

PROCESS OPTIMISATION AND QUALITY EVALUATION OF INSTANT CUSTARD POWDER INCORPORATED WITH RESISTANT STARCH FROM GRAND NAIN BANANA

SRUTHY. P. M, SHARON. C. L, SEEJA THOMACHAN,
A. N. JYOTHI, ANEENA E. R, AND LAKSHMY P. S.

*Department of Community Science, College of Agriculture, Kerala Agricultural University,
Vellanikkara, Thrissur, Kerala-680 656

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ABSTRACT

The research aimed (2023-2024) to create an instant custard powder utilizing resistant starch derived from the Grand Naine banana. The process involved peeling, slicing, drying, and powdering mature banana at 50°C, followed by isolating starch from banana flour using a modified water-alkaline extraction method. Isolated starch was modified by autoclaving at 121°C for 30 minutes with a moisture content of 10 per cent. Custard powder was prepared by incorporating resistant starch at different levels with corn flour and other suitable ingredients (T_0 - T_6). Custard were formulated using these treatments and subjected to organoleptic evaluation. The most effective treatment was selected through sensory evaluation using a scorecard with a nine-point hedonic scale. The maximum score for all the organoleptic attributes was obtained for custard (T_4), which were prepared by blending resistant starch (20 %), corn flour (15 %) and other ingredients (65 %). The nutritional composition of the selected custard powder included moisture (6.25 %) carbohydrate (63.64 g 100g⁻¹), starch (54.95 %), resistant starch (14.64 %) and *in vitro* digestibility of starch (45.2 %). The formulated custard powder containing banana resistant starch resulted in slowly digestible starch characteristics, accomplishing this without significantly affecting the sensory qualities.

Keywords: Banana starch, Custard powder, Grand Naine banana, Organoleptic and nutritional qualities, Resistant starch

INTRODUCTION

Banana is considered to be amongst the most significant fruit crops cultivated in India. Termed as Kalpatharu, signifying a plant with diverse uses, it holds the distinction of being the earliest fruit referred to as the 'Apple of Paradise'. The Grand Naine banana stands out as a renowned Cavendish banana cultivar, well-recognized for its productivity. This

particular cultivar is well-known for its abundant yield and is widely favoured in India. It makes a substantial impact on India's position as the leading banana producer globally, with an annual output of around 33 million tons. Its moderate stature and generous fruit production make it highly suitable for commercial agricultural purposes (NRCB, 2023).

Banana starch, derived from green banana, is a type of resistant starch that resists digestion in the small intestine and reaches the large intestine intact. The resistant starch content of green banana makes it a valuable prebiotic food. This resistant starch is not digested in the small intestine but is fermented in the large intestine. The consistent consumption of unripe banana flour, which boasts a high starch content, can offer diverse health advantages to individuals. Consequently, unripe banana flour has been employed as a functional component in food products (Zhang *et al.*, 2005).

Starchbased custard flour is commonly used to make a smooth and creamy gruel or paste by dissolving it in water and boiling it. The gelling capability and consistency of custard are attributed to corn starch, traditionally used as the main ingredient. However, corn starch is a high-energy food with a high glycemic index, making it less suitable for health-conscious individuals (O-Salami *et al.*, 2019). Consequently, there is a need to enhance the nutritional profile of custard to better cater to these individuals. One promising strategy is to partially substitute corn starch with health-promoting ingredients, such as green banana resistant starch, in the development of custard.

MATERIAL AND METHODS

The research was carried out between 2023 - 2024 at the Department of Community Science, College of Agriculture, Vellanikkara, Kerala Agricultural University, Thrissur. For this study, a fully mature Cavendish variety (AAA) (Grand Naine) was procured from the Banana Research Station, Kannara, of Kerala Agricultural University. All other ingredients required for the study were purchased from the local market.

