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Development of Curcumin Incorporated Pasta Using Chickpea and Pigeon Pea Flour

Ashique Mohammed
(M.Sc. Student), Dept. of Food Science and Technology, Lovely Professional University, Phagwara, Punjab, India
&
Assistant Professor Dr. Shweta*
(Dept. of Horticulture), Lovely Professional University, Phagwara, Punjab, India

Corresponding Author: **Dr. Shweta**

Abstract: The research focus on development and evaluation of curcumin-incorporated pasta using chickpea and pigeon pea flour. The primary objective is to explore the nutritional and sensory attributes, as well as the shelf-life stability, of the newly formulated pasta. Chickpea and pigeon pea flours were selected due to their rich nutritional profiles, including high protein content, dietary fiber, vitamins and minerals, which provide significant health benefits. Curcumin, known for its anti-inflammatory, antioxidant and anti-cancer properties, was incorporated to enhance the functional value of the pasta. Curcumin also contributes to the colour of the product without the addition of colouring agents. The study involved the preparation of ten pasta formulations with varying proportions of chickpea flour (CF) and pigeon pea flour (PF): T1 (100% CF); T2 (90% CF + 10% PF); T3 (80% CF + 20% PF); T4 (70% CF + 30% PF); T5 (65% CF + 35% PF); T6 (60% CF + 40% PF); T7 (55% CF + 45% PF); T8 (50% CF + 50% PF); T9 (45% CF + 55% PF) and T10 (40% CF + 60% PF). Sensory evaluation was conducted using a 9-point hedonic scale to assess colour, odor, texture, taste and overall acceptability. Among the formulations, T10 emerged as the best treatment with the highest scores in several sensory attributes: appearance (8.4), colour (8.2), texture (8.5), taste (8.2), mouth feel (8.4) and overall acceptability (8.7). Nutritional analysis of T10 revealed a comprehensive profile beneficial for health-conscious consumers. It showed highest values in ash content (4.19g), fat content (0.7g), protein content (12.83g), energy value (332.83) and antioxidant activity (72.08%). These values indicated a balanced nutritional composition, emphasizing the potential of T10 as a healthy pasta alternative.The results indicated that there was an increase in moisture content and microbial count, the moisture increased from 11.38% to 11.75% in T7 which had the highest moisture content among all the treatments. The microbial count ranged from 0.50×10^1 to 0.73×10^1 in T5, which had the lowest count among the treatments. The yeast and mould count analysis reveals that no detectable yeast or mould growth occurred in any of the treatments (T1-T10) throughout the 28 days storage period. During the storage period there was a diminishing in the colour after 21 days without any effect on its odour, texture and taste. This research provides valuable insights into the development of functional food products that meet the growing consumer demand for nutritious and health-promoting foods.

Keywords: Curcumin; Chickpea Flour; Pigeon Pea Flour; Sensory Evaluation; Nutritional Analysis; Shelf Life

Aim:

To develop and evaluate the sensory parameters, nutritive parameters andshelf-life of curcumin incorporated pasta made using chickpea flour and pigeon pea flour.

Introduction

Carbohydrates are a vital energy source for humans, with cereals, tubers, and pulses serving as primary dietary staples. Among these, pasta stands out as a globally beloved food renowned for its convenience, extended shelf life, affordability, and low glycemic index (GI) (Wrigley et al., 2015). A typical 100 g serving of cooked, unenriched pasta contains approximately 31 g of carbohydrates, 26.01 g of starch, 1.8 g of total dietary fiber, 5.8 g of protein, 0.93 g of fat, and trace amounts of minerals and vitamins, providing roughly 158 Kcal (USDA, 2019).

Grain legumes, such as chickpeas and pigeon peas, offer superior health benefits compared to cereal grains. Legume consumption is linked to reduced risks of type-2 diabetes, cardiovascular diseases, and myocardial infarction (Flight and Clifton, 2006; Jayathilake et al., 2018; Miller et al., 2017). They also improve gut health and aid in weight management (Clemente and Olias, 2017; McCrory et al., 2010). Legumes contain anti-cancer peptides that may prevent prostate and colorectal cancers (Luna-Vital and González de Mejía, 2018; Park et al., 2008; Zhu et al., 2015).

