Development And Analysis of Crackers Made by Using Composite Blend of Proso and Browntop Millet Flour as A Partial Replacement for Refined Wheat Flour

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***Abstract*— Crackers are thin, crispy, and crunchy, made from refined wheat flour, which contains a higher percentage of starch and less protein and fibre. The purpose of this study is to assess the feasibility of developing composite flour crackers using Browntop and Proso millet flour as partial alternatives to Refined wheat flour in order to increase customer acceptance of value added products made with millets belonging to the poaceae family. A standard cracker was prepared using 100 grams of refined wheat flour, and two variations were made by substituting composite flour (V1 - 50:50 ratio, V2 - 70:30 ratio). A sensory and nutritional evaluation was conducted on the sample. Sensory attributes indicated that variant V1 containing 50% composite flour and 50% refined wheat flour had the highest overall acceptability. On the basis of proximate nutrition analysis, it was determined that the crackers contained high levels of protein and fibre when compared to the standard crackers. The development of shelf-stable ready-to-eat snacks made from millets has the potential to be a promising prospect in the near future.**

***Index Terms*— Crackers, Proso millet flour, Browntop millet flour, refined wheat flour**

I. INTRODUCTION

Consumers are increasingly aware of the connection between diet, health, and the environment, leading to increased nutritional awareness. The trend is to explore health-oriented snack products with high protein, low calorie, and high fibre content [1]. Among the segments of the bakery industry, Crackers are the most popular baked product because it offers a variety of tastes, a long shelf life, and a low cost. A cracker is a thin, crispy, and crunchy baked good made from refined wheat flour that contains a higher percentage of starch and less protein and fibre. By using composite flours, these products can be made more nutritious and convenient for consumers [2]. Composite flour is a flour made by combining non-wheat flour with wheat flour to create leavened or unleavened baked goods or snacks with wheat flour. This approach increases nutritional density and offers similar properties to full-wheat flour, promoting the use of unusual foods with different characteristics and qualities. Therefore, the use of composite flour can positively influence the final product in terms of both functional and physicochemical properties, as well as health benefits [3]. Millets (*Poaceae* or *Gramineae family*) are commonly known as the 'God's own crops', are among the oldest and smallest cereal grains known to human beings from prehistoric times, and are used as bird and animal feed. The carbohydrates in these products are slow-releasing, which reduces the risk of developing diabetes [4]. It has also been determined that they are rich in dietary fibres, protein and minerals, including iron, magnesium, phosphorus and potassium, as well as being gluten-free. Crackers biscuits are commonly made with refined wheat flour, which is rich in starch but low in protein and fibre [5]. Using composite flours (Proso and Brown-top), which are rich in protein and fibre, two variations of crackers were developed in this study by substituting 50% and 70% of refined wheat flour. A formulation based on refined wheat flour and composite flour is V1- 50% (Composite flour): 50% (Refined wheat flour), V2- 70% (Composite flour): 30% (Refined wheat flour).

II. METHODOLOGY

Raw materials procurement:
Proso millet flour, Browntop millet flour, refined wheat flour, Oregano flakes, Active dry yeast, Sugar,

Salt, Butter, Ammonium bicarbonate were procured from the Retail Store in Chennai.

The preparation of crackers is carried out using the "Sponge and Dough" method. There are two stages in this method.

(i) Preparation of sponge

(ii) Preparation of the dough.

For sponge, Yeast is activated by using warm water and sugar which acts as food for yeast to grow and allow it to rest. Add this starter culture to 50% of composite and refined wheat flour and knead it to smooth dough with the required water. As for the dough, the sponge is added to the remaining ingredients such as composite and refined wheat flour, salt, sugar, butter, ammonium bicarbonate, oregano flakes and mixed into the dough before allowing it to ferment for a second time. When it has completed the second fermentation, the dough is ready to be baked. The fermented dough is sheeted to the thickness of about 1mm and cut into circular shape by using a mould, butter is greased and salt is sprinkled on the surface then docking is done. Then it is baked at 150ºc for 10-12 minutes. A metallised polyethylene pouch is used to package the baked crackers after they have been cooled to room temperature.

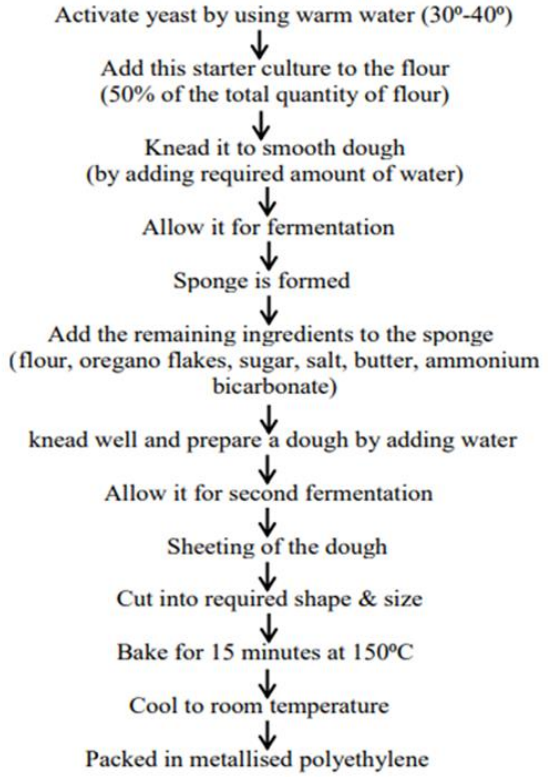

Fig 1: Process flow chart for formulation of Crackers

PROXIMATE ANALYSIS FOR CRACKERS

Moisture, Ash, Fat, Protein, and Crude Fibre content was determined using different procedures. The methods used were:

