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Standardisation of Jackfruit Seed Incorporated Chocolates and its Quality Evaluation

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ABSTRACT

Background: Chocolate is a popular product that millions enjoy every day due to its unique, rich and sweet taste. Jackfruit seeds rich in nutrients, produce a chocolaty aroma and could be potentially cheap abundant substitute for making chocolate. Hence, the present study was carried out to formulate nutritionally superior chocolates using jackfruit seed.

Methods: Jackfruit seed flour was used in varying proportions ranging from 30 to 70 per cent along with 10 to 50 per cent cocoa butter and 20 per cent other ingredients. Other ingredients used were cane sugar, cocoa powder and milk powder. The best treatment was selected through sensory evaluation using a score card with a 9 point hedonic scale.

Result: Based on organoleptic evaluation, chocolate prepared with 30 per cent roasted jackfruit seed flour and 50 per cent cocoa butter had a maximum mean score of 8.31 for overall acceptability. The selected roasted jackfruit seed flour based chocolate was subjected to physico-chemical analysis and observed to have moisture (7.62%), carbohydrate (63.03 g 100 g^{-1}), protein (3.78 g 100 g^{-1}), fat (1g 100 g^{-1}) and fibre (3.13g 100 g^{-1}).

Key words: Chocolate, Cocoa butter, Organoleptic evaluation, Roasted jackfruit seed flour.

INTRODUCTION

Chocolate is a perfect food and a little chocolate now and then doesn't hurt, but keeps the doctor at a bay. Chocolate, due to its unique structure and flavor, is a food usually consumed for pleasure that has been recently reconsidered as a source of healthy compounds. The chocolate is lauded for its tremendous antioxidant potential. The biologically active phenolic compound in cocoa has changed the perception of chocolates which was criticized for its high fat and sugar content. Several researches have shown beneficial effect of chocolate in reducing oxidative stress, blood pressure regulation and cardio vascular diseases (Buijsse *et al*., 2006).

Jackfruit (*Artocarpus heterophyllus* Lam.) is an integral crop component of homestead farming and bears the largest fruit among the edible fruits. It is a popular fruit consumed in the tropics. It is widely grown in India, Bangladesh, South East Asia and West Africa (APAARI, 2012). Among the fruit crops seen in Kerala, jackfruit has a prominent position, which comes to 89702 hectares as reported in Farm Guide (2014). Raw jackfruit is composed of nutritional and health promoting substances, especially minerals, antioxidant compounds, vitamins, folates, phytochemical components, dietary fibres and has relatively low calories (Murcia, 2009). However, the fruit is perishable and cannot be stored for long time because of its inherent compositional and textural characteristics. Every year considerable amounts of jackfruit are wasted due to lack of processing units and marketing. Jackfruit seeds make up around 10-15 per cent of the total fruit weight. Jackfruit seed is used occasionally as a minor supplement in culinary preparations, but greater portion is wasted. Jackfruit seed is considered as cheap non-conventional protein source, so it can be used for the prevention of malnutrition in developing countries like India (Chowdhury *et al*., 2012). Azeez *et al*. (2015) reported that the essential amino acids, fatty acids and trace amount of sugars present in jackfruit seeds make it a cheap source of dietary nutrients and health snack for overweight people. Carbohydrate, protein and fibre are the major constituents of seeds and these nutrients interact with each other during product development and play an important role in determining the final quality of the food products. As jackfruit seeds are bland in taste with no unique flavour, there is potential opportunity for utilising the seed in the form of flour for value addition in the industrial sector (Rajarajeshwari and Jamuna, 1999). The demand has come up for cost effective, nutritious chocolates based on locally available resources. Hence, the current study was conducted to

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identify the suitability of roasted jackfruit seed flour as an ingredient for the standardisation of chocolates which is nutritionally superior and cost effective.

Objectives

- To standardise nutritionally superior chocolates from jackfruit seed flour.
- To evaluate organoleptic and nutritional qualities of selected product.

