***Original Research Article***

# Dietetic Sweet *Boondi*: A Sugar-Free Innovation with Stevia and Polyols

## ABSTRACT

This study successfully developed a dietetic version of sweet *Boondi* by replacing traditional sugar syrup with a balanced blend of natural sweeteners, including stevia and polyols like erythritol, maltitol, sorbitol, and fructooligosaccharides (FOS). Through a detailed market survey and sensory analysis of the market sweet *Boondi* samples, the *Boondi* making process was adopted and on that basis of that process dietetic sweet *Boondi* was made, in which the syrup made with the proportion consisting of erythritol (22 g), maltitol (16 g), sorbitol (22 g), FOS (15 g), and stevia (0.082 g) per 100 g of syrup, emerged as the most favorable formulation. This combination achieved high scores across all sensory attributes scores with colour and appearance score (7.59 ± 0.09), Body and texture score (7.41 ± 0.09), flavour and taste score (7.47 ± 0.10) and overall acceptability score (7.53 ± 0.10). The findings underscore the importance of balancing polyol ratios to optimize sensory qualities, addressing consumer demand for healthier sweet without compromising on sensory attributes. This research provides a promising framework for developing dietetic versions of other traditional Indian sweets, paving the way for healthier options in the market.

*Keywords: Market survey; Sugar Substitutes; Polyols; Stevia; Erythritol; Maltitol; Fructooligosaccharides (FOS); Sorbitol.*

## 1. INTRODUCTION

India's rich cultural heritage has always embraced sweets as a significant element of celebrations and rituals. Traditional sweets like *Boondi* Ladoo are integral to various festive and religious occasions. These sweets symbolize auspiciousness and add sweetness to special moments in Indian culture [1]. *Boondi* is made by dripping a chickpea flour batter through a perforated ladle and then deep-frying the droplets [2], which are then sweetened with sugar syrup and shaped into round balls [1].*Boondi*, a beloved sweet from Rajasthan, India, holds a special place in Hindu culture. This treat is especially popular during festivals like Diwali and Rakshabandhan and is often offered as prasad in prayer rituals.

Stevia (*Stevia rebaudiana Bertoni*), part of the Asteraceae family and native to Paraguay, is known for its high-potency sweetness and zero-calorie content due to the presence of steviol glycosides in its leaves. This makes it an ideal sugar substitute for healthconscious individuals. Its popularity as a natural sweetener has grown worldwide, with Japan as a leading consumer and China accounting for 75% of global production [3] [4]. Stevia is also commercially farmed in countries like Brazil, Paraguay, Central America, Thailand, and Korea, and presents economic opportunities for Kenyan farmers as demand increases [5]. The genus Stevia comprises approximately 230 species, predominantly found in South America and Mexico [6].

Steviol glycosides, such as stevioside and rebaudioside A, are significantly sweeter than sugar and are deemed safe with a daily intake of 0-4 mg/kg body weight by the Joint FAO/WHO Expert Committee on Food Additives [7]. In addition to its sweetness and low-calorie content, stevia offers nutritional benefits like antioxidants and amino acids, making it a popular ingredient in food products like soft drinks and baked goods [8].

Polyols, or sugar alcohols, such as erythritol, maltitol, sorbitol, and fructooligosaccharides (FOS), are low-calorie sweeteners that mimic the functionality of sucrose. These compounds are created by modifying sugars, replacing the aldehyde or ketone group with a hydroxyl group [9]. Erythritol, a low-calorie sweetener produced by fermenting glucose with yeast, offers 60-80% of the sweetness of sucrose having only 0.2 kcal/g of energy and is known for its non-glycemic and antioxidant properties [10]. Maltitol, derived from maltose, closely mimics sucrose in sweetness (75-90%) and solubility, making it ideal for sugar-free and reduced-calorie foods [11]. Sorbitol, found naturally in fruits, serves as a sweetener and humectant due to its cooling sensation and stability having 60% of sweetness relative to sugar with 2.6 kcal/g. FOS are non-cariogenic oligosaccharides that act as prebiotics having 2 kcal/g with around 50% of sweetness relative to sugar, promoting beneficial gut bacteria and offering health benefits such as reduced blood lipid levels and improved mineral absorption [12]. These polyols are essential in creating sugar-free products like candies and baked goods while supporting oral health and catering to individuals with diabetes.

Chickpea (*Cicer arietinum* L.), also known as Bengal gram or chana, is an annual plant from the Fabaceae family is predominantly cultivated in temperate and semiarid regions worldwide [13]. According to Acharya N. G. Ranga Agricultural University, global chickpea production reached 158.71 lakh tonnes in 2022, with India as the largest producer, contributing 137.50 lakh tonnes, or 86% of the world's total production for the 2021-22 periods. Chickpea known for their high protein, carbohydrate, fiber, vitamin, and mineral content, chickpeas are utilized in diverse culinary applications, from Indian "dhal" and "besan" flour to stews, soups, and salads in Asia and Africa. Their health benefits include angiotensin-converting enzyme inhibition, hypocholesterolemic effects, and antioxidant activity, making them beneficial for managing various diseases [15].