Traditional pasta, made by mixing semolina from durum wheat or common wheat flour with water, is deficient in dietary fiber, vitamins, essential amino acids, and minerals. However, pasta can be fortified with bioactive ingredients, including proteins, phytochemicals, minerals, and vitamins. Depending on the ingredient and processing technology, up to 10–15% of non-traditional ingredients can be incorporated into pasta without significant loss of quality (Bustos et al., 2015). This makes pasta an ideal vehicle for delivering bioactive compounds, enhancing its nutritional profile and health benefits (Bresciani et al., 2022).

Chickpea (Cicer arietinum L.), known as garbanzo bean or Bengal gram, is grown in over fifty countries and is an excellent source of nutrients, especially protein, offering anti-diabetic, hypocholesterolemic, anti-cancer, and anti-inflammatory benefits (Yust et al., 2012). Chickpeas contain 18-22% protein, higher than other legumes, and are rich in lysine and arginine but lack sulfur-containing amino acids. They have a low glycemic index and high amylose content, providing anti-diabetic properties (Foster-Powell et al., 2002). Chickpeas also offer essential micronutrients like iron, calcium, zinc, and magnesium, along with vitamins E and B complex (Bar-El Dadon et al., 2017).

Pigeon pea [Cajanus cajan (L.) Huth] is a fast-growing pulse crop known for its drought tolerance, making it crucial for food security in dry climates (Bekele, 2007). Pigeon peas contain 20-22% protein, 1.2% fat, 65% carbohydrate, and 3.8% ash (FAO, 1982). They are rich in crude fiber, minerals, and water-soluble vitamins like thiamine, riboflavin, and niacin (Saxena et al., 2010).

Turmeric (Curcuma longa), a rhizomatous herb from the ginger family, is known for its numerous medical benefits, primarily due to curcumin. Curcumin has antioxidant, anti-inflammatory, antimicrobial, and therapeutic properties (Rathore et al., 2020). It is used as a natural food colorant and functional ingredient in the food industry (Abd El-Hack et al., 2021). Curcumin also exhibits anti-cancer effects by suppressing angiogenesis and lymphangiogenesis, crucial for cancer metastasis (Chatterjee et al., 2021; Caban and Lewandowska, 2021).

Research on fortifying pasta with various non-traditional flours is extensive, but no studies have explored using both chickpea and pigeon pea flour fortified with curcumin in pasta. This research aims to develop pasta using a combination of these flours, fortified with curcumin powder. The high levels of methionine and cysteine in pigeon pea flour will balance the lack of sulfur-containing amino acids in chickpea flour, providing a more balanced amino acid profile.

Material and methods

Chickpea flour (Cicer arietinum L.), Pigeon pea flour [Cajanus cajan (L.) Huth],Turmeric (Curcuma longa)and salt (brand: Tata) were purchased from markets of Jalandhar, Punjab. The majority of the chemicals and additives utilized in this research study were of analytical grade quality and available from the university laboratory.

Preparation and Standardization of Pasta

The control pasta formulation consisted of 100g Chickpea flour, 0.4 g curcumin powder, and 0.5g salt. Ten different formulations were prepared by changing the ratio for chickpea flour and pigeon pea flour were 100:0 (control); 90:10; 80:20; 70:30; 65:35; 60:40; 55:45; 50:50; 45;55 and 40:60 w/w. Across all formulations, the amounts of curcumin and saltkept as that of the control.

