

UTILIZATION OF SORGHUM FLOUR IN THE DEVELOPMENT OF ROAT: FORMULATION, SENSORY ACCEPTABILITY, PHYSICOCHEMICAL CHARACTERISTICS AND PRELIMINARY ECONOMIC ASSESSMENT

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Abstract : This study investigated the development of sorghum-flour roat, a traditional sweet baked product, by replacing the refined-wheat-flour component with sorghum flour at different levels. Four formulations were considered: a control (T0) containing semolina and refined wheat flour, and three experimental formulations containing 10, 15 or 20 parts sorghum flour alongside semolina. Sugar and fat were held at 20 parts each, with cardamom and chemical leavening agents included in the sorghum treatments. Sensory characteristics were assessed using a nine-point hedonic scale. Among the formulations, T1 (40 parts semolina and 20 parts sorghum flour) recorded the highest reported overall acceptability (8.3/9), with flavour receiving the highest score (8.6/9). The reported physical characteristics of the developed product were 20–25 g weight, 7.7 cm diameter, 1.16 mm thickness and a spread ratio of 6.63; the thickness unit requires verification. The report gives moisture (1.7%), fat (10.33%) and ash (8.67%) for the product, but the protein, fibre and carbohydrate results are inconsistent or incomplete across its sections. A preliminary costing estimated production cost at ₹119.37 per kg and sales revenue of ₹250 per kg-equivalent when sold as twenty-five 40-g packets at ₹10 each. These figures imply a gross difference of ₹130.63 per kg-equivalent before any unlisted overheads, taxes, wastage or distribution costs. The findings identify T1 as the most acceptable of the tested formulations in the reported sensory assessment. Further work should verify proximate-composition values, clarify the sensory-panel size and statistical analysis, and establish shelf life and commercial feasibility under controlled conditions.

IndexTerms - Sorghum flour; roat; millet-based bakery product; sensory evaluation; composite flour; product development; cost estimation

I. INTRODUCTION

INTRODUCTION

Traditional bakery products can provide a practical route for incorporating locally available cereal ingredients into familiar foods. Roat is a sweet baked product commonly prepared with semolina or wheat flour, sugar and fat, with cardamom used to contribute characteristic aroma. Its familiar format may offer an opportunity to explore alternative cereal formulations without requiring consumers to adopt an entirely new food category.

Sorghum (*Sorghum bicolor*) is a cereal adapted to warm and relatively dry growing environments and is used in a range of traditional foods. Sorghum flour contributes starch and protein and may also contribute dietary fibre, minerals and phenolic compounds, depending on the variety and processing history. Incorporating sorghum flour into bakery products may diversify cereal use and create value-added options for consumers. However, sensory characteristics such as flavour, colour, texture and mouthfeel can change as the proportion of an alternative flour increases.

The present project developed roat formulations using semolina and sorghum flour and compared their sensory scores. It also documented selected physical and chemical characteristics and a preliminary cost estimate. The work is a product-development study; claims regarding nutritional superiority, gluten-free status of the finished product, health effects or commercial viability require additional verification and are not assumed from the ingredient choice alone.

NEED OF THE STUDY.

- To formulate roat using different proportions of sorghum flour and semolina.
- To compare the sensory acceptability of the developed formulations using a nine-point hedonic scale.

- To document selected physical and proximate characteristics reported for the product.

TO ESTIMATE PRODUCTION COST AND POTENTIAL SALES REVENUE FROM THE AVAILABLE COSTING DATA.

3. MATERIALS AND METHODS:-

3.1 Raw materials

Sorghum flour, semolina, sugar, vanaspati ghee/fat, cardamom powder, baking powder, baking soda and milk were reported as ingredients. Raw materials were procured from local markets in Sangamner and Maldad, Maharashtra, India. The original report uses both the terms ghee and vanaspati ghee; the exact fat used should be confirmed before publication.

3.2 Formulation and treatment design

Four treatments were reported. Ingredient quantities are reproduced as parts/grams from the project formulation table; the basis should be confirmed as a 100-g batch because the table also lists small quantities of cardamom and leavening agents.

Treatment	Semolina (g)	Refined wheat flour (g)	Sorghum flour (g)	Sugar (g)	Fat (g)
T0 (control)	40	20	0	20	20
T1	40	0	20	20	20
T2	45	0	15	20	20
T3	50	0	10	20	20

The report additionally lists cardamom powder (0.3), baking powder (1) and baking soda (0.5) for T1–T3, but not for T0. Milk was added gradually during dough preparation; the report's costing table lists 15 ml per 100-g formulation. Confirm whether these quantities were applied consistently across treatments.

3.3 Processing procedure

Good-quality raw materials were selected and weighed according to the formulation. Dry ingredients were sieved. Semolina was roasted until lightly golden, and fat was creamed with powdered sugar. Roasted semolina and sorghum flour were incorporated, followed by cardamom and the leavening agents. Milk was added gradually to form a soft dough. The dough was rested for one hour, shaped into round pieces, and baked in a preheated oven at 170°C for approximately 25 minutes. Samples were cooled to room temperature before packaging and evaluation.

