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Cooking Performance and Sensory Characteristics of Gluten-Free Pasta Enriched with Indigenous Ingredients

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Abstract

The study titled *"***Cooking Performance and Sensory Characteristics of Gluten-Free Pasta Enriched with indigenous Ingredients***"* aimed to develop a gluten-free pasta using locally sourced flours and to evaluate its cooking qualities, sensory attributes, nutritional composition, and cost. Pasta was formulated using varying proportions of rice flour, corn flour, defatted soy flour, and guar gum flour across three treatments: T_1 (65:10:20:5), T_2 (50:10:30:15), and T_3 (35:10:40:15), with a standard wheat-based pasta serving as the control (T_0). Gluten content was assessed using the AACC Method 38-10 (2000), while cooking time and cooking loss were determined using AACC Method 66-50 (2000). Sensory evaluation was conducted using a 9-point Hedonic Scale.Results indicated that the gluten-free formulations contained no detectable gluten. Cooking time and cooking loss were reduced in gluten-free variants compared to the control. Among all samples, T_2 achieved the highest sensory scores in color, texture, flavor, and overall acceptability. The cooking loss showed significant gradual decrease along with the addition of rice flour, gaur gum flour, defated soyaflour and corn flour . Nutritional analysis revealed significantly higher levels of protein, fiber, energy, vitamins, and minerals in the gluten-free pasta, particularly T_2, when compared to the control. The cost per 100g of raw ingredients ranged from Rs. 6.00 for the control to Rs. 7.77 for T3.The study concludes that gluten-free pasta can be effectively prepared using rice flour, corn flour, defatted soy flour, and guar gum flour, with T_2 offering the best balance of sensory quality, nutrition, and affordability.

Key words – Gluten, pasta, cooking quality, sensory quality, Nutritional composition, defatted soy flour, guar gum**.**

Introduction;

Gluten-containing grains form a significant part of modern diets, with estimated daily intake in Western populations ranging from 5 to 20 grams. Gluten proteins are notably resistant to proteolytic enzymes in the digestive system, leading to incomplete digestion. As a result, large peptide fragments—chains of amino acids—may pass through the intestinal wall and enter the bloodstream, potentially triggering immune responses. This mechanism has been implicated in various gluten-related disorders, particularly celiac disease. The growing prevalence of such conditions has attracted significant attention from researchers seeking to develop suitable dietary alternatives.

Currently, the primary gluten-free options include rice, corn starch, and sorghum-based products. However, these alternatives often lack essential nutrients and offer limited nutritional value. To address this issue, functional gluten-free foods are being developed to enhance the dietary quality for individuals with celiac disease **(Shewry *et al*., 2002).** Pasta, a staple refined carbohydrate with a low glycemic index, is a promising vehicle for such enhancements. Incorporating gluten-free flours can contribute to improved gastrointestinal health by reducing symptoms and promoting the restoration of intestinal microvilli, which are vital for nutrient absorption.

Soybean flour, known for its high-quality protein and low saturated fat content, supports overall health and longevity. Guar gum, derived from guar seeds, exhibits high low-shear viscosity and is an effective natural thickener and stabilizer. It also offers therapeutic benefits, including relief from constipation, diarrhea, irritable bowel syndrome (IBS), and the regulation of blood pressure and cholesterol levels. Corn is rich in potassium and carotenoids—antioxidants beneficial for eye health—while rice flour contributes essential nutrients such as protein, B-complex vitamins, and choline, which supports liver function by aiding in lipid transport.

Over the past century, the food processing industry has evolved in response to consumer demand for healthier products. This shift has led to innovations in pasta production, particularly the incorporation of nonconventional ingredients. The addition of dietary fiber, vitamins, minerals, natural pigments, and antioxidants to pasta formulations enhances the functional and nutritional qualities of traditionally refined products, aligning with current health-focused consumer preferences.

MATERIALS AND METHODS

1. Study Location

The study was conducted in the Department of Food Nutrition and Public Health, Ethelind College of Community Science, Sam Higginbottom University of Agriculture, Technology and Sciences (SHUATS), Prayagraj, Uttar Pradesh.

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2. Procurement of Raw Materials

Raw materials including rice flour, corn flour, defatted soy flour, guar gum flour, and other required ingredients were procured from local markets in Prayagraj.

