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STANDARDIZATION OF JAGGERY BASED CHIA (*SALVIA HISPANICA L.*) NUTRI BAR

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ABSTRACT

Growing consumer interest in functional and ready-to-eat foods has encouraged the development of nutrient-dense snack options such as nutri bars. The present study focused on developing and standardizing a jaggery-based chia nutri bar. Eight formulations (T_1–T_8) and a control (T_0) were formulated in varying proportions of chia seeds, groundnuts, and flaxseeds. Sensory attributes appearance, texture, color, flavor, taste and overall acceptability were evaluated by a semi-trained panel using a nine-point hedonic scale. Data analysis was performed by calculating the mean and standard deviation (SD), and a completely randomized design (CRD). Among the treatments, T_2 (containing 60 % jaggery, 25 % groundnut, 10 % chia seed, and 5 % flaxseed) received the highest acceptability scores. The findings show that the jaggery-based chia nutri bar was well accepted by consumers and can be recommended as a nutritious and appealing snack.
Keywords **:** Chia nutri bar; Sensory evaluation; Nutrient rich snack; Functional foods.

Introduction

Consumers are increasingly seeking nutritious, convenient and functional food products that support a healthy lifestyle. Nutri bars have become popular due to their ease of consumption and nutrient content (Sharma *et al.* 2023). The word "*chia*" is derived from the Nahuatl language ‘chian', meaning oily. Chia (*Salvia hispanica L.*) is an annual plant of the mint family (Lamiaceae) native to Mexico and Guatemala, has been consumed as a staple food since 2600 B.C. (Ixtaina *et al.*, 2008). Worldwide chia production has increased markedly in the past decade. South America remains the largest producer, with Paraguay harvesting about 72,000 tonnes annually from 180,000 hectares, followed by Bolivia with 20,000 tonnes from 40,000 hectares; Argentina, Mexico, and Australia also contribute to global supply (Tradelink International, 2025; Mordor Intelligence, 2024). Typical yields are 0.3–0.5 tonne per hectare, although favourable conditions can raise yields to 2.5 tonne per hectare (ProQuest, 2018).

In India, commercial cultivation began in 2012 when CSIR–Central Food Technological Research Institute (CFTRI), Mysore, released two high-yielding varieties CHIAmpion W-83 and CHIAmpion B-1. Chia is currently grown in Madhya Pradesh, Andhra Pradesh, and Gujarat, Karnataka, Rajasthan, Haryana, and some areas of Uttar Pradesh. In Karnataka, white chia yields about 3 quintals per acre and black chia about 5 quintals per acre, with the white variety generally commanding a higher market price (Police Patil *et al.*, 2020).

Chia seeds are recognized for their rich and unique nutrient profile, containing 25–40% oil (approximately 60% omega-3 α-linolenic acid), 15–25% protein, 26–41% carbohydrate, 18–30% dietary fibre, and 4–5% ash. Chia seeds are rich in antioxidants, naturally gluten-free, and free from

detectable heavy metals and mycotoxins, making them a recognized "superfood" (Ali *et al.,* 2012).

Rapid urbanization and time constraints have resulted in strong demand for convenient, nutrient-dense snack options (Khoo and Knorr 2014). Understanding the problems caused by urbanization is important for creating food supply plans that work for both big and small cities (Knorr *et al*., 2018). Nutri bars provide balanced energy and health benefits. They can be fortified with cereals, legumes, nuts, seeds or other functional ingredients to enhance protein, fibre and micronutrient content (Bukya *et al.,* 2018). Regular consumption of nutri rich bars can promote satiety, support weight management and supply sustained energy and essential micronutrients. The bioactive compounds in chia seeds, including phenolics, tocopherols, carotenoids, polyphenols, tannins and phytates, scavenge free radicals, limit oxidative stress and has the potential to help prevent chronic diseases such as diabetes, inflammation and neurodegenerative disorders. Chia seeds also contribute to bone health, anaemia prevention and overall metabolic wellness, making them beneficial for women, children, athletes and individuals with celiac disease. (Agarwal *et al.,* 2023).