Preparation of banana flour

The fresh banana variety were washed and peeled. It was sliced to an average thickness of 1 cm. The slices were dried at 50°C for 8 hrs in a hot air oven. The dried chips were ground and sieved to obtain a uniform flour.

Isolation of starch from banana flour

Starch was isolated from the banana flour by a modified water-alkaline extraction process suggested by Vasanthan (2001). The powdered banana is then blended with water to form a paste. Additional water, in a ratio of 1:10, was added to the paste after grinding. A small amount of sodium metabisulphite, precisely 0.01%, is incorporated into the mixture. This mixture was then allowed to settle for 5-8 hours.

Table 1. Treatments for the formulation of custard powder

Sl.No	Treatments	Combinations
1	T ₀	35 % CF + 65 % OI
2	T ₁	35 % BRS + 65 % OI
3	T ₂	30 % BRS + 5 % CF + 65 % OI
4	T ₃	25 % BRS + 10 % CF + 65 % OI
5	T ₄	20 % BRS + 15 % CF + 65 % OI
6	T ₅	15 % BRS + 20% CF + 65 % OI
7	T ₆	10% BRS + 25 % CF + 65 % OI

BRS – Banana resistant starch, CF-Corn flour, OI-Other ingredients

Table 2. Mean score for organoleptic evaluation of Grand Naine banana RS incorporated custard

Sl.No	Parameters	T ₀	T ₁	T ₂	T ₃	T ₄	T ₅	T ₆	Kendall's W
1	Appearance	8.73 (6.55)	7.77 (2.50)	7.78 (2.55)	8.05 (3.23)	8.28 (4.63)	8.20 (4.33)	8.18 (4.23)	0.474**
2	Colour	8.78 (6.50)	7.42 (2.00)	7.70 (2.95)	7.72 (3.00)	8.18 (4.73)	8.00 (4.50)	7.98 (4.33)	0.533**
3	Flavour	8.63 (6.25)	7.51 (2.30)	7.77 (3.48)	7.81 (3.30)	8.10 (4.40)	8.07 (4.38)	7.95 (3.90)	0.368**
4	Texture	8.68 (6.45)	7.45 (1.88)	7.75 (2.93)	7.80 (2.85)	8.47 (5.80)	8.12 (4.23)	8.00 (3.88)	0.623**
5	Taste	8.68 (6.38)	7.87 (2.88)	7.88 (2.88)	7.91 (3.08)	8.25 (4.83)	8.12 (4.00)	8.10 (3.98)	0.381**
6	Overall acceptability	8.63 (6.60)	7.52 (2.23)	7.62 (2.60)	7.65 (2.78)	8.22 (5.33)	8.02 (4.50)	7.90 (3.98)	0.608**
	Total mean rank score	8.68	7.59	7.74	7.82	8.25	8.08	8.01	

The figures in parenthesis indicate the mean rank scores based on Kendall's coefficient of concordance (W), (** significant at 1 % level)

Following the settling period, the mixture was filtered through a double layer of cheese cloth. The filtered mixture was subsequently washed multiple times with water. Finally, the resulting slurry was dried using hot air oven at 60°C for 12 hours.

Processing of isolated starch

The isolated starch was modified by autoclaving at 121! for 30 minutes with a moisture content of 10 per cent. The mixture was cooled to room temperature and stored at 4! for 24 h. After three cycles of autoclaving and cooling, the sample was dried and ground into fine particles.

Standardisation of custard powder

Instant custard mix powder was standardised by incorporating corn flour, milk powder, modified banana resistant starch (BRS) and other suitable ingredients such as milk powder (15 %), sugar (40 %), cashew nuts (4 %), salt (1%), desiccated coconut (4%) and vanilla essence and permitted yellow orange food colour (1%).The treatments adopted for standardisation are given below.