Table 1:Different level of ingredients for standardization of pasta

Amount of flour			Other ingredients		
Treatments	**Chickpea flour (%)**	**Pigeon pea flour (%)**	**Curcumin (g)**	**Salt (mg)**	**Water (ml)**
T1	100	0	0.4	5	70
T2	90	10	0.4	5	70
T3	80	20	0.4	5	70
T4	70	30	0.4	5	70
T5	65	35	0.4	5	70
T6	60	40	0.4	5	70
T7	55	45	0.4	5	70
T8	50	50	0.4	5	70
T9	45	55	0.4	5	70
T10	40	60	0.4	5	70

Preparation of Pasta

Curcumin-infused pasta was prepared using a blend of chickpea and pigeon pea flours. Initially, chickpea and pigeon pea flour were weighed and thoroughly mixed in a large bowl to ensure uniform distribution.Curcumin was then added to the flour mixture at a concentration of 0.4 % by weight and the components were mixed again to achieve homogeneity.To this mixture, 70 ml of mildly heated water was added, while continuously stirring. The warm water helps activate the starches and proteins in the flours, aiding in the formation of a cohesive dough.The prepared dough was then loaded into an extruder fitted with a rigatoni shaped die. The dough was extruded through the die to form pasta of the desired shape. The extruded pasta was carefully collected and spread out in a single layer on drying trays. The drying process was carried out in a tray dryer, set to a temperature of 65°C. The pasta was dried for a duration of 4 hours to ensure that the moisture content was reduced to a safe level, preventing microbial growth and extended shelf-life. Proper drying is essential to achieve the desired texture and prevent spoilage. Once the drying process was complete, the pasta was allowed to cool to room temperature. The dried pasta was then stored in low-density polyethylene (LDPE) bags. These bags were selected for their barrier properties, which helps in protecting the pasta from moisture, oxygen and other environmental factors that could compromise its quality.

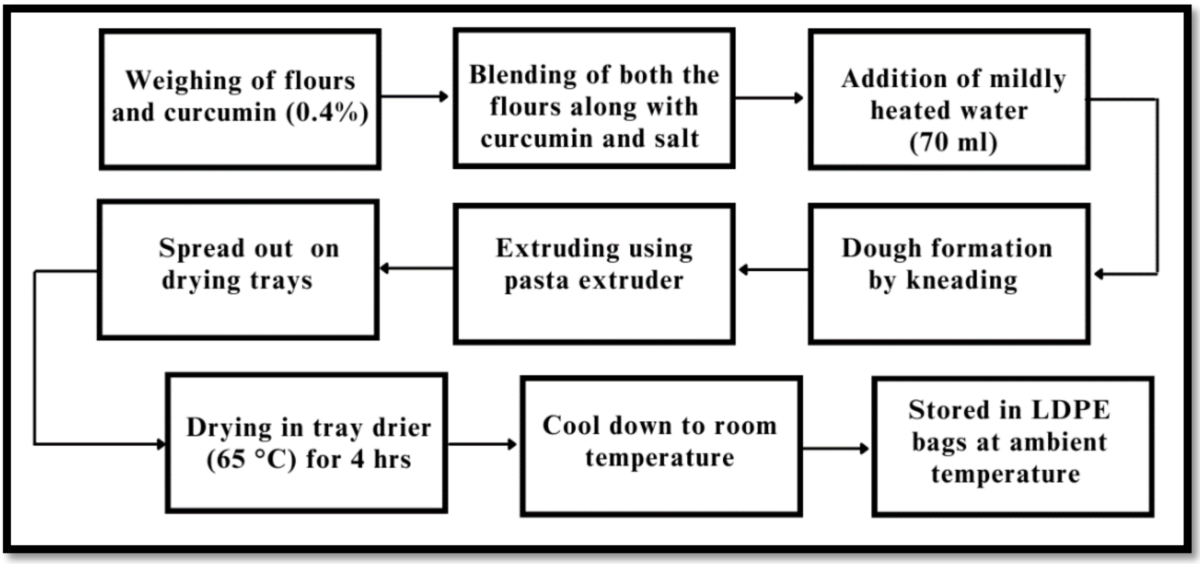


Fig 1: Flowchart for the preparation of curcumin-infused pasta using chickpea and pigeon pea flour

Sensory evaluation

The sensory evaluation was carried out by panelists using a 9-point hedonic scale from 1 to 9 (Mohite et al., 2020).A semi-trained panel of 10 members were participated in the evaluation of product on several sensory attributes including taste, flavour, colour, texture, mouthfeel, and overall acceptability. The panelists individually rated the product sample for each sensory attribute by selecting a number on the 9-point scale that best reflected their perception and preference level. Their scores were then compiled and analyzed statistically to determine the sensory profile and acceptability of the product.

