International Journal of Engineering Research and Science & Technology

www.ijerst.org

IF: 9.625

ISSN : 2319-5991



International Conference on Ensuring Global Food Safety-ICEGFS-2026

Vol. 22 No. 4(S) (2026)

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International Conference on Ensuring Global Food Safety-ICEGFS-2026
ISSN 2319-5991 www.ijerst.com
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QUALITY OPTIMIZATION OF GLUTEN-CONTAINING WHEAT BISCUITS ENRICHED WITH SORGHUM FLOUR

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Abstract
Biscuits are widely consumed bakery products because of their convenience, palatability, and extended shelf life. However, conventional wheat biscuits may contain relatively low levels of dietary fibre and certain minerals. Sorghum (Sorghum bicolor (L.) Moench) is a cereal grain with potential for improving the nutritional composition of baked products. This study is designed to optimize the incorporation of sorghum flour into wheat biscuits by evaluating nutritional, physicochemical, textural, and sensory characteristics. Five formulations containing 0%, 10%, 20%, 30%, and 40% sorghum flour will be developed by replacing equivalent proportions of wheat flour. The prepared biscuits will be evaluated for moisture, protein, fat, ash, crude fibre, carbohydrate, energy, colour, diameter, thickness, spread ratio, texture, and sensory acceptability. Statistical analysis will be performed to determine differences among formulations and identify the optimum blend. The study is expected to provide experimental evidence on the relationship between sorghum substitution level and biscuit quality. The findings may support the development of nutritionally improved cereal-based bakery products using locally available sorghum.
Keywords: Sorghum flour, wheat biscuits, composite flour, nutritional quality, texture, sensory evaluation, product optimization.

Received: 17-09-2026 Accepted: 22-10-2026 Published: 29-10-2026

Introduction

Biscuits are popular ready-to-eat products manufactured primarily from wheat flour, sugar, fat, and other ingredients. Their quality depends on flour composition, ingredient proportions, mixing conditions, baking temperature, and storage conditions. Sorghum is an important cereal cultivated in semi-arid regions, including parts of India. It contains starch, dietary fibre, protein, minerals, and various phenolic compounds. Its incorporation into bakery products can diversify cereal utilization and potentially improve the nutritional profile of conventional wheat-based foods[1].

Wheat flour contains gluten-forming proteins that contribute to dough structure and handling characteristics. Sorghum flour does not contain gluten-forming proteins equivalent to those in wheat. Therefore, replacing wheat flour with sorghum changes dough properties, spread, hardness, colour, and overall biscuit quality. Previous research has documented changes in nutritional composition and sensory characteristics following sorghum substitution in wheat-based biscuits. Research has also explored statistical optimization of sorghum-based biscuits to balance texture and consumer acceptability. Despite these findings, the optimal substitution level may vary with sorghum variety, flour particle size, recipe, processing conditions, and consumer preferences.

1.1 Aim of the study

To optimize the quality of wheat biscuits enriched with different proportions of sorghum flour.

1.2 Objectives

To formulate biscuits using different wheat–sorghum flour ratios. To evaluate their

proximate nutritional composition. To determine physical properties, including diameter, thickness, and spread ratio. To assess colour, texture, and sensory acceptability. To identify the most suitable formulation using statistical analysis.

2. Materials and Methods

2.1 Materials

The following ingredients and equipment are proposed for the study:

Refined wheat flour and cleaned sorghum grains or flour. Sugar, butter or vegetable fat, baking powder, salt, and water or milk as specified by the standardized recipe. Analytical balance, oven, grinder, sieve, measuring instruments, texture analyser if available, and laboratory equipment for proximate analysis[2].

2.2 Experimental design

Five formulations will be prepared by replacing wheat flour with sorghum flour.

Sample code	Wheat flour (%)	Sorghum flour (%)
W100S0	100	0
W90S10	90	10
W80S20	80	20
W70S30	70	30
W60S40	60	40

All other ingredients, dough preparation procedures, baking conditions, and cooling times should be kept consistent across treatments[3].

At least three independent batches per formulation are recommended, subject to available resources.

2.3 Preparation of biscuits

The sorghum and wheat flours will be weighed according to the experimental formulations and mixed thoroughly. Other ingredients will be added according to a standardized biscuit recipe. The dough will be mixed, sheeted to a uniform thickness, cut into equal shapes, and baked under predetermined conditions.

