Evaluation of Physico-chemical and Sensory Characteristics of Cookies developed from Proso Millet and Horse Gram Flour

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Abstract- Proso millet is a minor millet that is rich in protein and contains significant amounts of essential amino acids like leucine, isoleucine, and methionine. Horse gram is a low-cost, protein-rich legume that can be incorporated into different product formulations. The objective of this study was to utilise the underutilised proso millet and horse gram which have immense nutritional benefits, especially high protein content and complementary amino acid profile. Cookies were prepared using proso millet and horse gram flour in three different variations V1, V2 & V3 with ratios of 1:1, 1:2, and 2:1, respectively and the control cookie, C, was made from refined wheat flour. The cookies were analysed for physicochemical properties and sensory characteristics like appearance, aroma, texture, taste, and overall acceptability, and the scores were recorded. It was found that the cookie V2 had the highest amount of protein (9.17 g/100g) and fat (21.45 g/100g) and also received the highest score in sensory analysis which indicated that the formulation can be adapted for large scale production.

Keywords - Cookies, Underutilized, Proso millet, Horse gram, Protein-rich.

INTRODUCTION

Baked goods are the most popular category of processed food products among consumers. Cookies are baked goods that are made with major ingredients like flour, butter, and sugar and have a moisture content of less than 5%. Due to their increased variety, extended shelf life, and convenience, cookies are preferred by people of all age groups. They are now formulated with different whole grains and millets to improve the nutritional content.

Compared to other commonly consumed grains like rice and wheat, proso millet has higher protein content and is rich in nutraceuticals like dietary fibre, omega-3 fatty acids, phenolics, and flavonoids which helps in the treatment of degenerative diseases and metabolic disorders (1). It has a protein content of about 9.5 - 17% (2). Amino acid index of proso millet is higher than wheat due to the presence of certain essential amino acids like leucine, isoleucine, and methionine (3).

Horsegram is an underutilised legume that is mostly grown in southern India and popularly known as poor man's pulse crop (4). Horsegram is often viewed as an inexpensive form of protein and it is also rich in minerals such as calcium, phosphorus, iron and vitamins such as carotenes, thiamine, riboflavin, niacin and L-ascorbic acid (5).

Vegetarians make up the majority of the Indian population, and their diet is primarily composed of carbohydrates, which results in imbalanced diets and nutrient deficiencies (6).

Protein Energy Malnutrition is a deficiency disease in children under the age of five in which there is a gap between energy and protein intake and requirements, and they are supplemented with nutrient-dense foods to overcome the deficiency (7). Cookies formulated with high protein ingredients like proso millet and horse gram can act as a better supplement and provide complementary amino acids for their holistic development and serve to overcome the protein deficiencies of the general population. The objective of the present study was to develop protein-rich cookies using proso millet and horse gram flour and analyse the product for consumer acceptance.

MATERIALS AND METHODS

Procurement of raw materials
Raw materials required for the preparation of cookies, which includes Refined wheat flour, Butter, Sugar,

Vanilla extract, Baking powder, Milk and Choco Chips were procured from the local market. The major ingredients, proso millet flour and horse gram flour, were sourced from an online grocery store.

Preparation of Cookies

The cookies were prepared in three variations namely V1, V2 & V3 using proso millet and horsegram flour and control cookie C, which was prepared using refined wheat flour. The ratio of proso millet and horse gram flour used for the preparation of V1, V2 & V3 are 1:1, 1:2, 2:1 respectively. The process for the preparation of cookies is shown in Figure 1 along with the quantities of all the ingredients used in Table 1.

Ingredients	Control	V1 (1:1)	V2 (1:2)	V3 (2:1)
Butter	25g	25g	25g	25g
Sugar	25g	25g	25g	25g
Vanilla	5ml	5ml	5ml	5ml
Refined Wheat Flour	60g	-	-	-
Proso Millet Flour	-	30g	20g	40g
Horsegram Flour	-	30g	40g	20g
Baking Powder	2.5g	2.5g	2.5g	2.5g
Milk	10ml	10ml	10ml	10ml
Chocolate Chips	10g	10g	10g	10g

Table 1: Formulation of cookies: Control and Variations

The cookies were prepared by creaming method. Butter and sugar were creamed along with vanilla essence, and the dry ingredients, such as maida or proso millet flour and horse gram flour, were sieved and combined. To make the dough, milk was added. After adding the chocolate chips, the dough was shaped and baked at 180°C for 15 minutes (8).
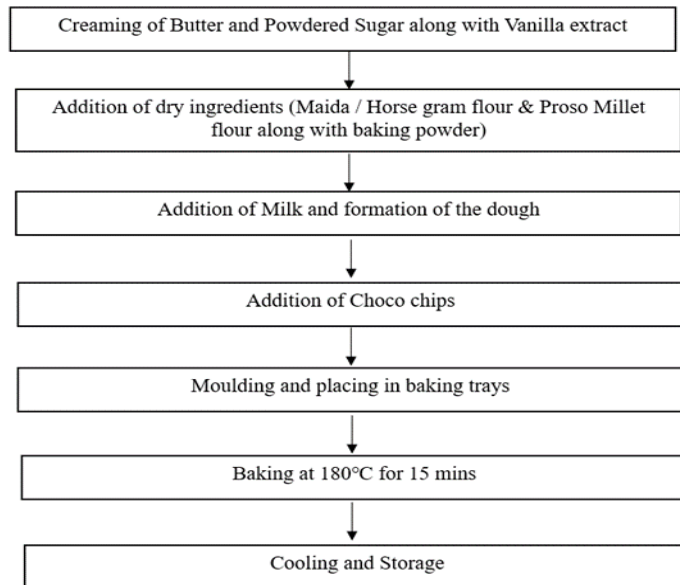

Figure 1: Process for the preparation of cookies

PHYSICOCHEMICAL ANALYSIS OF THE COOKIES

Vernier caliper was used to measure the thickness and diameter of the cookies. The moisture and ash% in the cookies were determined using the procedure provided in A.O.A.C. (2000) (9). The protein content of the cookies was determined using the Kjeldahl method, which involves acid digestion of the food sample, that releases nitrogen which can be measured using a titration method. While, the soxhlet method, which involves extracting the fat from the sample with a solvent and determining its weight, was used to assess the fat level. Carbohydrate content was calculated by subtracting from 100 the total of moisture, protein, and fat content per 100g of sample, and energy was calculated by multiplying the protein, fat, and carbohydrate content by their respective calorific value.