Nutritional and qualitative analysis

Proximate Analysis

Moisture, ash, fat, crude fibre, protein, carbohydrate and energy value of pasta was determined as per method mentioned by the AOAC (2016).

Antioxidant activity

The antioxidant activity was analysed by DPPH method outlined in the AOAC guidelines from 2005. The results were calculated as a percentage of inhibition, calculated by applying:

$$\text{DPPH Inhibition percentage (\%)} = (A_0 - A_S)/A_0 \times 100$$

Moisture content

According to AOAC, 2005 moisture estimation involved taking a 10g sample and placing it in a Petri dish, which was then dried in an oven at 105°C until the weight of the dish and its contents became constant. Before each weighing, the Petri dish was cooled in a desiccator. The moisture content of the sample was expressed as grams per 100 grams of the sample, calculated using the formula:

$$\text{Moisture content on dry basis (\%)} = \frac{\text{Initial weight} - \text{Final weight}}{\text{Initial weight}} \times 100$$

Total plate count

The total plate count method is used to quantify the number of microorganisms, including mould, yeast and bacteria, present in a sample. Initially, the material is diluted until a concentration of 10^-5 is achieved. Then, 1 ml of this diluted sample is transferred into a 15-20 ml Petri dish for total microbial analysis. The material in the Petri dish is allowed to solidify, followed by incubation with the dish inverted in an incubator for 24-48 hours at 36 °C. After the incubation period, the colonies that have grown are counted and recorded (Arifan et al., 2019).

$$\text{Number of microorganisms} = \text{Number of colonies } \times \frac{1}{\text{dilution factor}}$$

Yeast & Mould count

Take 1 g of the pasta sample and thoroughly mix it with 9 ml of normal saline to create the first dilution. From this first dilution, transfer 1 ml into 9 ml of fresh normal saline in a test tube to create the second dilution. Repeat this process to prepare dilutions of 10^3, 10^5 and 10^7. Transfer 1 ml from each of the 10^3, 10^5 and 10^7 dilutions into separate sterile Petri dishes. Prepare acidified Potato Dextrose Agar (PDA) by adjusting melted and cooled (40-45°C) PDA to pH 3.5 with a 1% sterile tartaric acid solution (added at 1% of the PDA volume). Pour 10-15 ml (or 15-20 ml if using 10 ml of diluted sample) of the acidified PDA into each Petri dish containing the diluted samples. Swirl the dishes to mix the contents and allow the agar to solidify. Incubate the Petri dishes at 24-37°C for 3-4 days. After incubation, count the colonies that have formed. To calculate the total yeast and mold count, multiply the average number of colonies per plate by the dilution factor (Arifan et al., 2019).

$$\text{Yeast and mould } \left(\frac{\text{cfu}}{\text{ml}}\right) = \frac{\text{Numberofcolonycount Serial}}{\text{serial dilution}} \times 100$$

Storage

The prepared pasta was packed in LDPE pouch and stored at room temperature. Then open the pasta at 7 days interval to analyse and observe its physical parametersandfindthestoragestabilityofitupto28 days.Thechangesoccurredinthe character of pasta were noted and its storage stability were analysed.

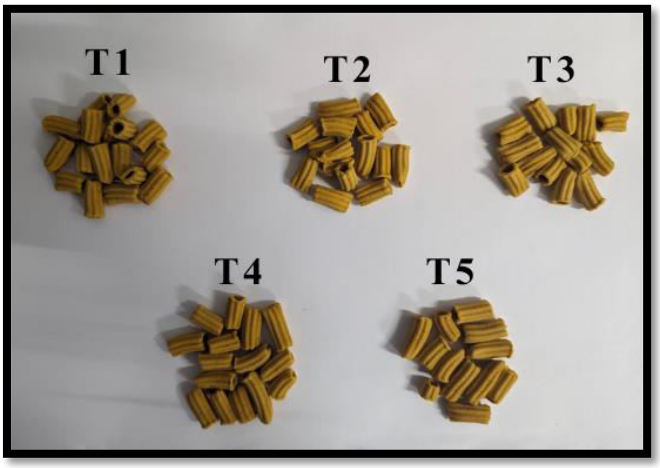
Results and discussion

Sensory evaluation

Table 2: Sensory evaluation chart of curcumin incorporated pasta using chickpea flour and pigeon pea flour