MATERIALS AND METHODS

Selection and collection of jackfruit seed flour

The experiment was conducted in 2019- 20 at the Research Cum Department of Community Science of College of Agriculture, Kerala Agricultural University, Thrissur. Jackfruit seeds were used as one of the major ingredients. Jackfruit seeds were collected from homesteads. Cocoa powder and cocoa butter were procured from Cocoa Research Centre of Kerala Agricultural University. All other raw ingredients needed for the study were purchased from the local market.

Standardisation of jackfruit seed flour based chocolates

Jackfruit seed flour was prepared based on standard procedure (Pandeay, 2004). Cocoa powder, cane sugar and milk powder were the other ingredients used in chocolate. The amount of other ingredients (OI) were kept in a fixed proportion of 20 per cent.

Preparation of jackfruit seed flour

Seeds
↓
Removal of outer peel
↓
Pressure cooking
↓
Slicing
↓
Drying (60°C for 12 hrs)
↓
Milling and sieving
↓
Roasting

Standardisation of ingredients in roasted jackfruit seed incorporated chocolates

Roasted jackfruit seed flour chocolate was prepared using roasted jackfruit seed flour (RJSF) with cocoa butter (CB) as a fat source in varying proportions ranging from 10 per cent to 50 per cent. Treatment T_0 (control)contain cocoa powder, cocoa butter, milk powder, cane sugar and vanilla essence, served as control. The details of treatments and combinations are detailed in Table 1.

Table 1: Details of combinations of jackfruit seed flour based chocolates.

Treatments	Combinations
T_0	30% CP + 35% CB + 10% MP + 20% CS + 5% VE
T_1	70% RJSF + 10% CB + 20% OI
T_2	60% RJSF + 20% CB + 20% OI
T_3	50% RJSF + 30% CB + 20% OI
T_4	40% RJSF + 40% CB + 20% OI
T_5	30% RJSF + 50% CB + 20% OI

[*RJSF-Jackfruit seed flour, CB- Cocoa butter, CP- Cocoa powder, MP- Milk powder, CS- Cane sugar, VE- Vanilla essence, OI- Other ingredients].

Organoleptic evaluation

A series of acceptability trails were carried out using simple triangle test at the laboratory level and selected a panel of fifteen judges between the age group of 18-35 years as suggested by Jellineck (1985). The organoleptic evaluation of the chocolates were carried out using a 9 point hedonic scale.

Physico-chemical analysis

The physico-chemical qualities like moisture (A.O.A.C. 1980), carbohydrate, protein, fat, energy and fibre (Sadasivam and Manickam, 1997) of best selected roasted jackfruit seed flour incorporated chocolate was determined initially. Analyses were carried out in triplicate.

Statistical analysis

The scores obtained for organoleptic evaluation were evaluated by Kendall's Coefficient of Concordance (W).

Cost of production

The cost of production of the most acceptable combination of roasted jackfruit seed flour incorporated chocolate were computed based on the market price of procured ingredients used for preparation of products along with labour charge, fuel charge, electricity charge and packaging cost. The cost was calculated for 100 g of the product and compared with similar products available in the market.

RESULTS AND DISCUSSION

Organoleptic evaluation

Sensory evaluation is used to measure, analyse and interpret how the attributes of a product are perceived by peoples. These sensory attributes are the combination of characteristics that together produce a sensory experience (texture, aroma, colour, flavour) and the human senses like sight, hearing, taste, smell and touch are used to measure the attributes. The aroma, flavour and texture are also sensory characteristics used to define chocolate and these depend on the manufacturing process. Cocoa butter is a natural and highly valued fat that contributes to the desirable textural and sensory properties of chocolate and confectionery products. The suitability of roasted jackfruit seed flour in combination with cocoa butter for the development of chocolate was assessed (Plate 1).

In the present study, the mean score obtained for the organoleptic qualities of each treatment were statistically analysed using Kendall's coefficient of concordance and the results are present in the Table 2.

The mean score for the appearance of chocolate varied from 8.06 to 9.00 with mean rank scores in the range of 2.10 to 4.70. Among different treatments tried for the preparation of RJSF chocolate, the highest mean scores of 9.00 for appearance was noticed in T_0 and T_4 and the lowest in T_1 and T_2 (8.06).