Organoleptic evaluation

The sensory evaluation of the prepared banana RS custard was conducted using a nine-point hedonic scale. A panel of 20 judges assessed six sensory parameters, including appearance, colour, flavour, texture, taste, and overall acceptability. The best treatment was determined based on organoleptic mean scores and selected for further studies alongside the control.

Nutritional properties of custard mix

The nutritional properties, such as moisture, carbohydrate, starch, resistant starch and *in vitro* digestibility of starch of best selected banana resistant starch custard powder were evaluated along with those of the control.

Statistical analysis

The data were analysed during the year 2023-2024 using appropriate statistical methods such as the best treatments were selected. The mean scores and mean rank scores were statistically analysed by applying

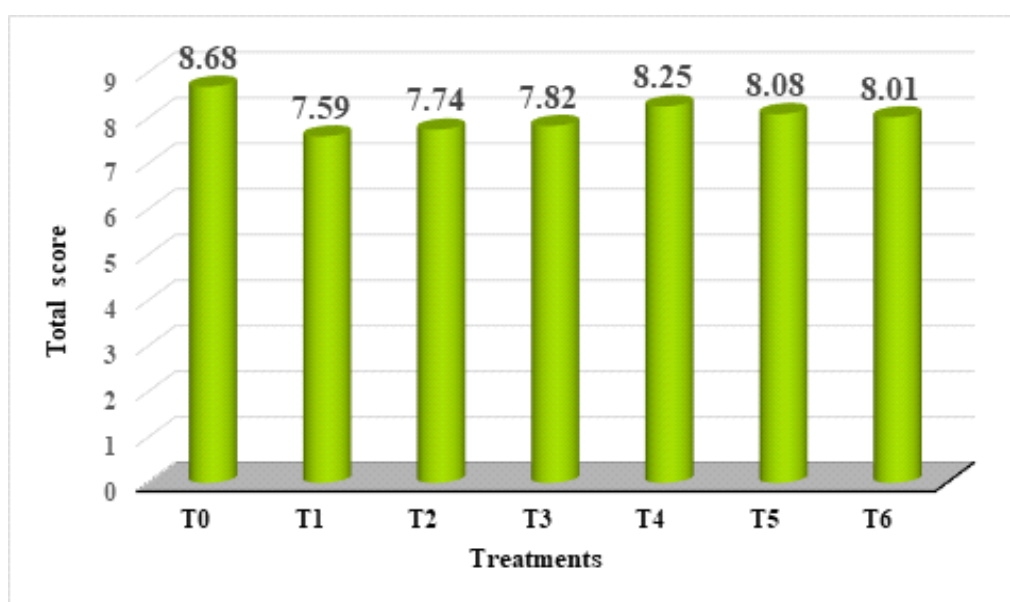


Fig 1. Total score of the organoleptic evaluation of Chengalikodan banana RS incorporated custard powder

Kendall's coefficient of concordance (W), and the nutritional parameters were subjected to an independent sample t-test using IBM SPSS Statistics software version 22.

RESULTS AND DISCUSSION

Organoleptic evaluation of custard

The custard was prepared using banana RS custard powder following the standard procedure of Shabina (2011). Sensory evaluation was conducted by a panel of 20 judges, and the organoleptic scores are presented in Table 2.

An evaluation of various treatments of banana resistant starch custard showed that treatment T_4 , containing 20 per cent banana resistant starch, received the highest scores in all categories including appearance, colour, flavour, texture, taste, and overall acceptability (refer to Plate 1 and 2). The quality of the custard influenced by the physical properties of the starch used, with texture being the most crucial aspect, followed by taste and flavour. Treatment T_4 had the highest average score of 8.25, followed by T_5 (8.08) and T_6 (8.01) (Fig 1). The judges also showed significant agreement in their evaluation of the different quality attributes of banana RS custard based

on Kendall's value (W). As per the organoleptic evaluation, treatment T_4 was selected for nutritional evaluation.