. No.	Treatment	Appearance	Colour	Texture	Taste	Mouth Feel	Overall Acceptability
1	T1	7.5	7.6	7.4	7.0	7.0	7.2
2	T2	8.0	8.2	7.9	7.7	7.7	7.8
3	T3	7.3	7.5	7.4	7.4	7.1	8.0
4	T4	8.2	8.1	8.3	8.2	8.3	8.4
5	T5	7.6	7.6	7.5	7.4	7.4	7.3
6	T6	8.1	7.8	7.5	7.4	7.4	7.3
7	T7	8.0	8.1	7.9	8.0	7.5	8.0
8	T8	8.7	8.6	8.5	8.2	8.6	8.5
9	T9	8.1	7.8	8.1	8.1	8.1	8.0
10	T10	8.4	8.2	8.5	8.2	8.4	8.7

The sensory evaluation of curcumin-infused pasta indicated that T10 was the most preferred formulation overall, scoring highest in texture (8.5), taste (8.2), mouthfeel (8.4), and overall acceptability (8.7). T10's superior performance across these parameters makes it the most promising treatment for further development and optimization due to its high acceptability and favorable sensory profile.



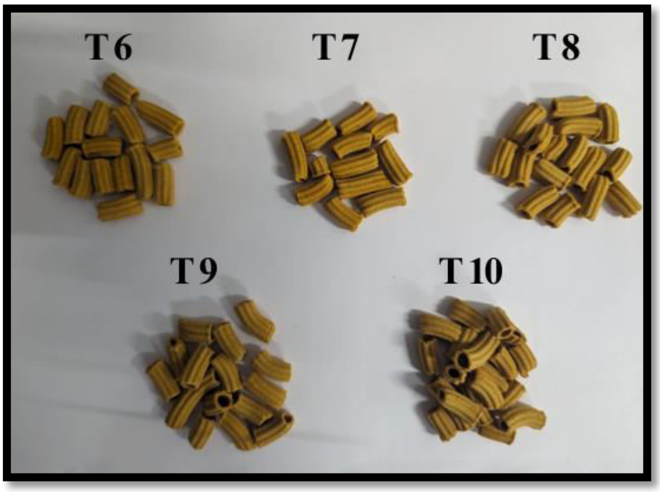


Fig 2:Curcumin incorporated pasta using chickpea and pigeon pea flour at different formulations