Several studies have explored the preparation and optimization of traditional Indian sweets using alternative ingredients and techniques to improve sensory and nutritional attributes. Ravi and Susheelamma (2004) found that *Boondi* made from chickpea flour batter with 40-42% solid concentration produced the best results in terms of aroma and texture. Yargatti and Muley (2022) revealed that using stevia in motichoor ladoo and gulabjamun resulted in better sensory acceptance compared to agave, though agave was preferred for jalebi. Ahmad and David (2017) reported that rasgullas soaked in 0.005% aspartame syrup offered the best organoleptic qualities, despite a slightly higher cost.

Geetha *et al*. (2015) identified optimal conditions for making chhana jalebi with desirable sensory properties using a 3% milk fat, 1:1 chhana to maida ratio, and specific frying parameters. Kushwaha *et al*. (2017) optimized a syrup formulation using stevia, sucralose, and maltitol for gulab jamun, achieving high acceptability with specific ratios. Chavan *et al*. (2014) developed a dietetic rosogolla using 2% milk fat and a sorbitol solution with aspartame, which provided favorable sensory and texture attributes. Chetana (2004) experimented with legume-based *Boondi* laddu, concluding that a sorbitol and mannitol blend closely matched traditional sugar syrup in quality, whereas maltodextrin and polydextrose combinations were less successful.

The increasing health concerns related to excessive sucrose consumption, such as obesity and diabetes, have driven interest in alternative sweeteners. High-intensity artificial sweeteners like acesulfame-K, aspartame, neotame, saccharin, and sucralose are commonly used as sugar substitutes, but they can have potential health risks, including unpleasant aftertastes or, in the case of saccharin, links to bladder cancer [23]. As a result, natural sweeteners have gained popularity, with stevia emerging as a leading alternative.

However, with the increasing prevalence of lifestyle diseases such as diabetes and obesity, there is a growing demand for healthier alternatives to traditional sweets. This study aims to develop a dietetic version of sweet *Boondi* by replacing sugar with natural sweeteners such as stevia and polyols like erythritol, maltitol, and sorbitol, along with FOS. The objective is to cater to health-conscious individuals, especially diabetics, without compromising on the traditional taste and texture of *Boondi*. The process involves optimizing the syrup preparation and the *Boondi*-making process to achieve the desired quality and shelf life of the dietetic sweet *Boondi*.

The main objectives of this study include market survey for the sweet *Boondi* making process, selecting and standardizing syrup preparation using sugar substitutes, formulating dietetic sweet *Boondi*, and conducting sensory analysis of the prepared product. By developing a dietetic sweet *Boondi*, this study aims to provide a healthier option for sweet lovers, particularly those who need to manage their sugar intake due to health concerns.



## 2. MATERIAL AND METHODS

### 2.1 Materials

Bengal gram flour was sourced from the local market in Anand, Gujarat, India. Amul pure ghee was used as the fat component. Stevia (rebaudioside a 97%) was obtained from Herboveda India Pvt. Ltd. Erythritol, maltitol and sorbitol were procured from Mirtillo International, Mumbai, while FOS were procured from Gujarat Enterprise, Ahmedabad. Stevia and polyols were chosen for their sweetness profiles, glycemic index, cooling effect and low-calorie content (table 1).

### 2.2 Market Survey of *Boondi* Making Process

A market survey was conducted in Anand city to study the *Boondi*-making processes used by seven different shops. The survey included observations and interviews using pre-designed questionnaires to collect information on traditional methods, raw materials, equipment, and preparation techniques. Key parameters such as flour type, flour-to-water ratio, frying time and temperature, and syrup °brix were recorded with the aim of standardizing the process. Sweet *Boondi* samples were then obtained from the surveyed manufacturers for sensory analysis to determine the optimal *Boondi*-making process. A semi-trained panel used a nine-point hedonic scale to evaluate the color and appearance, body and texture, flavor and taste, and overall acceptability.