3.4 Sensory evaluation

The project report states that sensory evaluation was performed using a nine-point hedonic scale, from 1 (dislike extremely) to 9 (like extremely). Attributes included appearance, colour, texture, flavour, aroma, taste and overall acceptability. The number and demographic characteristics of panelists, panel training, serving order, replication, ethical/consent procedure and statistical methods were not clearly available in the extracted report and should be added from the original records.

3.5 Physical and chemical analysis

Physical parameters documented in the report included weight, diameter, thickness and spread ratio. The report describes oven drying for moisture determination, muffle-furnace incineration for ash, solvent extraction for fat, Kjeldahl-based nitrogen estimation for protein, acid-alkali digestion for crude fibre, and calculation of carbohydrate by difference. The analytical results below are reported as recorded; inconsistencies between sections are explicitly identified rather than reconciled by assumption.

3.6 Preliminary economic assessment

Costing was based on the reported raw-material estimate, processing cost, packaging and labelling, and labour. The source estimates total production cost at ₹119.37 for the stated 1-kg production basis and assumes twenty-five 40-g packets sold at ₹10 each. This is treated as a preliminary estimate, not a validated profitability analysis.

4. RESULTS AND DISCUSSION

4.1 Sensory acceptability

The sensory scores reported in the project are presented in Table 2.

Treatment	Appearance	Colour	Texture	Flavour	Aroma	Taste	Overall acceptability
T0	8.2	8.2	7.8	8.1	7.9	7.9	8.0
T1	8.3	8.3	8.3	8.6	8.1	8.3	8.3
T2	8.1	8.1	8.1	7.8	8.1	7.9	8.0
T3	7.9	7.7	7.9	7.7	7.8	7.7	7.7

T1 received the highest reported overall acceptability (8.3), as well as the highest flavour score (8.6). Its appearance, colour, texture and taste scores were each 8.3. T0 and T2 both recorded overall acceptability of 8.0, while T3 recorded 7.7. These descriptive results suggest that, among the tested treatments, the formulation containing 20 parts sorghum flour with 40 parts semolina was preferred. Because panel size, variation measures and inferential statistics were not reported, the numerical differences should not be described as statistically significant.

4.2 Physical characteristics

Parameter	Reported value
Weight	20–25 g
Diameter	7.7 cm
Thickness	1.16 mm (unit requires verification)
Spread ratio	6.63
Spread factor	Not reported

The reported diameter and weight provide an initial product description. The stated thickness of 1.16 mm appears unusually small for a baked roat and may reflect a unit or transcription error; it must be checked against laboratory records before publication. Spread factor was listed but no value was supplied.

4.3 Chemical composition

Parameter	Value in results table/text	Reporting status
Moisture	1.7%	Reported
Ash	8.67%	Reported; verify against laboratory sheet
Fat	10.33%	Reported
Protein	22.8% in results narrative; 25.8% in abstract	Conflicting values—verify
Crude fibre	1.9% in abstract; blank in results table	Verify
Carbohydrate	26.9% in abstract; blank in results table	Verify calculation and units
Calcium	100 mg mentioned in narrative	Basis and analytical method not specified

The available report records moisture, ash and fat values, but the protein value differs between the abstract and results narrative. Fibre and carbohydrate are not populated in the results table, although values appear in the abstract. The carbohydrate-by-difference calculation also requires a complete and internally consistent set of proximate values. Consequently, these disputed values should not be presented as final verified composition until the original laboratory records are checked. The reported ash value is relatively high for a baked product and likewise warrants confirmation. No validated mineral analysis details were available for the calcium figure.

4.4 Preliminary cost estimate

Cost/revenue item	Reported estimate (₹)
Raw materials per kg-equivalent	92.15
Processing cost	8.00
Packaging and labelling	10.00
Labour	9.22
Total production cost	119.37
Assumed revenue (25 × 40-g packs × ₹10)	250.00
Difference between revenue and stated production cost	130.63

Using the source's figures, the difference between the assumed revenue and listed production cost is ₹130.63 per kg-equivalent. This represents approximately 52.25% of the assumed selling revenue ($\text{₹}130.63/\text{₹}250 \times 100$), not a profit margin on cost. The corresponding markup on the stated production cost is approximately 109.4% ($\text{₹}130.63/\text{₹}119.37 \times 100$). The article therefore reports the arithmetic transparently rather than repeating the source's ambiguous labelling of 52.25% as a profit margin. A complete feasibility assessment should include wastage, utilities, equipment depreciation, transport, retailer/distributor margins, taxes and unsold stock.

4.5 Market survey

The project describes online data collection using Google Forms and an offline survey involving visits to local supermarkets. It reports that the survey focus included consumers aged 18–35 and that respondents expressed interest in convenient, tasty bakery products with nutritional value.

5. CONCLUSION

A sorghum-flour roat was developed using semolina, sugar and fat, and four formulations were compared. The formulation T1 containing 40 parts semolina and 20 parts sorghum flour achieved the highest reported overall sensory acceptability (8.3/9), suggesting that it was the most promising formulation among those tested. Preliminary physical and cost data indicate that the product can be made in a small-scale setting, but the evidence is not yet sufficient to establish commercial viability or shelf stability.

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