



**CONCEPTUALISATION OF VALUE ADDED NUTRITIOUS CHOCOLATES
INCORPORATED WITH FINGER MILLET MILK**

KANCHANA K¹ AND PARAMESHWARI S^{2*}

1: Department of Nutrition and Dietetics, Periyar University, Salem-11, Tamil Nadu, India

2: Associate Professor, Department of Nutrition and Dietetics, Periyar University, Salem-11,
Tamil Nadu, India

***Corresponding Author: Parameshwari. S: E Mail: sparameshwari2009@gmail.com**

Received 19th June 2020; Revised 21st July 2020; Accepted 26th Aug. 2020; Available online 1st May 2021

<https://doi.org/10.31032/IJBPAS/2021/10.5.5481>

ABSTRACT

Ragi (*Eleusine coracana*) is the most popular and foremost finger millet in India. The present study was undertaken to develop nutritious and fibre rich chocolate by substituting a part of milk powder with cocoa powder and finger millet milk. Ragi (Finger millet) improves the nutritional value of chocolate by enhancing the calcium, iron and fibre content. The total dietary fibre of finger millet grain is comparatively higher than that of most of the other cereal grains, which helps to control blood glucose levels in diabetic patients. Ragi is also renowned for health beneficial effects such as anti-diabetic, anti-tumourigenic, atherosclerogenic effects, antioxidant and antimicrobial properties. This study aimed at the objective of developing chocolates by incorporating finger millet milk. The prepared chocolates subjected to analysis of physical characteristics, sensory evaluation and the accepted variation was subjected to analyze nutritional compositions. It observed that the finger millet milk incorporated chocolates were drastically rich in protein, fibre, niacin, calcium and iron compared to control chocolates. The cost calculation for 100g of developed chocolates was 19.25 rupees. It was evident that the prepared chocolates were more economical and affordable when compared with commercially available in the market.

Keywords: Chocolates, Finger millet milk, Nutritional composition, Value-added snacks

INTRODUCTION

Mandau and Ragi are the familiar names of Finger Millet (*Eleusine coracana L.*) in India. It is cultivated broadly in all parts of India and Africa [1]. Finger millet is a cereal crop and is mostly preferred as a staple food by the peoples from the arid and semi-arid region. However, the millets fulfil the hunger of thousands of peoples, especially those who live in the hot and humid climate. Millets are also essential foods in the many developing countries where adverse weather conditions like limited rainfall affect agricultural production. The grain of Ragi is similar to reddish mustered. Generally, it harvested during December and January. The only Ragi contributes 25% of overall food grains production [2].

Ragi (*Eleusine coracana*) is one of the essential cereals occupies the most significant areas under cultivation among the small millets, and it is an excellent source of iron [3], magnesium [4] and dietary fibre [5]. Ragi has also gained significance because of its functional components, such as slowly digestible starch and resistant starch [6]. Globally, 12% of the total millet area is under finger millet cultivation, covering more than 25 countries of Africa and Asia. It forms a predominant staple food for people living on marginal lands and with

limited economic resources. An agronomically sustainable crop, it can grow on marginal areas, high altitudes and can easily withstand drought and saline conditions require little irrigation and other inputs and yet maintain optimum yields [7].

India produces 1.2 million tons annually. Finger millet accounts for about 85% of all millets produced in India and is cultivated over 1.19 million hectares in India according to a recent report [8]. In India, Karnataka is the leading producer of finger millet accounting to 58% of its global production, yet only a few Indians are aware of its health benefits and nutritional value. The production area of finger millet in India stands sixth after wheat rice, maize, sorghum and bajra [1].

It is a humble grain with a low Glycemic index which makes it more suitable for diabetic patients [9]. Processing of Ragi using traditional as well as modern techniques for the development of value-added and available food products would be the possible solution for its promotion and enhancement of consumption, nutritional status and thereby increasing profitability and better livelihood to the tribal community. There are several benefits of malting of Ragi such as vitamin-C is elaborated, phosphorus

availability is increased, and lysine and tryptophan are synthesized [10].

MATERIALS AND METHODS

The study conducted in the Department of Nutrition and Dietetics, Periyar University Salem, Tamil Nadu. The ingredients required for the development of chocolates by the use of finger millet, milk powder, sugar, butter and cocoa powder procured from the local market, Salem, Tamil Nadu, India. The finger millet seeds were washed with cold water to get rid of the dirt particles. Drained out the water from the seeds and kept the finger millet in a cleansed vessel. The finger millets soaked in clean water for 12 hours. It helps to eliminate some of the indigestible sugars that cause flatulence. After 12 hours, the water was discarded from the seeds and carried out for the further process. The drenched finger millets were ground in a domestic grinder and filtered in a muslin cloth, and the extracted milk. The chocolates were standardized with two different variations of finger millet milk and coded as V1 and V2. The two different finger millet milk is taken one by one and boiled well and add sugar 15g, Cocoa powder 20g, butter 30g, milk powder and mix well, after transfer to setting plate and allow cooling for 24 hours in room temperature. After settled, the

finger millet milk incorporated chocolates were cut it into pieces.