SENSORY EVALUATION OF THE COOKIES

The sensory evaluation of all the four variations of the cookies was carried out with 12 untrained panellists using a 5 point hedonic scale. The average of the scores for different characteristics of the cookies such as, appearance, aroma, texture, taste and overall acceptability were recorded.

RESULTS

The thickness and diameter of the cookies were around the range of 1-2 cm and 4.5-5.5 cm respectively. The moisture content of the cookies was around 2–3%, which was found to be within the standard limit of less than 5%. This reduced moisture content contributes to the extended shelf life of the cookies. The cookies V1, V2, and V3, which were prepared with different proportions of proso millet and horse gram flour, had lower carbohydrate content than cookie C, which was made with refined wheat flour. Cookie V2 had the highest amount of protein (9.17 g/100g) and fat (21.45 g/100g) when compared to the other two variations and control. Higher amounts of protein and fat in the cookie V2 contributed to the highest energy value of 490.41 Kcal/100g than the other variations.

Parameters	C	V1	V2	V3
Thickness (cm)	1.75	1.48	1.42	1.39
Diameter (cm)	5.30	4.71	5.02	4.89
Moisture (%)	2.20	2.86	2.70	2.83
Ash (%)	0.55	1.48	1.51	1.35
Carbohydrate (g/100g)	71.62	68.71	65.17	69.49
Protein (g/100g)	6.84	8.70	9.17	8.67
Fat (g/100g)	18.79	18.25	21.45	17.66
Energy (Kcal/100g)	482.95	473.89	490.41	471.58

Table 2: Physicochemical Analysis of control and variations of cookies

SENSORY EVALUATION

In terms of appearance, aroma, texture, and overall acceptability, V2 received the highest sensory score among the three variations of the cookie, followed by V3; however, the panelists preferred V3 for the taste. Only a slight difference can be observed in the overall acceptability between the three variations, which indicates that this formulation can be adopted for the large-scale production of protein cookies.

Parameters	C	V1	V2	V3
Appearance	4.66	3.50	4.08	3.75
Aroma	4.41	3.33	3.75	3.41
Texture	4.41	3.33	3.91	3.66
Taste	4.83	2.91	3.58	3.66
Overall Acceptability	4.66	3.25	3.83	3.75

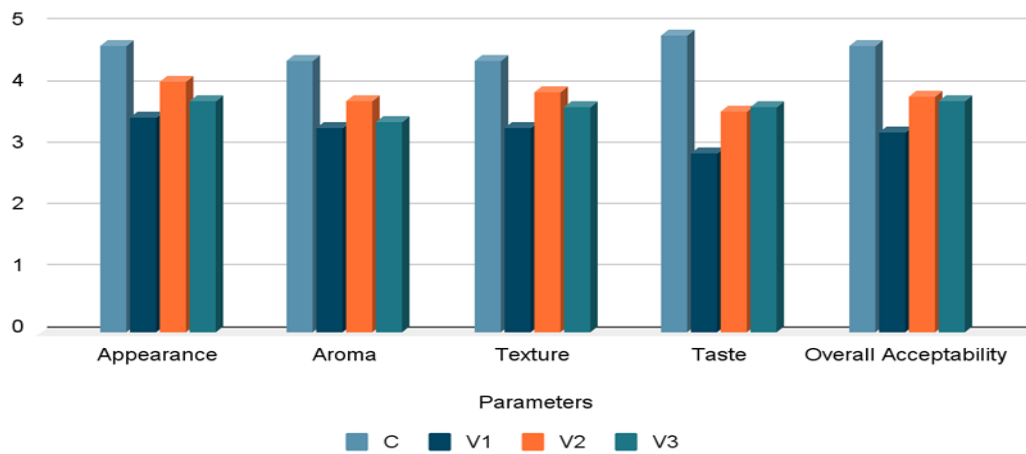Table 3: Sensory Evaluation of control and variations of the cookies

Figure 2: Sensory Evaluation of control and variations of the cookies

Figure 3: Images of the formulated cookies

CONCLUSION

Cookies formulated with proso millet and horse gram flour were analysed for the physicochemical and sensory characteristics. From the study, it was observed that cookie V2 with a ratio of 1:2 (Proso millet flour and Horse gram flour) were found to have high protein (9.17 g/100g) and fat content (21.45 g/100g) compared to the control cookie which was made with refined wheat flour. The higher protein content might be because of the increased amount of horsegram in the formulation. The sensory evaluation of the cookies showed that the variation V2 also had the most acceptable characteristics like appearance, texture and overall acceptability. It can be concluded that this formulation can be adopted for large scale production of protein cookies which can be offered as a snack to kids with Protein Energy Malnutrition (PEM) and can also be consumed by other individuals as a supplement to increase the daily intake of protein.

SCOPE OF FUTURE STUDY

● Measures can be taken to improve the taste and flavour of the cookies
● Shelf life study can be undertaken

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