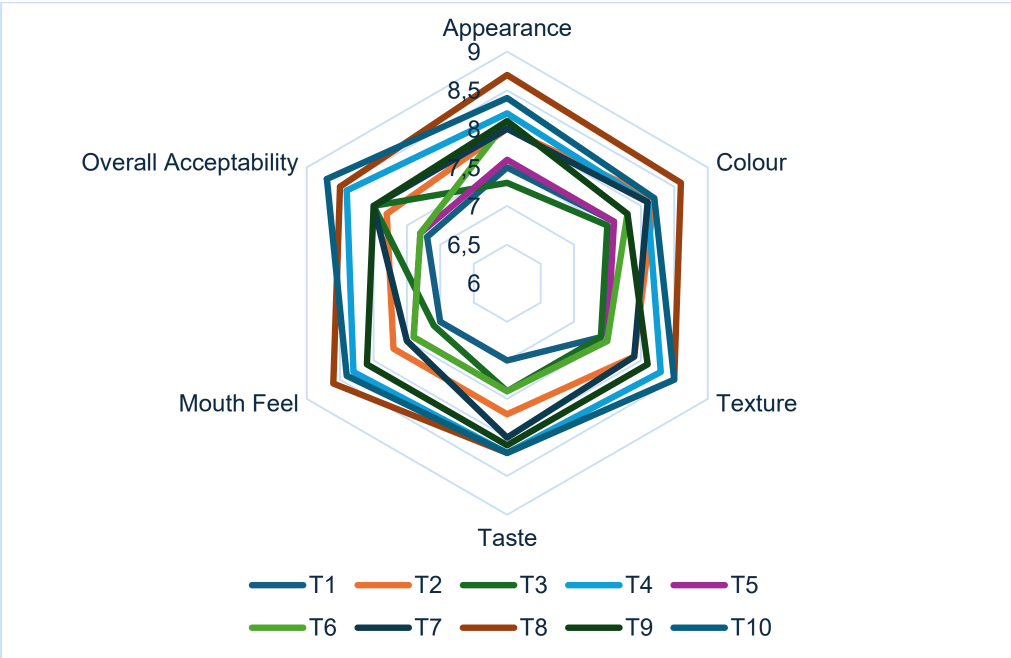


Fig 3:Graphical representation for sensory evaluation of pasta

Nutritional and qualitative analysis

Proximate analysis

Table 3 Proximate analysis of pasta at different treatments

Formulations	Moisture(%)	Ash(%)	Crude Fibre(%)	Fat(%)	Protein(%)	Carbohydrate(%)	Energy (Kcal)
T1	10.62	2.89	4.37	0.28	12.07	69.77	329.89
T2	10.95	3.16	4.28	0.39	12.10	69.12	328.38
T3	11.12	3.31	3.94	0.40	12.20	69.03	328.54
T4	11.08	3.44	3.71	0.30	12.23	69.24	328.58
T5	10.62	3.52	3.48	0.49	12.30	69.59	332.00
T6	10.92	3.63	3.25	0.44	12.37	69.39	330.99
T7	11.38	3.71	3.02	0.60	12.37	68.91	330.49
T8	11.15	3.87	2.79	0.64	12.43	69.18	332.24
T9	11.02	4.01	2.55	0.54	12.54	69.34	332.36
T10	11.18	4.19	2.30	0.70	12.83	68.80	332.83
C.D	0.44	0.09	0.27	0.05	0.13	0.54	2.06

Table 3 represents the proximate analysis variations across the different pasta treatments (T1-T10). Moisture content generally increased with higher proportions of pigeon pea flour, with T7 (11.38%) and T10 (11.18%) showing the highest values, suggesting a higher water retention capacity of pigeon pea flour. These values fall within the range reported by Asik et al. (2024) of 10.58% to 11.57%, indicating consistency with existing literature. Foschia et al. (2015) also found similar trends, attributing the moisture variation to the water-binding capacity of dietary fiber and proteins in legume flours. The ash content also increased with more pigeon pea flour, indicating a higher mineral content, with T10 having the highest ash content (4.19%), aligning with Kaur et al.'s (2012) range of 0.24% to 6.72%. Chinomso et al. (2017) and Wani et al. (2014) explained that pigeon pea flour's higher mineral content compared to chickpea flour contributes to this increase.Fat content followed a similar trend, with T10 (0.70%) and T8 (0.64%) exhibiting higher fat contents due to pigeon pea flour and curcumin's contribution, consistent with Slinkard's (2014) range of 0.25% to 0.96%. Torres et al. (2006) observed similar increases in fat content with higher proportions of pigeon pea flour in pasta formulations. Moreover, the lipophilic nature of curcumin, as noted by Sharifi-Rad et al. (2020), further contributes to the fat content.Crude fiber content decreased as pigeon pea flour increased, with T1 (4.37%) showing the highest fiber content, suggesting chickpea flour's higher fiber contribution. This trend is comparable to Maghaydah et al.'s (2024) range of 2.19% to 4.68%. The decrease in fiber content with higher pigeon pea flour ratios can be attributed to the lower fiber content in pigeon peas compared to chickpeas (Olalekan and