**Table 1. Properties of different polyols**

| Sweeteners | Calorie content (kcal/g) | GI | Sweetness (% relative to sucrose) | Cooling effect (kcal/g) |
|---|---|---|---|---|
| Stevia [24] | 0 | 0 | 470 | - |
| Erythritol [24] | 0.2 | 0 | 50 | -43 |
| Maltitol [24] | 2.4 | 35 | 90 | -18.9 |
| Sorbitol [24] | 2.4 | 4 | 60 | -26 |
| FOS [25] [26] | 1.5 | low | 50 | - |

GI=Glycemic Index; FOS=Fructooligosaccharides

### 2.3 DieteticSweet *Boondi* Preparation

The process for making *Boondi* was finalized through sensory analysis of commercially available sweet *Boondi*. This process was then adapted to create a dietetic version by substituting the sugar syrup with syrup made from selected polyols and stevia. Various proportions were tested to create sugar-free syrup, with the FOS level fixed at 15% in all syrups. Based on preliminary trials and sensory analysis of sweet *Boondi* made with syrup at 75 °brix, different ratios of the three polyols were tested, as shown in Table 2. Stevia was added as an intense to adjust the sweetness level of the syrup after the addition of polyols, which have different sweetness levels relative to sugar.

**Table 2: Experimental design for syrup making using stevia and polyols**

| Treatments | Erythritol (g) | Maltitol (g) | Sorbitol (g) | FOS (g) | Stevia (g) |
|---|---|---|---|---|---|
| **1** | 60 | 0 | 0 | 15 | 0.100 |
| **2** | 0 | 60 | 0 | 15 | 0.038 |
| **3** | 0 | 0 | 60 | 15 | 0.089 |
| **4** | 30 | 30 | 0 | 15 | 0.072 |
| **5** | 30 | 0 | 30 | 15 | 0.098 |
| **6** | 0 | 30 | 30 | 15 | 0.064 |
| **7** | 20 | 20 | 20 | 15 | 0.078 |
| **8** | 15 | 20 | 25 | 15 | 0.077 |
| **9** | 18 | 18 | 24 | 15 | 0.079 |
| **10** | 22 | 16 | 22 | 15 | 0.082 |
| **11** | 25 | 10 | 25 | 15 | 0.088 |
| **12** | 20 | 5 | 35 | 15 | 0.091 |
| **13** | 10 | 25 | 25 | 15 | 0.071 |

Values are per 100 g of syrup, for 75 °Bx of syrup

## 3. RESULTS AND DISCUSSION

### 3.1 Survey and Standardization of *Boondi* Making Process

A market survey conducted at seven *Boondi* manufacturing shops in Anand city, Gujarat, documented various *Boondi* making process parameters which are presented in Table 3, 4, 5, 6, and 7. Shops surveyed included RajbhogSweets, Khwaja Nasta House, Famous Jalebi House, Milan Sweets & Namkeen, Jay Jalaram Farsan& Namkeen, Adarsh Farsan House, and Dwarkesh. *Boondi* samples, labeled with $MSB_1$ to $MSB_7$, were collected for sensory analysis.

**Table 3. List of ingredients used for *Boondi* making by different manufactures**

| Ingredients / Samples | Besan | Sooji | Water | Sugar | Oil | Food colour |
|---|---|---|---|---|---|---|
| **$MSB_1$** | ✓ | | ✓ | ✓ | ✓ | |
| **$MSB_2$** | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| **$MSB_3$** | ✓ | ✓ | ✓ | ✓ | ✓ | |
| **$MSB_4$** | ✓ | | ✓ | ✓ | ✓ | |
| **$MSB_5$** | ✓ | | ✓ | ✓ | ✓ | ✓ |

| | | | | | | |
|---|---|---|---|---|---|---|
| **MSB $_6$** | ✓ | | ✓ | ✓ | ✓ | ✓ |
| **MSB $_7$** | ✓ | | ✓ | ✓ | ✓ | ✓ |

**Table 4. Parameters used for batter preparation for *Boondi* making**

| Parameters \ Samples | MSB $_1$ | MSB $_2$ | MSB $_3$ | MSB $_4$ | MSB $_5$ | MSB $_6$ | MSB $_7$ |
|---|---|---|---|---|---|---|---|
| **Ratio (Flour : Water)** | 3:3:8* | 4:2:3.5# | 5:2.5:7# | 5:6 | 1:1 | 1:1 | 1:1 |
| **Bulk density of batter (Kg/ m $^3$)** | 937.50 | 914.30 | 936.17 | 955.00 | 961.50 | 962.00 | 962.00 |
| **Fermentation time** | No | No | No | No | No | No | No |

Note:*=ratio of coarse besan:finebesan:water, #=ratio of besan:sooji:water

**Table 5. Parameters used for frying operation during *Boondi*making**

| Parameters \ Samples | MSB $_1$ | MSB $_2$ | MSB $_3$ | MSB $_4$ | MSB $_5$ | MSB $_6$ | MSB $_7$ |
|---|---|---|---|---|---|---|---|
| **Skimmers opening diameter (mm)** | 6 | 5 | 5-6 | 5-6 | 4-5 | 4-5 | 5-6 |
| **Frying temperature (°C)** | 185-195 | 182-194 | 190-193 | 190-200 | 185-195 | 195-200 | 200-210 |
| **Frying time (sec)** | 90-110 | 90-100 | 95-103 | 90-100 | 112-120 | 90-100 | 30-60 |
| **Holding time (sec)** | 10 | 10 | 5-10 | 10 | 10 | 10 | 8-10 |
| **Diameter of fried *Boondi* (mm)** | 7 | 6-7 | 6-8 | 6-8 | 6-7 | 6-7 | 6-8 |