3. Preparation of Flours

Each flour type used in the study was prepared in the laboratory using established methods with slight modifications:

Preparation of defatted soy flour: The method described by **Iwe, (2003)** was used with some modification to prepare defatted soy flour. Soy bean seeds were sorted, blanched for 30 minutes and soaked for about 12 hours. The grains were dehulled, dried in hot air oven at 40°C for 4 hours. The dried beans were milled using the attrition mill (dry milling). Water was added to the mill to from a mixture in the ratio of 4:1 of water to flour. The resultant mixture was stirred vigorously for 20 minutes and the oil was skimmed off. The process was repeated until the milk stopped 15 foaming. The defatted soy slurry was drained using clean muslin cloth, oven dried at 40°C for 4 hours and dry milled into flour. The flour was sieved to obtain fine particles

Preparation of Rice Flour: Processed as per Ghodke *et al.* (2013), with adaptations.

Preparation of Corn Flour: Prepared according to the method of Braz *et al*. (2004), with minor adjustments.

Preparation of Guar Gum Flour: Extracted using the procedure described by Kawamura for FAO/WHO (JECFA, 2008c), with modifications.

4. Gluten Content Analysis: The presence of wet gluten in the developed flour mixtures was determined using the hand-washing method as per the American Association of Cereal Chemists (AACC Method 38-10, 2000).

5. Development of Gluten-Free Pasta: Gluten-free flour mixtures were formulated by combining rice flour, defatted soy flour, corn flour, and guar gum flour in different ratios. Standard pasta recipe using refined wheat flour served as the control (T_0). Three treatment groups (T_1, T_2, T_3) were developed with varying proportions of gluten-free ingredients.

Table 1. Formulation of control and treatments of gluten free pasta:

Ingredients (%)	Control and Treatment			
	Control (T_0)	Treatment (T_1)	Treatment (T_2)	Treatment (T_3)
Refined Flour	100	-	-	-
Rice Flour	-	65	50	35
Defatted Soy Flour	-	10	10	10

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Corn Flour	-	20	30	40
Gaur –gum	-	5	10	15

Gluten-free pasta was then prepared using these formulations. The ratio of ingredients was modified on a trial basis to optimize texture, flavor, and cooking characteristics.

A-T_1

B-T_2

C-T_3

D-T_0

Plates 1. Different treatments of prepared pasta (T_1,T_2 T_3) and control(T_0)

6. Evaluation of Cooking Quality

- **Optimum Cooking Time (OCT)**: Spaghetti strands (20 g) were cut in an equal length of 100 mm and cooked in 300 ml of boiling water. During cooking, the optimal cooking time was evaluated every 30s by observing the time of disappearance of the white core of spaghetti, by squeezing it between two transparent glass slides according to the AACC Approved Methods of Analysis Method 66-50(2000). The time at which the white core completely disappeared was taken as the optimum cocking time (OCT).
- **Cooking Loss (CL)**: The amount of solid substance lost in the cooking water was determined according to the (AACC Approved Methods of Analysis Method 66-50, 2000) Ten grams of spaghetti was cooked in 300 ml of boiling water at OCT. Rinsed with 100 ml of cold water, trained for 30s to determine the cooking loss of the pasta. The cooking water was collected in aluminum

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vessel, placed in an air oven at 105 0C to evaporate the water until a constant weight was reached. The residue was weighted and reported as a percentage of starting materials. The analysis was carried out in triplicate.

- **Moisture Content**: Assessed for dry pasta using the method described by AOAC (1990).

7. Sensory Evaluation

Sensory acceptability of cooked *pasta* was evaluated by a panel of five trained judges. The 9-point Hedonic Scale (Sri Lakshmi, 2007) was used to assess the Color and Appearance, Body and Texture, Taste and Flavor and Overall Acceptability attributes of prepared and cooked *pasta*.

8. Nutritional Analysis

The nutritional content of the prepared pasta was estimated using standard calculation methods based on the Indian Food Composition Tables (Gopalan *et al.,* 2007). Nutrients analyzed included energy, protein, fat, carbohydrate, fiber, calcium, iron, and vitamin A.