After baking, the biscuits will be cooled to room temperature and stored in clean, airtight containers before analysis.

Flow chart 1. Biscuit preparation flowchart

Selection and cleaning of sorghum grains→Grinding and sieving of sorghum flour→Blending with wheat flour (0–40% substitution)→Addition of other ingredients and dough mixing→Sheeting, cutting, and baking→Cooling and packaging→Nutritional, physical, textural, and sensory evaluation

2.4 Proximate nutritional analysis

The following parameters will be measured using validated laboratory procedures, such as the relevant AOAC methods:

Moisture content, crudeprotein, crudefat,Totalash, crudefibre, carbohydratecontent, energyvalue, carbohydrate may be calculated by difference using the selected analytical convention. Energy may be estimated from the measured macronutrients using appropriate conversion factors[4].

2.5 Physical and textural evaluation

The physical properties of biscuits will be assessed as follows:

Diameter: measured using a ruler or digital caliper.

Thickness: measured at standardized points.

Spread ratio: calculated as diameter divided by thickness.

Hardness: measured using a texture analyser, if available.

Colour: assessed using a calibrated colorimeter or a standardized visual protocol.

2.6 Sensory evaluation

Sensory acceptability will be assessed by a suitable panel using a nine-point hedonic scale, with informed participation and appropriate institutional approval where required. Attributes may include appearance, colour, aroma, taste, crispness, texture, and overall acceptability.

Samples should be coded, presented in randomized order, and accompanied by drinking

water for palate cleansing. Participants must be informed about ingredients and potential allergens[5].

2.7 Statistical analysis

Experimental data will be summarized as mean ± standard deviation. One-way analysis of variance (ANOVA) may be used to compare formulations, followed by an appropriate post-hoc test where assumptions are satisfied. Statistical significance will be assessed at \(p<0.05\).If optimization software is available, response surface methodology or a desirability function can be used to identify a formulation that balances nutritional, physical, and sensory responses.

3. Results and Discussion

This section should be completed after conducting the experiment. The following tables and figures are templates; they contain no measured experimental results.

3.1 Proximate composition

Table 1. Proximate composition of wheat–sorghum composite biscuits

Parameter	W100S0	W90S10	W80S20	W70S30	W60S40
Moisture (%)	—	—	—	—	—
Protein (%)	—	—	—	—	—
Fat (%)	—	—	—	—	—
Ash (%)	—	—	—	—	—
Crude fibre (%)	—	—	—	—	—
Carbohydrate (%)	—	—	—	—	—
Energy (kcal/100 g)	—	—	—	—	—

Note: Enter the mean of independent experimental batches and report variability. Specify whether values are expressed on a wet-weight or dry-weight basis[6].

The results will show whether increasing sorghum flour incorporation changes the nutritional composition of the biscuits. Differences should be interpreted in relation to the composition of the starting flours and the effects of baking.

3.2 Physical and textural properties

Table 2. Physical and textural characteristics of biscuits

Formulation	Diameter (mm)	Thickness (mm)	Spread ratio	Hardness (N)
W100S0	—	—	—	—
W90S10	—	—	—	—
W80S20	—	—	—	—
W70S30	—	—	—	—
W60S40	—	—	—	—

The physical properties may change as wheat flour is replaced with sorghum flour. Such changes can be associated with differences in gluten formation, water absorption, particle size, and dough consistency. The direction and magnitude of these effects must be established experimentally[7].

3.3 Sensory evaluation

Table 3. Sensory acceptability of biscuits using a nine-point hedonic scale

Attribute	W100S0	W90S10	W80S20	W70S30	W60S40
Appearance	—	—	—	—	—
Colour	—	—	—	—	—
Aroma	—	—	—	—	—
Taste	—	—	—	—	—
Crispness	—	—	—	—	—
Texture	—	—	—	—	—
Overall acceptability	—	—	—	—	—

Sensory scores will be used to determine which formulation is most acceptable to the panel. A formulation with improved fibre content may not necessarily receive the highest sensory score, so nutritional and sensory outcomes should be considered together[8,9].

4. Figures for the research article



Figure 2. Appearance of biscuits prepared from different flour blends

Recommended: photograph the actual five experimental formulations under identical lighting, with sample codes visible.