Sensory evaluation is a critical step in food product development as it reflects consumer preferences and helps to standardize the best accepted formulation. Therefore, this study aimed to formulate, standardize and evaluate the sensory attributes of jaggery based chia nutri bars. The study further focused on identifying the best accepted formulation as a nutritious and appealing snack.

Material and Methods

Procurement of Raw Materials

Chia seeds (*Salvia hispanica L.*), flaxseeds, groundnuts and jaggery were procured from the local market in Shivamogga, Karnataka, India. The ingredients were stored in hygienic conditions at room temperature until further use.

Formulation and preparation of jaggery based chia nutri bars

Jaggery based chia nutri bars were developed using chia seeds, groundnuts and flaxseeds, with jaggery included in a fixed proportion as a sweetening and binding agent. A total of eight formulations (T_1–T_8) along with a control (T_0) were prepared as shown in Table 1. The control did not contain chia, whereas formulations T_1–T_8 varied in proportions of chia, groundnuts and flaxseeds to identify the best accepted combination based on sensory evaluation.

Table 1 : Jaggery based Chia Nutri bar development

Ingredients	Control	T1	T2	T3	T4	T5	T6	T7	T8
Chia (g)	0	05	10	15	20	25	30	35	40
Jaggery (g)	60	60	60	60	60	60	60	60	60
Groundnut (g)	40	30	25	20	15	10	05	0	0
Flaxseed (g)	0	05	05	05	05	05	05	05	0

Preparation Method

Chia seeds, groundnuts and flaxseeds were cleaned and dry roasted. Jaggery was melted and mixed with the dry roasted ingredients in the proportions. The mixture was spread evenly in silicone moulds, allowed to cool at room temperature. Prepared bars were packed in HDPE covers (Fig. 1).

Sensory evaluation

Sensory evaluation was performed using a 9-point hedonic scale, where 1 indicated "dislike extremely" and 9 indicated "like extremely" (Wichchukit and O'mahony, 2015). A semi-trained panel from College of Agricultural Sciences, KSNUAHS, Iruvakki, Shivamogga participated in the sensory evaluation. Attributes such as appearance, colour, taste, texture and overall acceptability were assessed.

Statistical analysis

This study used a completely randomized design (CRD) with four replicates for each parameter. The data are expressed as mean ± standard deviation (SD). One-way ANOVA was performed to assess significant differences among treatments, and all statistical analyses were carried out in Microsoft Excel. Significance was set at $p < 0.01$.