Formula: $\text{Nutrient /100gproduct} = \frac{\text{Ingredient used (g) X Nutritive value of the ingredient}}{100}$

9. **Cost of product**

Cost of the prepared product was calculated by taking into account the cost of individual raw ingredients used in the preparation of food product as the prevailing market price.

10. Statistical analysis

Analysis of variance (ANOVA), Critical Difference, T- test were used to analysed the data **(Gupta and Kapoor, 2002).**

FINDINGS

The present study, **"Cooking Performance and Sensory Characteristics of Gluten-Free Pasta Enriched with indigenous Ingredients"** aimed to develop a gluten-free pasta formulation and evaluate its functional, sensory, nutritional, and economic characteristics. Data collected was analyzed and is presented under the following subheadings:

A. Gluten Content in Developed Flour Mixture

Chemical analysis confirmed that the blended flours—rice flour, corn flour, defatted soy flour, and guar gum contained **no detectable gluten**. This validates the formulations as suitable for individuals with gluten intolerance or celiac disease. Supporting research by Gallaher (2000) highlights those gluten-free products can act as "double" functional foods by serving as carriers of beneficial nutrients like fiber, prebiotics, and calcium.

B. Cooking quality of developed *Pasta*

Table no. 2. Cooking quality of gluten free *Pasta* (per 100g)

Control and Treatment	Optimum cooking time (OCT)(min)	Cooking loss (CL) (%)	Moisture (dry pasta) (%)
T_0	6.00	6.03	6.12
T_1	5.30	4.79	5.2
T_2	5.31	4.88	5.8
T_3	5.32	5.79	5.92

Optimum Cooking Time (OCT): The optimum cooking time (OCT) for the prepared pasta samples is presented in Table 2. The results indicate a reduction in cooking time with the addition of rice flour, guar gum flour, defatted soy flour, and corn flour compared to the control. The control sample had an optimum cooking time of 6.00 minutes, whereas the gluten-free pasta samples showed reduced cooking times of 5.30 minutes (T_1), 5.31 minutes (T_2), and 5.79 minutes (T_3), respectively. These findings suggest that substituting refined flour with rice flour, guar gum flour, defatted soy flour, and corn flour increased the protein content of the pasta, which in turn led to a decrease in cooking time. This trend aligns with the observations reported by **Padalino *et al*. (2014),** who noted similar results in gluten-free pasta made with refined flour substitutes. The reduction in cooking time may be attributed to the enhanced rate of water penetration into the pasta, likely due to the disrupted protein-starch network in the absence of gluten. This disruption facilitates faster water diffusion through the pasta matrix, allowing the water to reach the core more quickly during cooking, as supported by **Padalino *et al.* (2014).**

Cooking Loss (CL) The cooking loss of gluten *pasta* was illustrated in Table 2.The cooking loss showed significant gradual decrease along with the addition of rice flour, gaur gum flour, defated soyaflour and corn flour.The optimum cooking loss of control was 6.03 percent, while the optimum cooking loss of gluten free *pasta* was 4.79 percent(T_1), 4.88 percent (T_2) and 5.79 percent (T_3) respectively. Solubility of nutrients leads to their losses, water absorbance by *pasta* during cooking, whereby cause the mass fractions of the nutrients to decrease **(Filip and Vidrih, 2015).** According to **AACC Approved Methods of Analysis, Method 66-50, (2000),** all the cooking loss obtained values are within the acceptable limits since the solid loss in cooking water should not exceed 9%.

Moisture Content: The moisture content of gluten-free pasta is shown in Table 2. A significant and gradual decrease in moisture content was observed with the addition of rice flour, guar gum flour, defatted soy flour, and corn flour, compared to the control. The control sample had a moisture content of 6.12%,

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while the gluten-free pasta samples recorded values of 5.20% (T1), 5.80% (T2), and 5.92% (T3), respectively. Gluten-free pasta variants had **lower moisture content** than the control, which may enhance shelf-life and texture.