RESULTS AND DISCUSSION

1. Development of the finger millet milk incorporated chocolates.

The finger millet milk added chocolates in different variations viz. V1 and V2 and other mix agents also measured in different quantity and combined in different variations. The composition of ingredients used for developing chocolates of different variations are shown in **Table 1**.

2. Physical characteristics of the developed chocolates

The physical characteristic of chocolates, namely, thermographic parameters of weight length and thickness, were measured. Compared to control chocolates, chocolates formulated with finger millet milk showed an increase in height, weight and thickness (**Table 2**).

3. Sensory evaluation of the developed finger millet milk incorporated chocolates

Sensory evaluation was done for all the formulated chocolates supplemented with finger millet milk. By using this finger millet milk, different variations of chocolates

prepared, and sensory evaluation was done in all the developed variations of prepared chocolates by semi-trained panel members using 9 points hedonic rating scale (**Table 3**).

The results of the **Table 3** revealed that the mean score obtained for colour found to be a maximum score ($8.22 \pm 0.12bc$) than control and V2. Mean score of texture was high ($7.55 \pm 0.74a$) in V1 compared to control and V2. The results revealed that the mean score obtained for the flavour of V1 found to be superior ($7.86 \pm 0.76a$) compared to control and V2. Variation 1 had the maximum mean scores of $8.64 \pm 0.22bc$ for mouthfeel, thus confirming that addition of finger millet milk at 60ml was more acceptable whereas V2 had scored lower than V1 due to the less addition of other ingredients which affected the mouthfeel of the end product. Mean taste scores of control chocolate was low ($4.85 \pm 0.15a$) compared with variation 1 & 2 ($8.74 \pm 0.12bc$, $3.61 \pm 0.16a$ & 4.15 ± 1.19) respectively. As an overall result, the overall acceptability of the finger millet milk incorporated (60ml)

chocolates of variation-1 was high ($8.61 \pm 0.26bc$) on a hedonic scale.

Among the dietary constituents, polyphenolics reported to play a significant role as antioxidants in the protective effect of plant-derived foods and contribute immensely to the sensory quality such as colour, taste and flavour of foods [11]. Results on Duncan Multiple Range test showed that there was a significant difference ($p < 0.05$) between control and the different variations of chocolates on colour, texture, flavour, mouthfeel, taste and overall acceptability.

4. Nutritional composition of accepted variation of the developed chocolates

Based on the physical characteristics and sensory evaluation of the developed chocolates, 60% of finger millet milk incorporated chocolates (Variation 1) was highly accepted. Hence the nutrient analysis was done for variation 1. The nutrient analyses of control chocolates and chocolates formulated with 60% of finger millet milk are shown in **Table 4, Figure 1**. It shows that nutrient level present in the 60% incorporated of finger millet

milk in the chocolates (variation 1) and control chocolates. The moisture content of the finger millet milk chocolate was 10.26 % which is higher than the control chocolates. There is a slight change in the calorie content between the finger millet milk chocolates and control. The protein content is improved because finger millet has higher protein content which shows in the chocolate nutrient level. The finger millet milk incorporated chocolates have 12.21g of protein whereas standard chocolates have 7.3g. The carbohydrate content of the finger millet milk chocolates was 65.38g, which is higher than the control chocolates. The calcium content of the finger millet milk chocolates was 0.10mg, and the iron content of finger millet milk incorporated chocolates was 1.2mg. In contrast, the control

chocolates do not have any iron content which shows that finger millet milk incorporated chocolates will improve the iron level. The niacin content of the finger millet milk chocolates was 0.4mg. In contrast, the control chocolates do not have any niacin content which shows that finger millet milk incorporated chocolates will improve niacin level.

5. Cost calculation of the developed food products

The cost calculation for the production of 100gm of finger millet milk incorporated chocolates revealed that the total production cost (100g) was Rs 19.15 by incorporating finger millet, milk powder, cocoa powder, butter, sugar powder. It was evident that the prepared chocolates were more economical and affordable when compared with commercial chocolates available in the markets.

Table 1: Ingredients for finger millet milk incorporated chocolates

| Ingredients | Control | Variation 1 | Variation 2 |
|--------------------|---------|-------------|-------------|
| Milk powder | 100g | 40g | 30g |
| Finger millet milk | - | 60g | 70g |
| Sugar powder | 15g | 15g | 15g |
| Cocoa powder | 20g | 20g | 20g |
| Butter | 30g | 30g | 30g |

Table 2: Physical characteristics of the developed chocolates

| Variations | Height(cm) | Weight(kg) | Thickness(cm) |
|-------------------------------|------------|------------|---------------|
| Control chocolates | 1.5 | 1.65 | 2 |
| Finger millet milk chocolates | 1.6 | 2 | 1.8 |

Table 3: Statistical analysis of sensory evaluation of developed chocolates

| Parameters | Control | Variation I | Variation II |
|-----------------------|-------------------------|-------------------------|-------------------------|
| Colour | 4.21±0.66 ^a | 8.22±0.12 ^{bc} | 6.45±0.45 ^d |
| Texture | 6.52±0.12 ^{bc} | 7.55±0.74 ^a | 5.74±0.18 ^{cd} |
| Mouth feel | 4.47±0.62 ^a | 8.64±0.22 ^{bc} | 4.62±0.32 ^b |
| Flavour | 5.74±0.38 ^b | 7.86±0.76 ^a | 3.22±0.25 ^a |
| Taste | 4.85±0.15 ^a | 8.74±0.12 ^{bc} | 3.61±0.16 ^a |
| Overall acceptability | 4.99±0.32 ^a | 8.61±0.26 ^{bc} | 4.56±0.12 ^b |

Values are mean ± SD of triplicate determination. Samples with different superscripts within the same column were significantly ($p \leq 0.05$) different.