Simi *et al.*, (2016) standardised ready-made custard powders using canna starch and cornstarch in different combinations. The overall acceptability of custard prepared completely with rhizome starch (35%) was 8.69, which was selected as the best combination. Elias (2018) reported that custard powder prepared from 60 per cent cornstarch and 40 per cent Tannia starch powder had the highest average score of 8.5.

Nutritional composition of BRS custard powder

The best banana RS custard powder (T_4) was selected for the organoleptic evaluation and was subjected to nutritional analysis along with control (Table 3). The moisture content of the selected banana RS custard powder was measured at 6.25 per cent, slightly higher than the control's 5.6 per cent. The carbohydrate content of the selected custard was 63.64 g 100g⁻¹, which was slightly lower than that of the control (68.57 g 100g⁻¹). Ezegebe *et al.* (2021) standardised a custard powder with soya bean, sweet potato and corn starch. The custard



Plate 1. Banana RS Custard powder



Plate 2. Custard

Table 3. Nutritional composition of banana RS custard powder

Sl.No	Parameters	Control	T ₄	t value
1	Moisture (%)	5.6	6.25	5.58*
2	Carbohydrate (g 100g ⁻¹)	68.57	63.64	2.77*
6	Starch (%)	62.91	54.95	3.70*
7	Resistant starch (%)	10.21	14.64	2.30*
8	<i>In vitro</i> digestibility of starch (%)	52.70	45.20	2.70*

*Significant at 5% per cent level, (T₄ – 20 % banana resistant starch, 15 % corn flour, 65 % other ingredients)

powder samples had a carbohydrate content ranging from 68.87 to 76.90 g per 100g. The protein content of the control was 3.56 g per 100g, while the banana starch custard powder had 3.47 g per 100g. According to t test there was a significant difference between the treatments in all the parameters.

In this study, the starch content of the control custard powder was 62.91 %, and that of the developed banana starch custard powder contains 54.95 per cent starch. The developed banana starch custard had a resistant starch content of 14.64%, slightly greater than that of the control (10.21%). Alimi *et al.* (2017) conducted a study on standardized corn banana custard. They found that custard paste prepared with modified starch contained the highest resistant starch level, around 14%, compared to 11% in custard paste made with native banana starch and the control sample. The increased resistant starch content in the custard paste containing modified starch is due to its higher amylose content, which limits the amylase enzyme's access to amylose and reduces amylolytic hydrolysis. The formation of type 3 resistant starch, formed through hydrothermal modification of starch could improve its health benefits

The *in vitro* digestibility of starch of the selected custard powder was found to be 45.20 %, slightly lower than that of the control

(52.70%). Alimi *et al.* (2017) reported that custard paste containing native banana starch (BS) had slightly higher rapidly digestible starch (RDS) content compared to those made with modified banana starch. This suggests that banana starch modification may lead to the formation of an indigestible starch fraction. The interaction between banana-resistant starch (RS) and corn flour in custard powder enhances its nutritional properties by lowering the glycaemic index and promoting gut health through prebiotic effects. This combination also improves texture, reduces caloric density, and enriches the micronutrient profile, making the custard healthier and more appealing to health-conscious consumers.

CONCLUSIONS

The study concluded that custard powder was formulated with varying levels of banana resistant starch, corn flour and other ingredients (T₀-T₆) and evaluated for sensory properties. The selected (T₄) formulation, containing 20% resistant starch, 15% corn flour, and 65% other ingredients, achieved the highest sensory scores (8.25). The nutritional composition of the selected treatments was found to be moisture (6.25%), carbohydrates (63.64 g/100g), resistant starch (14.64%) and *In vitro* digestibility of starch (45.20%). The incorporation of banana starch, whether in its natural form or hydrothermally treated,

enhances the consistency of custard powder. It also increases the proportion of slowly digested starch, making it potentially beneficial for the dietary management of various diseases. The improved functional characteristics of custard powder samples could lead to their production on a commercial scale.

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