- Moisture (AOAC Method)
- Ash (AOAC Method)
- Fat (Solvent Extraction Method)
- Protein (Kjeldahl Method)
- Crude fibre (AOAC Method)

MOISTURE ANALYSIS:

Dry the empty dish and lid in the oven at 105ºC for 3 hours and transfer to desiccator to cool. Weigh the empty dish and the lid. Weigh about 5g of sample to the dish. Spread the sample with spatula. Place the dish with sample in the oven. Dry for 3 hours at 105ºC. After drying, transfer the dish with partially covered lid to the desiccator to cool. Reweigh the dish and its dried sample

CALCULATION:

$$\text{MOISTURE (\%)} = \frac{(W1 - W2) * 100}{(W1)}$$

Where:

W1 = weight (g) of sample before drying

W2 = weight (g) of sample after drying

ASH ANALYSIS:

Place the crucible and lid in the furnace at 550ºC overnight to ensure that impurities on the surface of crucible are burned off. Cool the crucible in the desiccator for 30 minutes. Weigh the crucible and lid to 3 decimal places. Weigh about 3g sample into the crucible. Heat over low Bunsen flame with lid half covered. When fumes are no longer produced, place crucible and lid in furnace. Heat it at 550ºC overnight. During heating, do not cover the lid. Place the lid after complete heating to prevent loss of fluffy ash. Cool down in the desiccator. Weigh the ash with crucible and lid when the sample turns to grey. If not, return the crucible and lid to the furnace for the further ashing.

CALCULATION:

$$\text{Ash (\%)} = \frac{(\text{Weight of ash}) * 100}{\text{Weight of sample}}$$

FAT ANALYSIS:

Place the bottle and lid in the incubator at 105ºC overnight to ensure that weight of bottle is stable. Weigh about 3-5 g of sample to paper filter and wrap.

Take the sample into extraction thimble and transfer into soxhlet. Fill petroleum ether about 250 ml into the bottle and take it on the heating mantle. Connect the soxhlet apparatus and turn on the water to cool them and then switch on the heating mantle. Evaporate the solvent by using the vacuum condenser. Incubate the bottle at 80-90ºC until solvent is completely evaporate and bottle is completely dry. After drying, transfer the bottle with partially covered lid to the desiccator to cool. Reweight the bottle and its dried content.

CALCULATION:

$$\text{Fat (\%)} = \frac{\text{(Weight of fat) * 100}}{\text{Weight of sample}}.$$

PROTEIN ANALYSIS:

Place sample (0.5 – 1.0) in digestion flask. Add 5g Kjeldahl catalyst and 200 ml of conc. H_2SO_4. Prepare a tube containing the above chemical expect sample as blank. Place flasks in inclined position and heat gently unit frothing ceases. Boil briskly until solution clears. Cool and add 60 ml of distilled water cautiously. Immediately connect flask to digestion bulb on condenser and with tip of condenser immersed in standard acid and -7 drops of mix indicator in receiver. Rotate flask to mix content thoroughly; then heat until all NH_3 is distilled. Remove receiver, wash tip of condenser and titrate excess standard acid distilled with standard NaOH solution.

CALCULATION:

$$\text{Protein (\%)} = \frac{\text{(A-B) * N * 14.007*6.25}}{\text{W}}.$$

Where,

A = volume (ml) of 0.2 N HCL used sample titration

B = volume (ml) of 0.2 N HCL used blank titration

N = Normality of HCL

W = weight (g) of sample

14.007 = atomic weight of nitrogen

6.25 = the protein – nitrogen conversation factor for sample product.

CRUDE FIBRE ANALYSIS:

Measure 200 ml of 0.128M sulphuric acid and pour the acid solution into a 500 ml conical flask. Take a homogenized portion of sample (about 2gm) to weight. Transfer the sample into conical flask to mix with Acid solution. Place the flask on a hot plate and bring to boil the sample for 30 min. Shake the conical flask periodically to ensure the proper boiling of sample. After 30 min of boiling, take a discard conical flask of 100 ml. Set a funnel with cotton cloth with the discard flask. Filter the boiled sample to drain the acid solution. Wash the conical flask with hot water to remove the acid residue completely. Also, wash the filtrate with hot water to remove the acid solution. Again, place another funnel to the cleaned conical flask and measure 200 ml of 0.313M NaOH solution. Pour the NaOH solution into the conical flask washing the filtrate. Boil the sample with another 30 min. Shake the conical flask periodically to ensure the proper boiling of sample. After 30 min of boiling, again filter the sample to drain NaOH solution. Wash with hot water to remove NaOH residue completely. Collect the filtrate in a clean and dried crucible till no filtrate is left. Now, place the crucible in the Hot Air Oven at 230°C for 2 hrs. After 2 hrs., take out the crucible from the hot air oven and cool in desiccator. After 20 min, take weight of crucible containing fibre and note the weight. Place the crucible with its lid inside the muffle furnace and burn the fibre at 550°C for 2 hrs. After 4 hrs., takeout the crucible from muffle furnace and cool in desiccator. Take weight of the crucible containing ash and note the weight.