Table 4: Nutritional composition of accepted variation of the developed chocolates

| S.NO | Nutrients | Control chocolates | Finger millet milk incorporated chocolates | Deficient or Excess |
|------|-------------------|--------------------|--------------------------------------------|---------------------|
| 1. | Moisture (%) | 8.7 | 10.26 | +1.56 |
| 2. | Energy (kcal) | 350 | 375 | +25 |
| 3. | Protein(g) | 7.3 | 12.21 | +4.91 |
| 4. | Carbohydrate(g) | 61.6 | 65.38 | +3.78 |
| 5. | Fat(g) | 6.5 | 7.13 | +0.63 |
| 6. | Dietary fibre (g) | 0.15 | 0.18 | +0.03 |
| 7. | Niacin (mg) | - | 0.4 | +0.4 |
| 8. | Calcium (mg) | 0.8 | 0.10 | +0.7 |
| 9. | Iron (mg) | - | 1.2 | +1.2 |

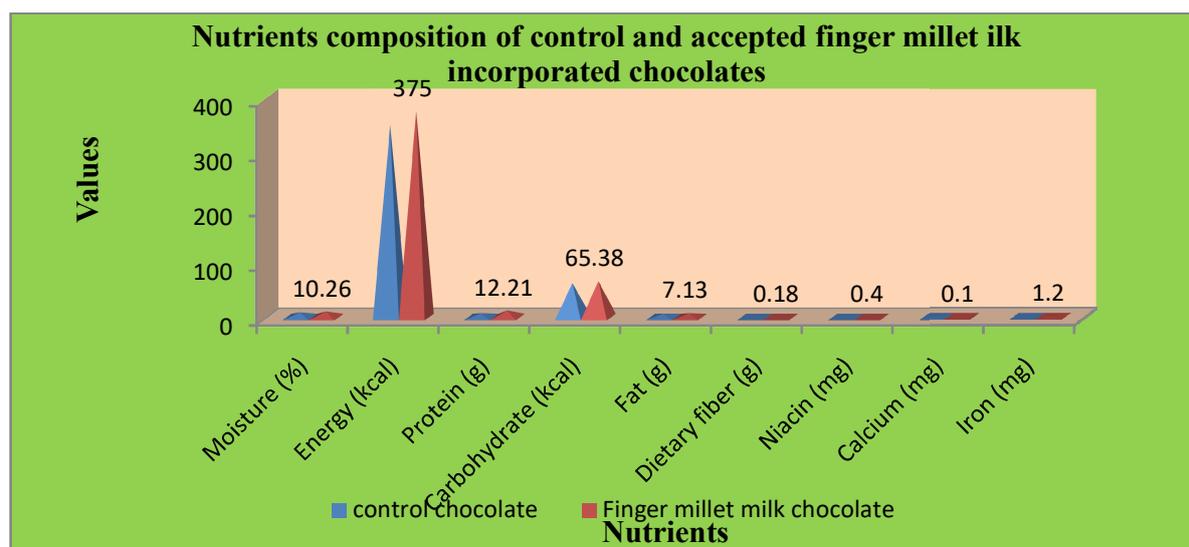


Figure 1: Nutrient composition of control and accepted variation of chocolates

CONCLUSION

In conclusion, Finger millet is a staple food in different parts of India and abroad promoted as an extremely healthy food. Incorporation of finger millet milk resulted in increased protein, fibre, niacin, calcium and iron in the chocolates. Chocolates with 60% finger millet milk added were highly acceptable by the consumers. This novel finger millet milk for incorporation in chocolates could permit a reduction of formulation cost without affecting sensory attributes of the developed product to which the consumer familiarized. Its nutritional and functional properties have been reviewed and found best among all cereals grains. Vitamins, minerals, fatty acids and antioxidant properties of this make its brawny contribution to human nutrition. Regular consumption of finger millet as a food or even as snacks helps in managing diabetes and its complications by regulation of glucose homeostasis and prevention of dyslipidemia.

Acknowledgement:

The authors are highly thankful to the Department of Nutrition and Dietetics, Periyar University, Salem and Nutri Science Research Laboratory Pvt. Ltd., (NABL Accredited Laboratory), Salem for provided

necessary facilities and support to carry out this research work.

Conflict of Interest:

The authors declare that they have no conflict of interest.

Funding support:

The authors declare that they have no funding support for this study

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