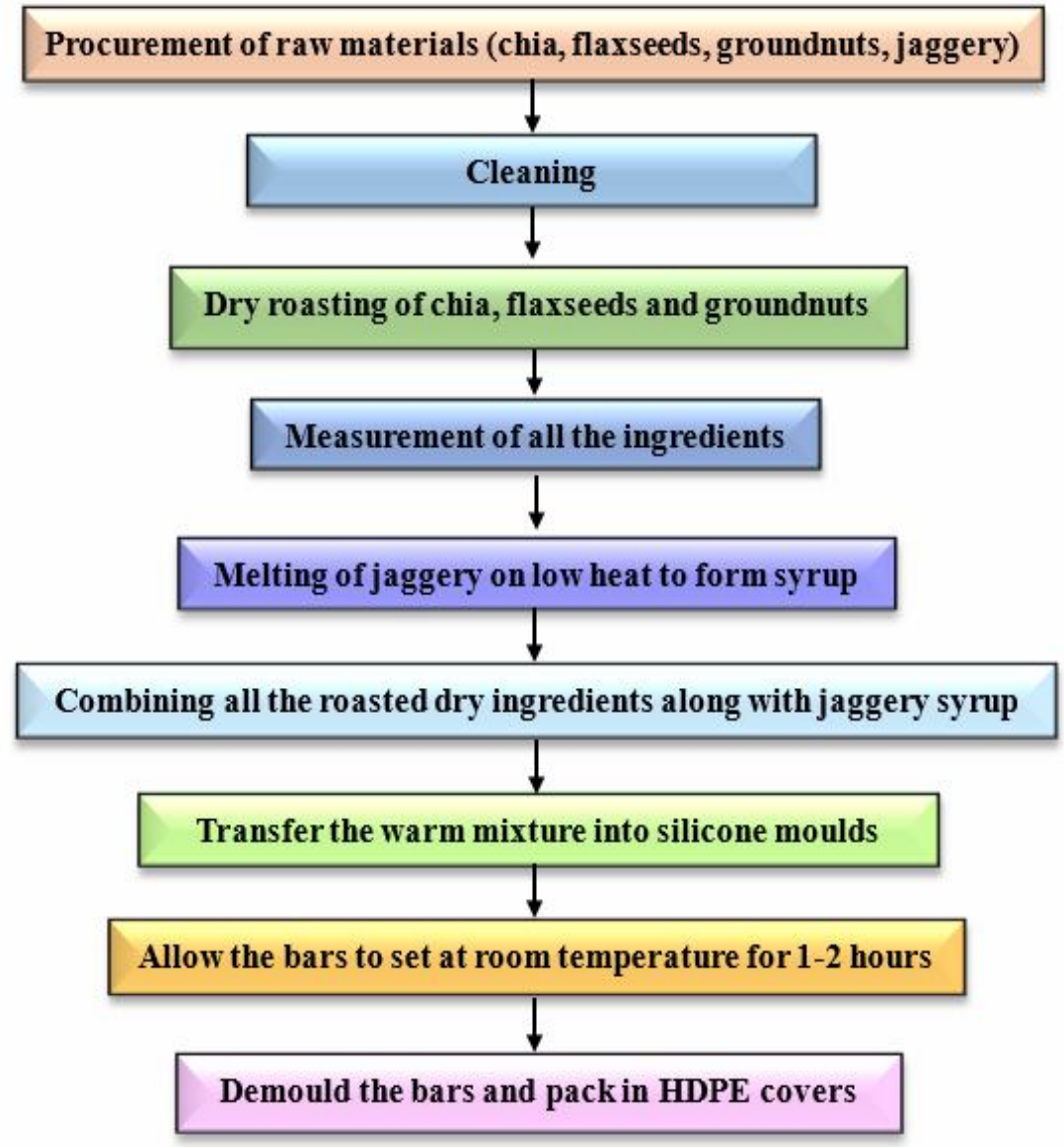

Fig 1. : Flow chart of the preparation of Jaggery based Chia Nutri Bar

Results

The formulations of jaggery based Chia nutri bars are shown in Figure 2. Table 3 and Figure 3 represent the sensory evaluation of jaggery based chia nutri bar. Sensory evaluation of jaggery based chia nutri bars showed significant variation among treatments for every attribute. The control sample showed the highest mean scores for appearance (8.24 ± 0.23), texture (8.48 ± 0.13), colour (8.24 ± 0.15), flavour (7.48±0.16), taste (8.48 ± 0.20) and overall acceptability (8.48 ± 0.16). Among all treatments, the T_2 formulation (60 % jaggery, 25 % groundnut, 10 % chia, and 5 % flaxseed) was most preferred, receiving sensory scores of appearances (7.84 ± 0.11), texture (7.88 ± 0.04), colour (7.72 ± 0.08), flavour (7.28 ± 0.13), taste (7.84 ± 0.26), and overall acceptability (8.04 ± 0.08), which did not differ significantly from the control. T_1 showed overall acceptability score (7.96 ± 0.21) whereas, T_3 (7.04 ± 0.21), T_4 (6.96 ± 0.14), T_5 (7.24 ± 0.07), T_6 (6.80 ± 0.14), T_7 (6.28 ± 0.14) and T_8 (5.28 ± 0.10), indicated a gradual decline in consumer preference from T_1 to T_8. The SEm (±) ranged from 0.06 to 0.08, and the critical difference (CD) at 1 % ranged from 0.25 to 0.31, indicates that the variations observed among treatments were highly significant.