The highest mean score for colour (8.83) was noticed in T_4 and the lowest mean score for colour was observed in T_1 (8.23). The mean rank scores of various treatments ranged between 2.40 and 4.60. The mean score for flavour of chocolate was 6.56 to 8.60 with the maximum in T_0 (8.60). The mean score for the texture of RJSF chocolate varied from 6.16 to 7.33 with mean rank scores in the range of 1.95 to 5.15. The mean score for taste of different RJSF chocolate ranged from 5.86 to 7.50. The treatments T_3, T_4, T_5 and T_2 obtained mean scores of 6.08, 6.02, 6.00 and 5.55 respectively.

The highest mean score of 8.13 (6.00) for overall acceptability was noticed in T_0. The lowest mean score (6.68) with mean ranking score of 2.20 was noticed for treatment T_2. The mean scores and mean rank scores for sensory parameters (appearance, colour, flavour, texture, taste and overall acceptability) of chocolates prepared with roasted jackfruit seed flour and cocoa butter was the highest for treatment T_5 (30% RJSF + 50% CB + 20% OI). The highest total score of 48.49 was noticed in T_0 followed by 47.56 (T_5), 46.85 (T_4), 44.35 (T_3), 41.65 (T_2) and 42 (T_1) respectively. Kendall's value shows that there was significant agreement between the judges at 1% level. Shahanas (2019) found that osmodehydrated jackfruit blended alkalized chocolate (95% alkalised chocolates + 5% osmodehydrated jackfruit) secured a total score of 53.24 for all quality attributes like appearance, colour, flavor, texture, taste and overall acceptability. A similar study was conducted by Ravindran *et al*. (2020), who reported that the jackfruit seed powder incorporated chocolate scored 7.5 for overall acceptability.

Physico-chemical analysis of the chocolates

Based on sensory evaluation, the treatments T_5 (30% RJSF+ 50% CB). The nutritive value of selected roasted jackfruit seed flour based chocolate prepared with cocoa butter observed to have moisture (1.71%). The results are in accordance with the findings of Mehta. (2017), who reported that the moisture content of 1.1 per cent to 1.5 per cent in

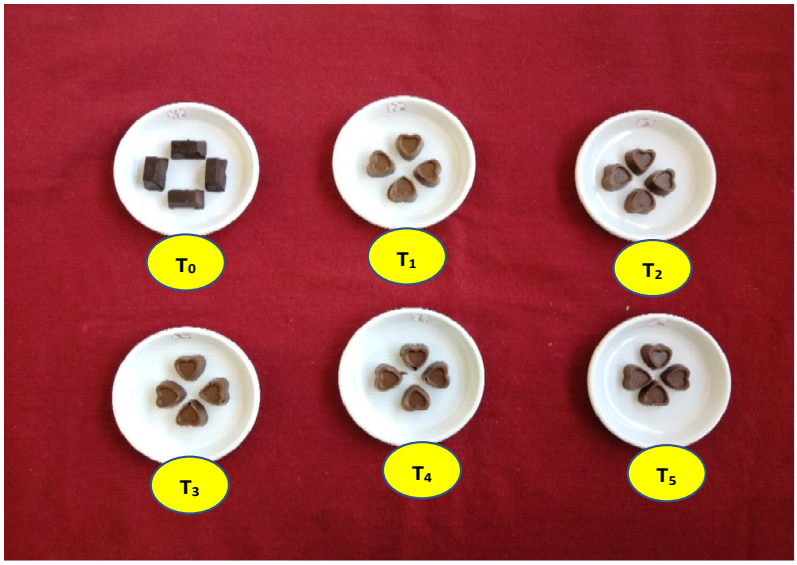

Plate 1: Roasted jackfruit seed flour incorporated chocolates.

Table 2: Mean scores for organoleptic evaluation of roasted jackfruit seed flour incorporated chocolates.