CALCULATION

$$\text{Crude Fibre (\%)} = \frac{(W_1 - W_2) * 100}{W_s}.$$

Where,

Ws is weight of sample

W_1 is weight of crucible with fibre

W_2 is weight of crucible with Ash

Table 1: Formulation of Crackers

ANALYSIS	STANDARD SAMPLE	VARIATION V1 (50:50)	VARIATION V2 (70:30)
MOISTURE	4.33%	3.93%	3.48%
ASH CONTENT	1.77%	1.45%	1.32%
FAT CONTENT	12.62%	12.49%	12.18%
PROTEIN CONTENT	0.54g	5.47g	5.79g
FIBRE CONTENT	0.68g	3.49g	3.82g

III RESULTS AND DISCUSSION

As part of the development process, refined wheat flour was reduced in the product and was replaced with composite flour containing a combination of Proso and Browntop Millets. Overall, the nutritional aspect of crackers made with Browntop and Proso composite millet flour is likely to be improved over crackers made from refined whole wheat flour.

A sensory and nutritional evaluation was conducted on the sample. A sensory evaluation of crackers prepared using different variations of Composite Millet flour was conducted in order to determine the quality attributes of the cracker, such as Appearance, Colour, texture, Taste, Flavour, Aroma, Snap, Crunchiness and overall acceptability. The evaluation was carried out by a total of 35 consumer panellists. The results of this study were analysed using a nine-point Hedonic scale with 1 representing the least score (dislike extremely) and 9 representing the highest score (like extremely). Sensory attributes indicated that variant V1 containing 50% composite flour and 50% refined wheat flour had the highest overall acceptability with a score of 8.89 followed by variant V2 containing 70% composite flour and 30% refined wheat flour of had the overall acceptability score of 8.78.

Proximate nutrition analysis was conducted for the highest overall acceptability sample variation V1 by analysing moisture, ash, fat, protein, and fibre. Based on the results of our analysis, the Variation V1 crackers contained: Moisture: 3.93%, Ash: 1.45%, Fat: 10.49%, Protein: 5.47%, Fibre: 3.49%. Comparing Variation V1 with the standard crackers, proximate nutritional analysis revealed that Variation V1 contained high levels of protein and fibre.

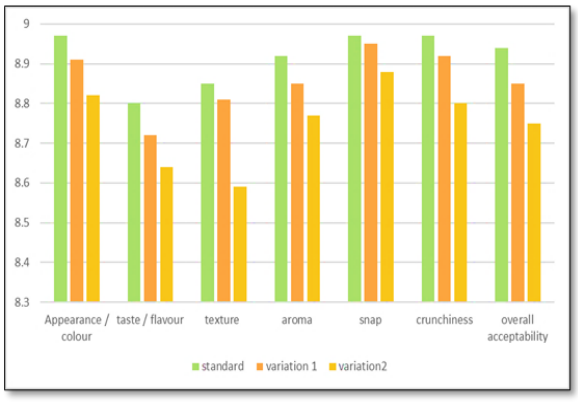

Fig 2: Sensory Analysis of Crackers

Table 3: Proximate Analysis of Crackers

INGREDIENTS	FORMULATIONS		
	CONTROL	V1	V2
Refined Wheat Flour	100g	50g	30g
Proso Millet Flour	-	25g	35g
Brown-Top Flour	-	25g	35g
Oregano Flakes	2g	2g	2g
Yeast	1.5g	1.5g	1.5g
Salt	3g	3g	3g
Sugar	2g	2g	2g
Ammonium Bicarbonate	1g	1g	1g
Butter	10g	10g	10g
Water	40ml	40ml	40ml

Fig 3: Control Sample

Fig 4: Variation (V1)

Fig 5: Variation (V2)

IV CONCLUSION

According to the results of the proximate and sensory tests, variant V1 exhibited the highest overall acceptability with a score of 8.89, as compared to variant V2 in sensory analysis. The proximate analysis indicated that variation V1 and V2 contains a higher level of protein and fibre than the standard sample. According to the results of the study, the moisture levels in V1, V2 and the control sample were 3.93%, 3.48 and 4.33%, respectively, which indicates that V1 and V2 had a lower water activity and a longer shelf life than the standard sample. Thus, we can conclude that developing shelf-stable ready-to-eat snacks made from millets in the near future could be promising.

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