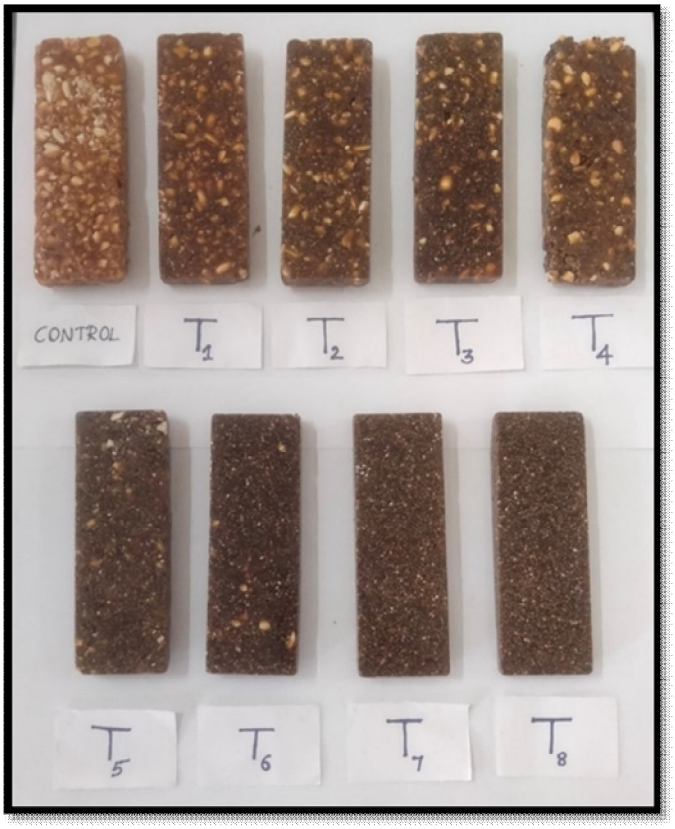

Fig. 2 : Jaggery based Chia nutri bars

Discussion

The findings show that moderate inclusion of chia seeds enhances the nutritional quality of nutri bars without affecting sensory characteristics (Table 3 and Figure 3), whereas higher levels negatively influence texture and flavor. This agrees with the report of Hein *et al.* (2023), observed that nutri bars containing 20 *per cent* partially sprouted chickpea flour achieved the highest consumer acceptance, while greater additions reduced palatability despite improved nutrient content. Likewise, Mathur and Kumari (2022) noted that fiber and protein enriched composite bars displayed varying sensory scores with some formulations surpassing the control in overall acceptability.

In the present work, the T_2 formulation (10 % chia seeds) achieved the best consumer preference. The results further indicated that although functional ingredients can improve the nutrient profile of nutri bars, sensory acceptability remains a key factor in their standardization.

Table 2: Sensory Evaluation of jaggery based Nutri bar

Sample	Appearance	Texture	Colour	Flavour	Taste	Overall acceptability
Control	8.24±0.23	8.48±0.13	8.24±0.15	7.48±0.16	8.48±0.20	8.48±0.16
Treatment 1	7.48±0.10	7.52±0.20	7.52±0.19	7.88±0.19	7.52±0.08	7.96±0.21
Treatment 2	7.84±0.11	7.88±0.04	7.72±0.08	7.28±0.13	7.84±0.26	8.04±0.08
Treatment 3	7.76±0.10	7.48±0.18	7.04±0.20	7.24±0.19	7.00±0.13	7.04±0.21
Treatment 4	6.96±0.05	7.00±0.22	6.00±0.10	7.28±0.11	6.48±0.08	6.96±0.14
Treatment 5	7.00±0.20	6.76±0.15	6.80±0.19	7.04±0.10	7.24±0.15	7.24±0.07
Treatment 6	7.00±0.01	7.04±0.17	6.56±0.03	6.04±0.19	7.04±0.20	6.80±0.14
Treatment 7	7.04±0.14	6.28±0.04	6.04±0.08	5.56±0.15	5.28±0.03	6.28±0.14
Treatment 8	5.92±0.16	7.00±0.14	5.52±0.12	4.56±0.10	5.04±0.44	5.28±0.10
S. Em±	0.07	0.08	0.07	0.06	0.08	0.08
CD at 1%	0.29	0.31	0.28	0.25	0.31	0.30