Bosede, 2010). Tiwari and Cummins (2021) also reported variations in fiber content based on the type and ratio of legumes used.Protein content increased with more pigeon pea flour, enhancing the overall protein quality due to complementary amino acid profiles, with T10 having the highest protein content (12.83%), within Sissons' (2022) range of 10% to 14%. Chickpea and pigeon pea flours have complementary amino acid profiles that enhance the overall protein quality when combined. Madurapperumage et al. (2021) and Babarinde et al. (2020) noted that blending these two flours provides a more balanced amino acid profile, improving nutritional quality.Carbohydrate content generally decreased with higher pigeon pea flour, with T1 having the highest carbohydrate content (69.77%), aligning with Garcia-Valle et al.'s (2021) range of 41.25% to 74.67%. Sachanarula et al. (2022) also reported lower carbohydrate content in samples with higher pigeon pea flour ratios. Energy values were influenced by carbohydrate and fat contents, with T10 having the highest energy value (332.83 Kcal) due to its high carbohydrate and fat content, while formulations with higher crude fiber had lower energy values. These values were comparable to those reported by Zarzycki et al. (2021), ensuring the validity of the product. The observed trends indicate that variations in composition, particularly carbohydrates and fats, significantly impact energy content, providing insights into formulating treatments based on desired energy levels and nutritional profiles. These trends align with existing literature, indicating consistency and validity in the formulations used in this study.

Antioxidant activity

Table 4: Antioxidant activity of pasta at different concentrations

S. No.	Treatments	Antioxidant activity (%)
1	T1	62.06
2	T2	63.31
3	T3	64.62
4	T4	64.11
5	T5	65.04
6	T6	66.85
7	T7	68.03
8	T8	69.40
9	T9	70.50
10	T10	72.08

The antioxidant content in pasta increased with higher pigeon pea flour percentages, owing to the inherent antioxidant properties of pigeon pea. Despite the high antioxidant activity of curcumin, its combination with pigeon pea flour further enhances the overall antioxidant content, offering additional health benefits such as reduced oxidative stress.

The proximate analysis of antioxidant content revealed significant variations due to the incorporation of legume flours and curcumin. Pigeon pea flour, known for its higher antioxidant capacity compared to chickpea flour, significantly contributed to the increased antioxidant content (Sekhon et al., 2017; Sharma et al., 2019). For instance, T1 (100% chickpea flour) had the lowest antioxidant content (62.06%), while T10 (40% chickpea flour and 60% pigeon pea flour) had the highest (72.08%). Intermediate treatments (T2-T9) showed progressive increases, consistent with Atuna et al. (2023) and Schettino et al. (2021).

Shelf-life and storage study

Moisture Content Analysis

Table 5: Moisture content analysis of pasta at different concentrations for a period of 28 days

Treatment	0th day	7th day	14th day	21th day	28th day
T1	10.62	10.75	10.83	10.96	11.05
T2	10.95	11.07	11.14	11.25	11.33
T3	11.12	11.23	11.35	11.41	11.52
T4	11.08	11.16	11.25	11.36	11.48
T5	10.62	10.74	10.85	10.97	11.12
T6	10.92	11.05	11.13	11.25	11.34
T7	11.38	11.46	11.55	11.64	11.75
T8	11.15	11.23	11.32	11.45	11.51
T9	11.02	11.15	11.22	11.31	11.43
T10	11.18	11.25	11.33	11.45	11.52

The moisture content of the pasta, initially ranging from 10.62% to 11.38%, increased slightly to between 11.05% and 11.75% by the 28th day, with treatment T7 reaching the highest level at 11.75%. This gradual increase is typical in pasta made with legume flours like chickpea and pigeon pea, known for their higher water absorption capacities compared to wheat flour (Bojnanska et al., 2021). The LDPE (low-density polyethylene) packaging used helps maintain moisture stability by acting as a barrier against environmental moisture and contaminants (Kibirkstis et al., 2022). Research by Singhal et al. (2016) suggests that such pasta products can maintain stable moisture levels over time due to the cohesive structure formed by legume proteins and starches, enhancing shelf-life. Overall, these factors contribute to the controlled moisture increase observed in the curcumin-infused pasta over its 28-day storage period, ensuring its quality and stability.