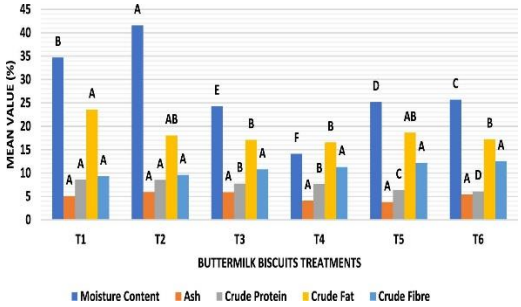


Figure 3. Comparison of nutritional composition

Create grouped bar charts from measured protein, fibre, ash, and moisture values. Include error bars when replicate data are available[10,11].



Figure 4. Sensory acceptability of composite flour biscuits

Plot mean sensory scores for each formulation, with uncertainty measures and a clear nine-point scale.

5. Conclusion

The proposed study will evaluate the effects of sorghum flour substitution on the nutritional, physical, textural, and sensory properties of wheat biscuits. By comparing five flour blends, the study will identify a formulation that provides a suitable balance between nutritional composition and consumer acceptability.

The optimum formulation should be selected on the basis of measured results rather than assuming that a particular substitution level is best. The findings may contribute to the development of value-added cereal products and promote the utilization of sorghum in bakery applications.

References

1. Asrat, U., Gudisa, A., &Zerihun, M. (2025). Quality evaluation of biscuit from sorghum and wheat composite flour. Cogent Food & Agriculture, 11(1), Article 2581360. https://doi.org/10.1080/23311932.2025.2581360 .

2. Mitra, J., et al. (2014). Effect of inulin on textural and sensory characteristics of sorghumbased high fibre biscuits using response surface methodology. Journal of Food Science and Technology. Read the article.

3. Assessment of quality and sensory properties of sorghum–wheat flour cookies. (2016). Cogent Food & Agriculture. https://doi.org/10.1080/23311932.2016.1245059 .

4. Yu, et al. (2020). Comparison of nutritional quality and sensory acceptability of biscuits obtained from wheat, native, or extruded sorghum flour. Cereal Chemistry. https://doi.org/10.1002/cche.10349.

5.Medeiros R.J., dos Santos L.M.G., Freire A.S., Santelli R.E., Braga A.M.C.B., Krauss T.M., Jacob S.C. Determination of inorganic trace

elements in edible marine fish from Rio de Janeiro State, Brazil. Food Control. 2012;23:535–541. doi: 10.1016/j.foodcont.2011.08.027. [DOI] [Google Scholar]

6.Medeiros R.J., dos Santos L.M.G., Freire A.S., Santelli R.E., Braga A.M.C.B., Krauss T.M., Jacob S.C. Determination of inorganic trace elements in edible marine fish from Rio de Janeiro State, Brazil. Food Control. 2012;23:535–541. doi: 10.1016/j.foodcont.2011.08.027. [DOI] [Google Scholar]

7.Taylor J.R.N., Schober T.J., Bean S.R. Novel food and non-food uses for sorghum and millets. J. Cereal. Sci. 2006;44:252–271. doi: 10.1016/j.jcs.2006.06.009. [DOI] [Google Scholar]

8..Chavez D., Ascheri J., Martins A., Carvalho C., Bernardo C., Teles A. Sorghum, an alternative cereal for GF product. Rev. Chil. Nutr. 2018;45:169–177. doi: 10.4067/S0717-75182018000300169. [DOI] [Google Scholar]

9..Ofosu F.K., Elahi F., Daliri E.B.M., Yeon S.J., Ham H.J., Kim J.H., Oh D.H. Flavonoids in decorticated sorghum grains exert antioxidant, antidiabetic and antiobesity activities. Molecules. 2020;25:2854. doi: 10.3390/molecules25122854. [DOI] [PMC free article] [PubMed] [Google Scholar]

10.Pontieri P., Mamone G., De Caro S., Tuinstra M.R., Roemer E., Okot J., De Vita P., Ficco D.B., Alifano P., Pignone D. Sorghum, a healthy and gluten-free food for celiac patients as demonstrated by genome, biochemical and immunochemical analyses. J. Agric. Food Chem. 2013;61:2565–2571. doi: 10.1021/jf304882k. [DOI] [PubMed] [Google Scholar]

11.Palavecino P.M., Ribotta P.D., León A.E., Bustos M.C. Gluten-free sorghum pasta: Starch digestibility and antioxidant capacity compared with commercial products. J. Sci. Food Agric. 2019;99:1351–1357. doi: 10.1002/jsfa.9310. [DOI] [PubMed] [Google Scholar]