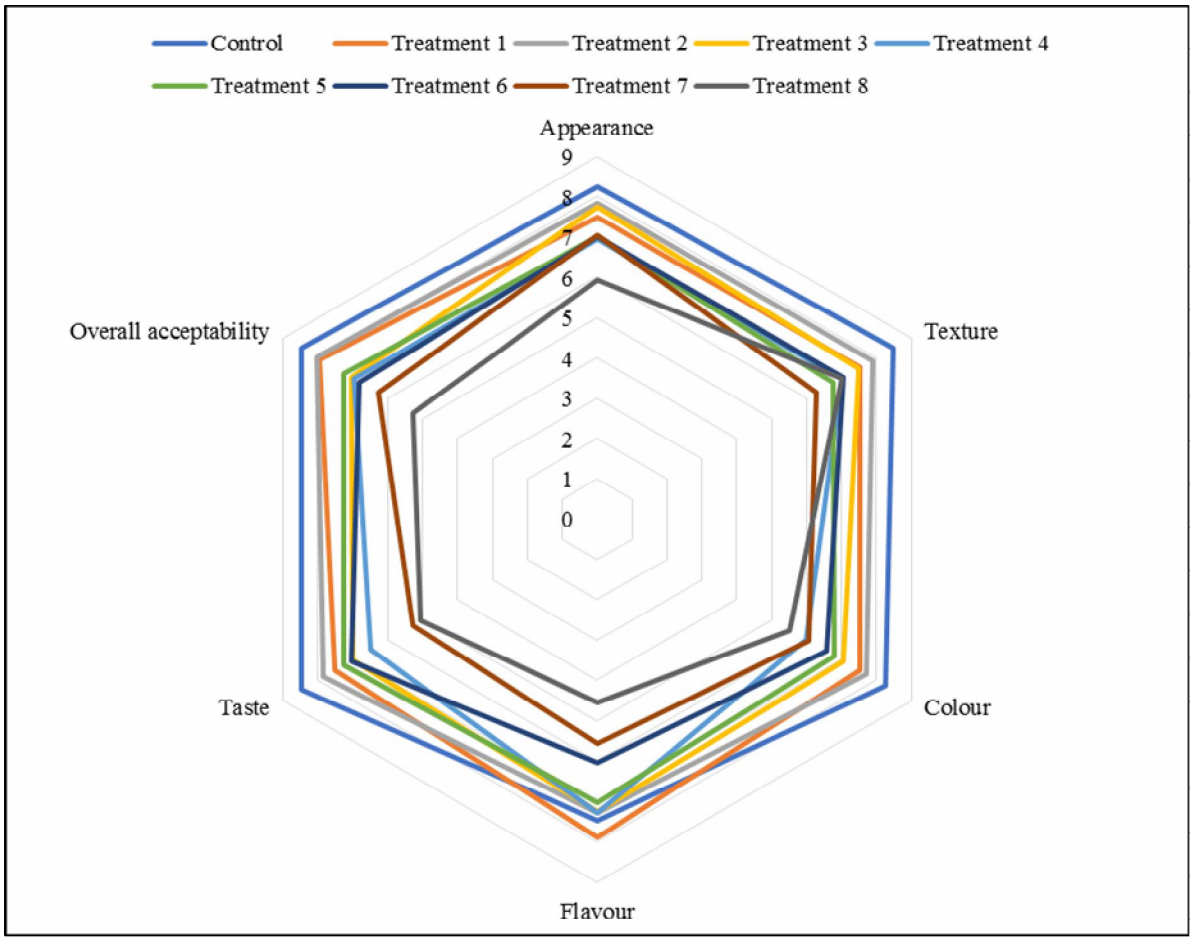

Fig. 3 : Sensory evaluation of jaggery based chia Nutri bar

Conclusion

The study successfully developed and standardized jaggery based chia nutri bars using chia, groundnuts and flaxseeds. Among the eight treatments Treatment 2 (T_2) was the best accepted based on sensory evaluation. This may be due to the balanced sweetness of jaggery and the crunchy texture from the roasted chia seeds, groundnuts and flaxseeds. Therefore, the jaggery based chia nutri bar can be recommended as a appealing functional snack.

References

Agarwal, A., Rizwana, Tripathi, A. D., Kumar, T., Sharma, K. P. and Patel, S. K. S (2023). Nutritional and functional new perspectives and potential health benefits of quinoa and chia seeds. *Antioxidants*, **12**, 1413.

Ali, N. M., Yeap, S. K., Ho, W. Y., Beh, B. K., Tan, S. W. and Tan, S. G (2012). The promising future of chia, Salvia hispanica L. *J. Biomed. Biotechnol*., 2012, 1–12.

Bukya, A., Asmita, S. and Dnyaneshwari, G.N. (2018). Development, characterization and optimization of cereal, legume and millet incorporated nutri-bar and its storage studies. *Int. J. Sci. Res*., **7**(3), 81-83.

Hein, K.M., Lin, M., Zar, T. and Kyaw, P.N. (2023). Development of cereal-based nutri bar combining with different levels of partially sprouted chickpeas flour. AGPE The Royal Gondwana Research *J. Hist. Sci. Econ. Polit. Soc. Sci*., 27–37.

Ixtaina, V.Y., Nolasco, S.M. & Tomas, M.C. (2008). Physical properties of chia (Salvia hispanica L.) seeds. *Industrial Crops and Products*, **28,** 286–293.