**Table 6. Parameters used for Syrup preparation for *Boondi*making**

| Parameters \ Samples | MSB $_1$ | MSB $_2$ | MSB $_3$ | MSB $_4$ | MSB $_5$ | MSB $_6$ | MSB $_7$ |
|---|---|---|---|---|---|---|---|
| **Ratio (Sugar : Water)** | 5:4 | 5:5 | 5:2.5 | 5:3 | 5:3 | 3:2 | 3:2 |
| **Cooking temperature for syrup (°C)** | 105-110 | 104 | 100-105 | 108-112 | 100-110 | 105-110 | 110-112 |
| **°Brix of sugar syrup** | 73 | 72.9-74.1 | 75 | 73-75 | 70-75 | 75-80 | 73-78 |
| **Soaking time (sec) in syrup** | 120-300 | 170-210 | 70-110 | 90-110 | 150-170 | 120-180 | 90-150 |

**Table 7. Packaging material used and selling price for the market sweet *Boondi***

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Packing material used for packing** | PP | PP | PP | PP | PP | PP | PP |
| **Selling price (Rs./kg) of *Boondi*** | 200 | 160 | 140 | 200 | 200 | 160 | 200 |

PP = poly propylene

**Table 8. Sensory attributes scores of the market sweet *Boondi* (MSB) Samples**

| Sample code | Colour & Appearance | Body & Texture | Flavour & Taste | Overall acceptability |
|---|---|---|---|---|
| **MSB$_1$** | 7.56 ± 0.31 | 7.29 ± 0.37 | 7.24 ± 0.29 | 7.51 ± 0.33 |
| **MSB$_2$** | 6.23 ± 0.12 | 6.56 ± 0.16 | 6.54 ± 0.11 | 6.43 ± 0.08 |
| **MSB$_3$** | 6.59 ± 0.40 | 6.43 ± 0.36 | 6.30 ± 0.32 | 6.44 ± 0.35 |

| | | | | |
|---|---|---|---|---|
| **$MSB_4$** | 7.37 ± 0.33 | 7.46 ± 0.17 | 7.52 ± 0.35 | 7.55 ± 0.35 |
| **$MSB_5$** | 6.70 ± 0.48 | 6.47 ± 0.34 | 6.54 ± 0.36 | 6.56 ± 0.40 |
| **$MSB_6$** | 6.66 ± 0.40 | 6.80 ± 0.28 | 6.62 ± 0.32 | 6.71 ± 0.26 |
| **$MSB_7$** | 7.18 ± 0.10 | 6.92 ± 0.30 | 7.08 ± 0.11 | 7.08 ± 0.13 |
| **Sem±** | 0.24 | 0.21 | 0.20 | 0.21 |
| **CD (0.05)** | 0.71 | 0.63 | 0.61 | 0.63 |
| **CV%** | 5.90 | 5.26 | 5.09 | 5.21 |

Results: Each observation is mean ± SD of three replicates (n=3), CD = Critical difference; CV% = coefficient of variance; SEm = Standard error of mean

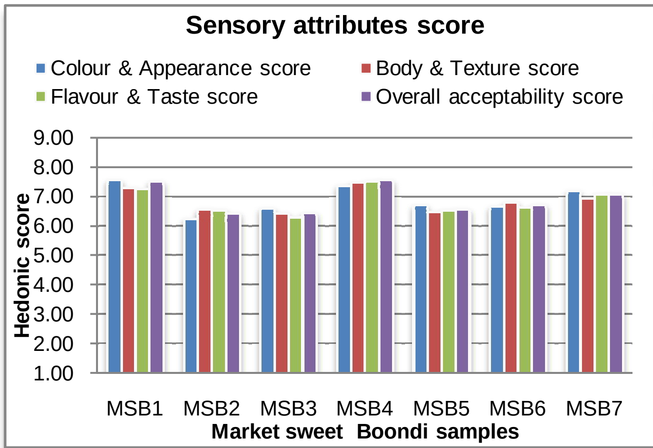


**Figure 1. Variation in sensory attributes score of MSB samples**

A semi-trained panel used a nine-point hedonic scale to evaluate color and appearance, body and texture, flavor and taste, and overall acceptability. Each sample was assessed for sensory analysis in three replications as shown in the table 8. This structured sensory evaluation aimed to standardize the *Boondi*making process by identifying the most acceptable practices based on panelist ratings from "dislike extremely" to "like extremely."