C. Sensory Characteristics of Prepared *pasta*

Table 3 .Sensory Characteristics of Prepared *pasta*

Control & Treatment	Attributes			
	Color & Appearance	**Body & Texture**	**Taste & Flavor**	**Overall acceptability**
T_0	6.6	8.5	7.6	8.4
T_1	7.0	7.7	7.6	8.5
T_2	8.3	8.6	9.0	8.7
T_3	7.6	8.3	8.3	7.9
F – test (5%)	Significant	Significant	Significant	Significant
C.D	1.074	0.890	0.761	0.244

Color and Appearance: Table 3 presents the mean sensory scores for pasta based on color and appearance. Treatment T_2 received the highest score (8.3), followed by T_3 (7.6), T_1 (7.0), and the control T_0 (6.6). These results indicate that T_2, which consisted of 50% rice flour, 30% corn flour, 10% defatted soy flour, and 10% guar gum, was rated as "very much liked" by the judges. In comparison, T3 was considered "moderately liked" in terms of color and appearance. T_2 received the highest score (8.3), indicating high visual appeal.

Body and Texture:_ Table 3 presents the mean sensory scores for pasta in relation to body and texture. Treatment T_2 received the highest score (8.6), followed closely by the control T0 (8.5), T_3 (8.3), and T_1 (7.7). These results indicate that T_2, consisting of 50% rice flour, 30% corn flour, 10% defatted soy flour, and 10% guar gum, was rated as "very much liked" by the judges for its body and texture. In contrast, T_3 was considered "moderately liked."The data suggest a significant difference among the treatments in terms of texture. Therefore, it can be concluded that the use of varying levels of rice flour, corn flour, defatted soy flour, and guar gum positively influences the body and texture of pasta, with certain combinations—such as T_2 yielding the most favorable results.

Taste and flavor : Table 3 shows that the mean sensory scores obtained for Pasta in relation to taste and flavor, shows that T_2 has the highest score (9.0), followed by T_3 (8.3), T_0 (7.6) and T_1 (7.6). It indicates that the treatment T_2 (50% Rice flour + 30% Corn flour + 10% Deffated soy Flour +10%Gaur-gum) wasliked very much by the judges, whereas T_3 was liked moderately regarding the taste and flavor of Pasta by the judges. It expressed that there is a significant difference between the all three treatments of *Pasta* regarding the Taste and flavor, so it can be easily concluded that Pasta prepared with different level of Rice flour, Corn flour, Deffated soy flour, Gaur-gum has improved the taste and flavor and is best in certain amount of treatments.

Overall Acceptability: Table 4.2 presents the mean sensory scores for pasta in terms of overall acceptability. Treatment T2 received the highest score (8.7), followed by T1 (8.5), T0 (8.4), and T3 (7.9). These results indicate that T2—composed of 50% rice flour, 30% corn flour, 10% defatted soy flour, and 10% guar gum—was rated as "very much liked" by the judges. In comparison, T1 was considered "moderately liked" in terms of overall acceptability.

All attributes showed statistically significant differences ($p<0.05$), confirming that ingredient proportions substantially affected product quality.

D. Nutritional Value of Prepared Pasta (Per 100g)

Table 4. Nutritional content of prepared *pasta* on the basis of raw ingredient per 100g.

Nutrients / 100g	**Control and Treatments**			
	T_0	**T_1**	**T_2**	**T_3**
Energy(kcal)	**348**	337	320	304
Fat (g)	0.9	2.95	3.32	**3.59**
Crude fiber (g)	0.3	1.2	1.6	**2.0**
Carbohydrates (g)	**74.0**	67.22	62.15	57.84
Protein (g)	11.0	10.86	11.37	**11.48**
Calcium (mg)	23.0	38.35	45.0	**50.65**
Iron (mg)	2.7	2.204	2.19	**3.93**
Vitamin A(mcg)	0.00	4.3	6.6	**8.9**

As shown in Table 4, the nutritional composition of the pasta samples varied significantly with different formulations. T_3 showed the highest content of **fiber, fat, calcium, iron, and vitamin A**, while T_2 provided a balanced profile of **protein, micronutrients**, and overall nutritional value. Though energy and carbohydrate content decreased with increased incorporation of functional ingredients, this trade-off was offset by higher nutrient density. These results suggest that incorporating alternative flours, particularly in the T3 formulation, significantly enhances the nutritional profile of pasta, especially in terms of protein, fiber, minerals, and vitamins, despite a slight reduction in energy and carbohydrate content.