Treatments	Sensory attributes						Total score
	Appearance	Colour	Flavour	Texture	Taste	Overall acceptability	
T_0	9.00(4.70)	8.70(4.50)	8.60(5.40)	7.26(4.40)	6.80(3.75)	8.13(6.00)	48.49
T_1	8.06(2.10)	8.23(2.40)	6.76(2.45)	6.36(2.65)	5.90(2.20)	6.69(2.50)	42
T_2	8.06(2.10)	8.33(3.10)	6.56(2.40)	6.16(1.95)	5.86(1.95)	6.68(2.20)	41.65
T_3	8.83(3.70)	8.33(2.55)	7.00(2.55)	6.5(2.95)	6.33(2.80)	7.36(3.05)	44.35
T_4	9.00(4.70)	8.83(4.60)	7.50(3.80)	7.00(3.90)	7.16(4.85)	7.36(3.10)	46.85
T_5	8.83(3.70)	8.50(3.20)	8.00(4.40)	7.33(5.15)	7.5(5.45)	7.40(4.25)	47.56
Kendall's w value	.649**	.262**	.631**	.570**	.680**	.588**	

Values in parentheses is mean rank score based on Kendall's W.

**Significant at 1% level.

different brands of chocolates. The moisture content of blended chocolates ranged between 1.16 to 1.24 per cent (Shahanas, 2019).

The formulated chocolate contained 36.78 g 100 g^{-1} of carbohydrate. Suzuki *et al*. (2011) reported that the carbohydrate content of different branded chocolates was 60.5 to 68.1 per cent. Shahanas (2019) also found that the carbohydrate content of osmodehydrated jackfruit blended alkalized chocolate (95% alkalised chocolates + 5% osmodehydrated jackfruit) was 34.28 g/100 g. Ravindran *et al*. (2020) also found that the carbohydrate content in jackfruit seed powder incorporated diet chocolate was 34.5 g/100 g.

Protein content of developed chocolate is 6.60 g 100 g^{-1}. Pandey and Singh (2011) also found that the protein content of chocolates (control) and soy blended chocolates was 8.4 g/100 g and 10.3 g/100 g respectively. Ary (2018) reported that the protein content of jackfruit seed powder incorporated chocolate was 7.53 g/100 g. Mirkovic *et al*. (2018) also reported that the protein content in control and probiotic chocolates was 9.88 and 9.90 g/100 g respectively.

Fat content of selected chocolate is 56.55 g 100 g^{-1}. Shahanas (2019) also found that the fat content of osmodehydrated jackfruit blended alkalized chocolate (95% alkalised chocolates + 5% osmodehydrated jackfruit) was 46. 40 g/100 g. Mirkovic *et al*. (2018) reported that the fat content of different chocolates was 39.92 g to 40.02 g. Moreno *et al*. (2015) also found that the fat content in chocolates was 31.20 to 32.30 g/100 g.

Fibre content of developed chocolate is 1.37 g 100g^{-1}. Onwuka and Abasiekong (2006) observed that the crude fibre content of legume chocolate bars was 0.79 to 1.79 per cent. Ary (2018) reported that the fibre content of jackfruit seed powder incorporated chocolate was 1.34 g/100 g.

Cost of roasted jackfruit seed flour based chocolates

The cost of roasted jackfruit seed flour based chocolate prepared with cocoa butter was Rs. 48.74/100 g. Shahanas (2019) observed that the cost of blended chocolates varied from Rs. 46.54 to Rs. 50.62 /40 g of chocolate bar. The cost of dark chocolate produced by Cocoa Research Station, Kerala Agricultural University was Rs. 40/40 g. The cost of commercial chocolate, dairy milk silk was Rs. 98/100 g. The cost of the chocolates prepared in the present study was lesser as compared to the commercial chocolates may be due to the incorporation of jackfruit seed.

CONCLUSION

Chocolate is a product widely consumed and occupying larger space in the consumer market which not only satisfy the hunger, but has been proven as a quality source of nutrients. Roasted jackfruit seed flour incorporated chocolates had high organoleptic qualities. It is a good source of protein, carbohydrate and fibre. From the study it is evident that highly acceptable chocolates could be prepared from jackfruit seed flour. The treatment T_5 (30% RJSF+ 50% CB+ 20% OI) was the most acceptable combination. Incorporation of underutilised fruits like jackfruit for the development of chocolates increased the nutritive value and reduced the cost. The possibility of producing such novel products from jackfruit bring about an era of prosperity with the right blend of employment generation and profit.

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