Based on the data presented in table 8 and illustrated in figure 1, it can be observed that shop 1 ($msb_1$) received the highest scores for color and appearance (7.56 ± 0.31), ranked second for body and texture (7.29 ± 0.37), and overall acceptability (7.51 ± 0.33), indicating a superior quality product. Similarly, shop 4 ($msb_4$) demonstratedexcellent performance across all evaluated attributes, particularly excelling in body and texturescore (7.46 ± 0.17), flavor and tastescore (7.52 ± 0.35), and overall acceptabilityscore (7.55 ± 0.35). The process flowchart adopted from the survey for manufacturing of sweet *boondi* is depicted in figure 2.

### 3.2 Syrup preparation using sugar substitutes for dietetic sweet *Boondi*

The sensory evaluation of dietetic sweet *Boondi* showed significant variations in color and appearance as shown in the Figure 3 due to the type and concentration of polyols used. Treatments with erythritol, known for its strong cooling effect and tendency to recrystallize, received lower scores for color and appearance. For instance, treatment no. 1, which used 60 g of erythritol, had a score of 5.70 ± 0.17. In contrast, treatment no. 10, which featured a balanced combination of erythritol (22 g), maltitol (16 g), and sorbitol (22 g), scored the highest with 7.59 ± 0.09. This combination provided better moisture retention and stability, resulting in a more visually appealing product. These findings indicate that a balanced mix of polyols enhances the appearance of sweet *Boondi*, while a high concentration of a single polyol can negatively affect its color.

The body and texture of the sweet *Boondi* were also significantly affected by the different levels of polyols used as shown in the Figure 4. Treatment no. 1, which contained a high level of erythritol (60 g), scored the lowest (6.00g ± 0.17) due to erythritol's tendency to crystallize and create a gritty texture. In contrast, treatments with balanced polyol ratios, such as treatment no. 10 (erythritol (22 g), maltitol (16 g), sorbitol (22 g)), scored the highest for body and texture (7.41 ± 0.09). The combination of maltitol and sorbitol contributed positively to the *Boondi*'s body and texture, resulting in a smooth and cohesive mouthfeel. These results highlight the importance of a balanced mix of polyols in achieving a desirable texture in sweet *Boondi*.