E. Cost Analysis of Prepared Pasta (Per 100g)

Cost is very important factor which affect the market ability of the product and need to be considered while manufacturing of the food product It is the basis for price fixation and determining the profit on the cost of production. The cost has been calculated on the basis of prevailing price of raw material. According to the finding the total cost for T_3 was 7.77 Rs/100g, T_2 was 7.1Rs/100g, T_1 was 6.42and $T_0$was 6 Rs/100g. The cost of production increased with the addition of functional, gluten-free ingredients. T3 had the highest cost (Rs. 7.77/100g) due to a higher proportion of corn and guar gum flour. However, the added nutritional and functional benefits justify the cost increment, especially for health-conscious or gluten-intolerant consumers.

CONCLUSION

The study concludes that gluten-free pasta can be effectively formulated using indigenous ingredients—rice flour, corn flour, defatted soy flour, and guar gum flour. All gluten-free variations were free of gluten and demonstrated improved cooking performance (shorter cooking time, lower cooking loss), enhanced sensory acceptability, and higher nutritional value compared to the control.Among the treatments, T_2 (50% rice flour, 30% corn flour, 10% defatted soy flour, and 10% guar gum) emerged as the most favorable in terms of sensory quality, nutrient profile, and consumer acceptability. While the cost increased slightly, it remained within an acceptable range, indicating that value-added, gluten-free pasta is a feasible and beneficial product for both health and market potential.

REFERENCES

- **AACC Approved Methods of Analysis, Method, (2000).**MethodNumber; 66-50pp 16-18.
- **Blades, M., (1997),** Food allergies and intolerances: an update. *Nutricion and Food Science*, **4**: (5), 146-151.
- **Bello, A.A., Gernah D.I., Ariahu C.C andIkya J.K(2020),** (*American Journal of Food Science and Technology.*, 8(1), 1-13 doi:10.12691/ajfst-8-1-1
- **Filip,S., Vidrih,R.,(2015).**Amino acid composition of protein-enriched dried pasta:is it suitable for a low-carbohydrates diet? *Food Technol.Biotech*.53,298-306.
- **Ghandhi, A.P. (1988)** Nutritional quality of soybean processing and utilization in India, edited by Ali, N. CIAE Bhopal. 170-181.

- **Gallaher, E., (2000),**Ash town Food research centre, Teagasc, Ash town, Dublin 15, Ireland done Gluten free research says that Gluten products can be regarded as a 'double' functional food.*Journal of food tech*, 5th issue:59
- **Ghodke, K.D., and Chavan, D.H. (2013)**. Preparation of gluten free rice flour biscuits. *Food Sci. Res. J.,* 4(2): 111-115
- **Gopalan C., and Ramasastri B.V., (2007),** "Food and their nutrient content", *Nutritive Value of Indian's food, national Institute of Nutrition*. India council of Medical Research (ICMR) Hyderabad, 49-60.
- **Messina, Mark (2004).** "Soybean isoflavone exposure does not have feminizing effects on men: A critical examination of the clinical evidence". *Fertility and Sterility* 93 (7): 2095-2104.
- **Padalino, L.,Mastromatteo,M., Lecce, L., Spinelli, S., Conte, A., Nobile, M.A.,(2014).** Optimization and characterization ofgluten free flours. *Inter.J.FoodSci.Nutr*.7486,1-11.
- **Tandon, M. and Singh, G. (1987).** Effect of addition of defatted soya flour on physiochemical characteristics and acceptability of green gram. *J. Food Sci.Technol.,* 24: 283.
- **Rasane P., (2015)** Nutritional advantages of oats and opportunities for its processing as value added foods-a review. *Journal of food science and technology***52** (2): p. 662-675.
- **Raiz (1999),** The new "Whole Foods Encyclopaedia", *Penguin Books*, New York:71
- **Shewry, P.R., Halford, N.G., Belton, P.S. and Tatham, A.S., (2002)**357,133–142
- **SreenivasReddy Bathula.,Ravishankar B.V., andPujarBasayyaGullaya(2018)***MOJ Proteomics Bioinform*;**7**(3):199–2

<u>WEB REFERENCE</u>

- https://www.researchgate.net/figure/Guar-gum-manufacturing-flow-chart-JECFA-2008c-prepared-by-Kawamura-for-FAO-WHO_fig2_314029108 [DOI 14 Feb, 2022].