Khoo, C.S., Knorr, D. (2014). Grand challenges in nutrition and food science technology. Front Nutr (2014) 1,4.

Knorr, D., Khoo, C.S.H. and Augustin, M.A. (2018). Food for an urban planet, Challenges and research opportunities. *Front Nutr*, **4**, 73.

Mathur, M. and Kumari, A. (2022). Development and evaluation of multigrain fibre and protein enriched composite bars. *Pharma Innov. J*., 30–41.

Meilgaard, M., Civile, G.,V. & Carr, B.T. (2007). Sensory evaluation techniques. 4th Ed. CRC Press. Boca Raton, FL, USA. pp. 1-464.

Mordor Intelligence (2024). South America Chia Seeds Market Size & Share Analysis. https,//www.mordorintelligence. com/ (Accessed on 5 September, 2025)

Police Patil, A.S., Ambrish, G., Reddy, S. B. and Reddy, B.S. (2020). Importance of Chia (*Salvia hispanica*) cultivation in Indian agriculture. *Vigyan Varta*, **1**, 17-19.

ProQuest (2018). Chia Seed Global Production and Yield Report. ProQuest. Available at, https://www.proquest.com/ (Accessed on 6 September, 2025)

Sharma, R., Patel, S. & Kaur, J. (2023). Nutritional bars, A rising trend in functional convenience foods. *Journal of Food Science and Nutrition,* **12,** 55–63.

Tradelink International (2025) *Crop Report – Early 2025*, Tradelink International. https://tradelinkinternational.com/crop-report-early-2025/ (Accessed on 2 September, 2025)

Wichchukit, S., & O'mahony, M. (2015). The 9-point hedonic scale and hedonic ranking in food science, Some reappraisals and alternatives. Journal of the Science of Food and Agriculture, **95**, 2167-2178.