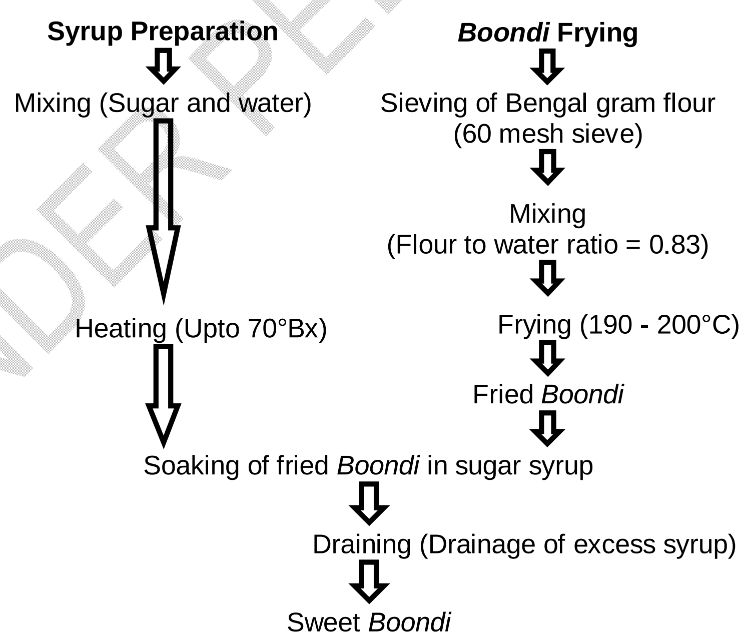


**Figure 2. Process flowchart derived from the survey for sweet *Boondi* manufacturing**

**Table 9.Sensory attributes scores of the dietetic sweet *Boondi*(DSB) Samples**

| Treatments No. | Colour & Appearance | Body & Texture | Flavour & Taste | Overall acceptability |
|---|---|---|---|---|
| 1 | $5.70^{f} \pm 0.17$ | $6.00^{g} \pm 0.17$ | $5.55^{g} \pm 0.10$ | $5.72^{h} \pm 0.12$ |
| 2 | $6.65^{e} \pm 0.13$ | $6.40^{f} \pm 0.13$ | $6.45^{f} \pm 0.11$ | $6.45^{g} \pm 0.10$ |
| 3 | $6.75^{de} \pm 0.14$ | $6.80^{e} \pm 0.14$ | $6.50^{f} \pm 0.11$ | $6.65^{fg} \pm 0.12$ |
| 4 | $6.85^{d} \pm 0.11$ | $6.85^{de} \pm 0.11$ | $6.80^{e} \pm 0.14$ | $6.83^{ef} \pm 0.09$ |
| 5 | $7.15^{bc} \pm 0.16$ | $7.18^{abc} \pm 0.16$ | $6.80^{e} \pm 0.09$ | $7.10^{cd} \pm 0.10$ |
| 6 | $6.75^{de} \pm 0.11$ | $6.50^{f} \pm 0.11$ | $6.50^{f} \pm 0.06$ | $6.63^{fg} \pm 0.11$ |
| 7 | $7.24^{b} \pm 0.12$ | $7.40^{ab} \pm 0.12$ | $7.38^{ab} \pm 0.16$ | $7.39^{ab} \pm 0.18$ |
| 8 | $7.31^{b} \pm 0.10$ | $7.21^{abc} \pm 0.10$ | $7.18^{bc} \pm 0.19$ | $7.19^{bcd} \pm 0.15$ |
| 9 | $7.32^{b} \pm 0.08$ | $7.16^{abc} \pm 0.08$ | $7.20^{bc} \pm 0.15$ | $7.25^{bc} \pm 0.20$ |
| 10 | $7.59^{a} \pm 0.09$ | $7.41^{a} \pm 0.09$ | $7.47^{a} \pm 0.10$ | $7.53^{a} \pm 0.10$ |
| 11 | $7.17^{bc} \pm 0.16$ | $7.02^{cde} \pm 0.16$ | $6.87^{de} \pm 0.11$ | $6.80^{ef} \pm 0.11$ |
| 12 | $7.17^{bc} \pm 0.08$ | $7.09^{cd} \pm 0.08$ | $7.04^{cd} \pm 0.10$ | $7.00^{de} \pm 0.08$ |
| 13 | $7.05^{c} \pm 0.16$ | $7.15^{bc} \pm 0.16$ | $6.75^{e} \pm 0.09$ | $6.70^{f} \pm 0.09$ |
| **SEm±** | 0.056 | 0.074 | 0.070 | 0.072 |
| **CD (0.05)** | 0.162 | 0.214 | 0.204 | 0.208 |
| **CV%** | 1.39 | 1.84 | 1.78 | 1.81 |

Results: Mean ± SD, (n=3) superscripts (a, b, c, d, e and f) indicates critical difference between the means ($P<0.05$)

