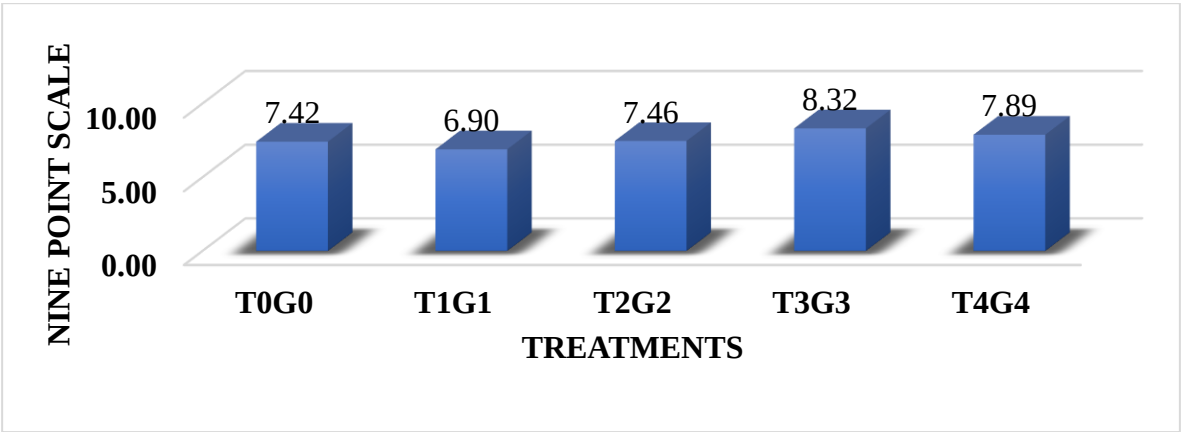


Fig. 3. Score for Body and texture of Gulabjamun

3.4 Overall Acceptability

The effect of different levels of Sweet Potato pulp on overall acceptability of Gulabjamun is tabulated in Table 4 and illustrated in Fig. 4. For overall acceptability, average score obtained for colour and appearance, body and texture and flavour was considered.

Table 4 observed that average figures of overall acceptability, it is clear that Gulabjamun prepared from 15 per cent Sweet Potato pulp scored highest points (8.32), followed by 10 per cent Sweet Potato pulp in Gulabjamun (7.89). The score was 7.75, 7.18 and 6.94 at T_1G_1, T_0G_0 and T_4G_4, respectively. On the basis of results obtained we can affirmatively state that amongst different levels of Sweet Potato pulp, T_3G_3 (15 per cent Sweet Potato pulp) treatment was found more acceptable for blending by the judges. Also good quality Gulabjamun was obtained with 10 per cent Sweet Potato pulp. From the results of overall acceptability scores, thus, indicate that Gulabjamun blended with 15 per cent Sweet Potato pulp is superior. However, Sweet Potato pulp @ 10 per cent can produce good quality Gulabjamun. The proportion of Sweet Potato pulp 5 per cent and 20 per cent show low sensory quality score for Gulabjamun.

Kardule [11] reported that overall acceptability score of control T_0 (8.32) sample was significantly lower than T_1 (8.43), T_2 (8.51) and T_3 (8.60).

Table 4. Score for overall acceptability of gulabjamun

Treatment	R-I	R-II	R-III	R-IV	R-V	R-VI	Mean
T_0G_0	7.23	7.01	8.05	6.84	7.51	6.43	7.18^{b}
T_1G_1	8.52	7.99	6.41	8.59	7.53	7.43	7.75^{ab}
T_2G_2	6.34	8.94	7.06	6.90	9.15	8.95	7.89^{ab}
T_3G_3	8.54	8.08	8.31	7.98	8.74	8.27	8.32^{a}
T_4G_4	6.57	6.84	7.31	7.18	7.54	6.21	6.94^{bc}
Mean	7.65	7.77	7.42	7.49	8.09	7.45	7.62

Anova Table

S.V.	DF	SS	MSS	Fcal	F tab 5%	F tab 1%	RESULT
Treatments	4	7.401633	1.850408	3.213024	2.75871	4.17742	SIG
Error	25	14.39772	0.575909				
Total	29	21.79935					

S. E.	CD at 1%	CD at 5%
0.43814	1.2213	0.90237

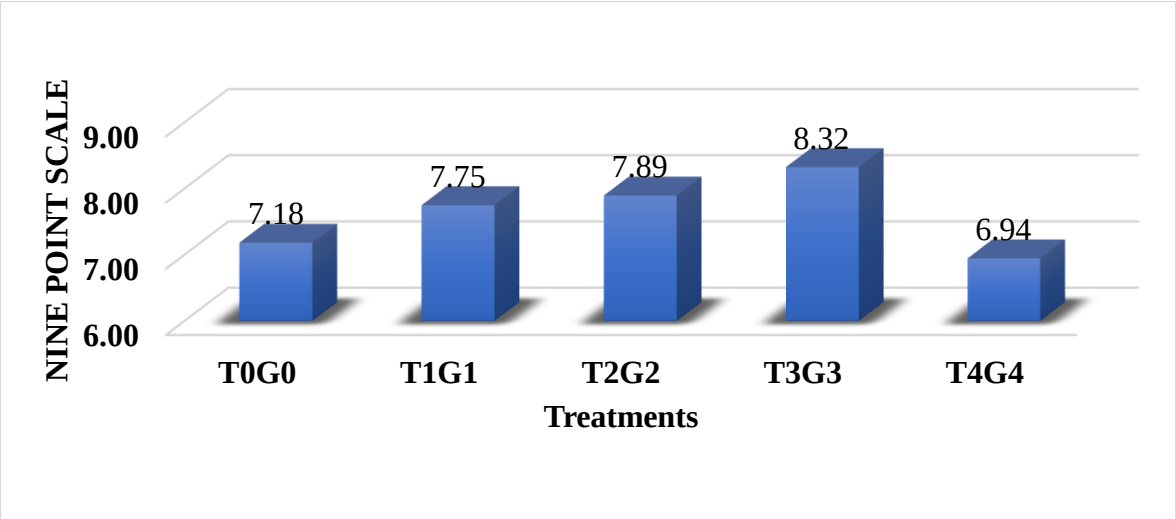


Fig. 4. Score for Overall acceptability of Gulabjamun

4. CONCLUSION

According to the findings, Gulabjamun made from utilization of sweet potato pulp at 15% was best organoleptic characteristics, including colour and appearance, body and texture, flavour and overall acceptability. Thus, T_3G_3 treatment was found as most acceptable.

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc) and text-to-image generators have been used during writing or editing of this manuscript.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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