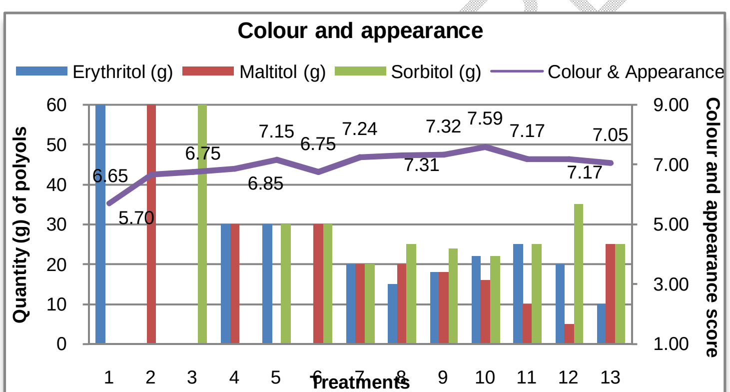


**Figure 3. Effect of different levels of polyols on colour and appearance score of DSB**

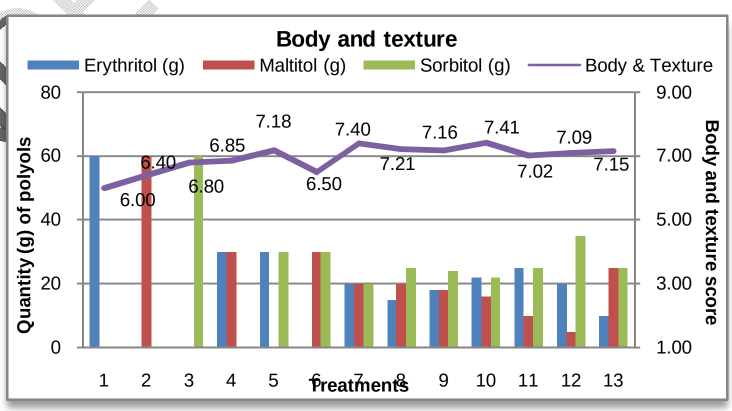


**Figure 4. Effect of different levels of polyols on body and texture score of DSB**

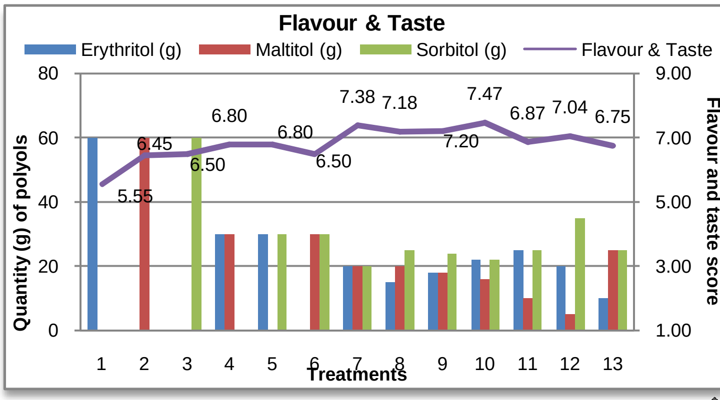


**Figure 5. Effect of different levels of polyols on flavour and taste score of DSB**

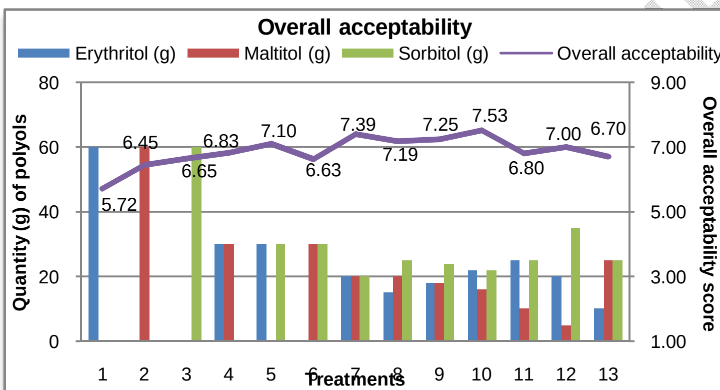


**Figure 6: Effect of different levels of polyols on overall acceptability score of DSB**

Flavor and taste were also influenced by the polyol composition as shown in the Figure 5. Treatment no. 1, with a high erythritol content, received the lowest scores (5.55 ± 0.10) due to erythritol's cooling effect, which can overpower other flavors and leave a lingering aftertaste. Conversely, treatment no. 10, with a balanced mix of polyols, achieved the highest score for flavor and taste (7.47 ± 0.10). The harmonious blend of erythritol, maltitol, and sorbitol provided a more rounded flavor profile, avoiding the dominance of any single polyol's distinct characteristics. This demonstrates the importance of a balanced polyol mix in achieving a pleasant flavor and taste in sweet *Boondi*.

The overall acceptability scores reflected the trends observed in individual sensory attributes, Figure 6 highlighting the impact of polyol composition on the overall product quality. Treatment no. 10, with a balanced mix of erythritol, maltitol, sorbitol, FOS, and stevia, achieved the highest overall acceptability score (7.53 ± 0.10). This formulation resulted in a product with a pleasing appearance, smooth texture, and balanced sweetness, leading to higher consumer satisfaction. In contrast, treatments with high concentrations of a single polyol, such as treatment no. 1 and treatment no. 2, scored lower in overall acceptability. These findings underscore the importance of optimizing polyol ratios to achieve a desirable sensory profile in sweet *Boondi*, with treatment no. 10 standing out as the most promising formulation.

## 4. CONCLUSION

Development of dietetic version of sweet *Boondi* includes replacement of traditional sugar syrup with a blend of stevia and polyols such as erythritol, maltitol, sorbitol, and fructooligosaccharides (FOS). The optimized formulation containing erythritol (22 g), maltitol (16 g), sorbitol (22 g), FOS (15 g), and stevia (0.082 g) per 100 g of syrup-achieved high sensory scores in color and appearance, body and texture, flavor and taste, and overall acceptability. These findings highlight the importance of balancing polyol ratios to meet consumer demand for healthier sweets without compromising sensory qualities, offering a promising framework for developing dietetic versions of other traditional Indian sweets.

## REFERENCES


1. Gulati S, Misra A. Sugar intake, obesity, and diabetes in India. *Nutrients.* 2014;6(12):5955-5974.
2. Bhat KK,Bhattacharya S. Deep fat frying characteristics of chickpea flour suspensions. International Journal of Food Science and Technology. 2001;36(5):499-507.
3. Dhange PR, Srinatha TN,Kandpal K. Stevia farming: A moneymaking venture for farmers. Indian Farming. 2023;73(12):19-22.
4. Hossain MF, Islam MT, Islam MA, Akhtar S. Cultivation and uses of stevia (*Stevia rebaudiana Bertoni*): A review. African Journal of Food, Agriculture, Nutrition and Development.2017;17(4):12745-12757.
5. Megeji NW, Kumar JK, Singh V, Kaul VK, Ahuja PS. Introducing Stevia rebaudiana, a natural zero-calorie sweetener. Current Science. 2005:801-804.
6. Borgo J, Laurella LC, Martini F, Catalan CA, &Sulsen VP. Stevia genus: phytochemistry and biological activities update. Molecules. 2021;26(9):2733.
7. World Health Organization. Steviol glycosides. In *JECFA database*. 2023. Available:https://apps.who.int/food-additives-contaminants-jecfa-database/Home/Chemical/267
8. Schiatti-Siso IP, Quintana SE, Garcia-Zapateiro LA. Stevia (*Stevia rebaudiana*) as a common sugar substitute and its application in food matrices: an updated review. Journal of Food Science and Technology. 2023;60(5):1483-1492.
9. Rice T, Zannini EK, Arendt E, Coffey A. A review of polyols–biotechnological production, food applications, regulation, labeling and health effects. Critical Reviews in Food Science and Nutrition. 2020;60(12):2034-2051.
10. Martau GA, Coman V, VodnarDC. Recent advances in the biotechnological production of erythritol and mannitol. Critical reviews in biotechnology. 2020;40(5): 608-622.
11. Saraiva A, Carrascosa C, Raheem D, Ramos F,Raposo A. Maltitol: Analytical determination methods, applications in the food industry, metabolism and health impacts. International Journal of Environmental Research and Public Health. 2020;17(14):5227.
12. Bali V, Panesar PS, Bera MB, Panesar R. Fructooligosaccharides: production, purification and potential applications. Critical reviews in food science and nutrition. 2015;55(11):1475-1490.
13. Rachwa-Rosiak D, Nebesny E, Budryn G. Chickpeas-composition, nutritional value, health benefits, application to bread and snacks: a review. Critical Reviews in Food Science and Nutrition. 2015;55(8):1137-1145.
14. Acharya N.G. Ranga Agricultural University.9-Bengalgram Outlook Report - January to December 2022. *Crop Outlook* Reports of Andhra Pradesh. 2022. Available:https://angrau.ac.in/downloads/AMIC/OutlookReports/2022/9-Bengalgram%20Outlook%20Report%20-

%20January%20to%20December%202022.pdf
15. Kaur R, Prasad K. Nutritional characteristics and value-added products of Chickpea (*Cicer arietinum*)-A review. Journal of Postharvest Technology. 2021;9(2):1-13.
16. Ravi R, Susheelamma NS. The effect of the concentration of batter made from Chickpea (*Cicer arietinum* L.) flour on the quality of a deep-fried snack. International Journal of Food Science and Technology. 2004;39(7):755-762.
17. Yargatti R, Muley A. Sensory characteristics of selective traditional Indian sweets using agave syrup and stevia: An observatory study. Functional Foods in Health and Disease. 2022;12(12):748-758.
18. Ahmad A, & David J. Effect of different levels of low-calorie sweetener aspartame on sensory attributes of diabetic *rasgulla*.The Pharma Innovation Journal. 2017;6(5):82-84.
19. Geetha P, Arivazhagan R, Selvam SP, Ida IM. Process standardization, characterization and shelf life studies of Chhana jalebi – A traditional Indian milk sweet. International Food Research Journal. 2015;22(1):155-162.
20. Kushwaha R, Vinti Singh MP, Kaur D. Traditional sweet: *Gulab jamun*. International Journal of Current Research and Review. 2017;9(21):45-53.
21. Chavan RS, Prajapati PS, Chavan SR, Jana A. Technology for the manufacture of diabetic *rosogolla*. Critical Reviews in Food Science and Nutrition. 2014;54(7):863-868.
22. Chetana R. *Studies on the use of sucrose alternatives in traditional sweetmeats* (Doctoral dissertation, University of Mysore).2004 Available:http://ir.cftri.res.in/276/1/Chethana.pdf
23. Pol J, Hohnova B, Hyotylainen T. Characterisation of Stevia rebaudiana by comprehensive two-dimensional liquid chromatography time-of-flight mass spectrometry.Journal of Chromatography A. 2007;1150(1-2):85-92.
24. O'Donnell K, Kearsley M. 2nd ed. Sweeteners and sugar alternatives in food technology;2012.
25. Kherade M, Solanke S, Tawar M, Wankhede S.Fructooligosaccharides: A comprehensive review. Journal of Ayurvedic and Herbal Medicine. 2021;7:193-200.
26. Zeng J, Hu Y, Gao H, Sun J, Ma H. Fructooligosaccharides impact on the hydration and retro-gradation of wheat starch and gel. International journal of food properties. 2016;19(12):2682-2692.