Microbial Count Analysis

Table 6: Microbial count of pasta at different concentrations for a period of 28 days

Treatment	0th day	7th day	14th day	21th day	28th day
T1	0.52×10^1	0.57×10^1	0.63×10^1	0.68×10^1	0.74×10^1
T2	0.54×10^1	0.59×10^1	0.65×10	0.70×10^1	0.76×10^1
T3	0.53×10^1	0.58×10^1	0.64×10	0.69×10^1	0.75×10^1
T4	0.55×10^1	0.60×10^1	0.66×10	0.71×10^1	0.77×10^1
T5	0.50×10^1	0.55×10^1	0.62×10^1	0.67×10^1	0.73×10^1
T6	0.51×10^1	0.56×10^1	0.63×10^1	0.68×10^1	0.74×10^1
T7	0.52×10^1	0.58×10^1	0.65×10^1	0.70×10^1	0.76×10^1
T8	0.53×10^1	0.59×10^1	0.66×10^1	0.71×10^1	0.77×10^1
T9	0.56×10^1	0.61×10^1	0.68×10^1	0.73×10^1	0.79×10^1
T10	0.55×10^1	0.60×10^1	0.67×10^1	0.72×10^1	0.78×10^1

Initially, the microbial load was low across all treatments, ranging from 0.50×10^1 CFU/g (T5) to 0.56×10^1 CFU/g (T9). Treatment T5 consistently showed the lowest counts: 0.55×10^1 CFU/g (7th day), 0.62×10^1 CFU/g (14th day), and 0.67×10^1 CFU/g (21st day). By the 28th day, microbial counts ranged from 0.73×10^1 to 0.79×10^1 CFU/g. This gradual increase in microbial count over time is typical due to natural microbial growth.

The controlled microbial increase observed over the 28-day storage period indicates that the curcumin-infused pasta was initially well-processed and packaged under sanitary conditions. Despite the slight increase, microbial counts remained within acceptable limits throughout the study period, suggesting effective inhibition of microbial growth. Curcumin, known for its antimicrobial properties against a broad spectrum of microorganisms (Hussain et al., 2022), likely contributed to this inhibition. Chickpea and pigeon pea flours, with inherent antimicrobial properties, further supported these findings.

The LDPE packaging used in this study played a critical role in maintaining microbial stability by creating a barrier against moisture and contaminants (Huang et al., 2019). This barrier effect helped create an unfavourable environment for microbial proliferation, thereby extending the product's shelf life.

In conclusion, the combination of curcumin infusion, antimicrobial properties of legume flours, and effective LDPE packaging contributed to the curcumin-infused pasta's stability over the 28-day storage period. Future research could explore additional natural preservatives and alternative packaging materials to further enhance microbial stability and overall product quality.

Yeast and Mould Count

Table 7: Yeast and Mould Count (cfu/ml) for pasta for a period of 28 days

Treatment	0th day	7th day	14th day	21th day	28th day
T1	0	0	0	0	0
T2	0	0	0	0	0
T3	0	0	0	0	0
T4	0	0	0	0	0
T5	0	0	0	0	0
T6	0	0	0	0	0
T7	0	0	0	0	0
T8	0	0	0	0	0
T9	0	0	0	0	0
T10	0	0	0	0	0

Throughout the 28-day storage period, no detectable yeast or mould growth was observed in any of the treatments (T1-T10) of the curcumin-infused pasta, highlighting the effective microbial inhibition facilitated by curcumin infusion. Curcumin, known for its broad-spectrum antimicrobial properties against bacteria, fungi, and yeasts (Adamczak et al., 2020), was complemented by the natural antimicrobial compounds present in chickpea and pigeon pea flours (Begum et al., 2023). The LDPE (low-density polyethylene) packaging used in the study played a critical role by creating a barrier against moisture and environmental contaminants, which are conducive to microbial growth (Marsh and Bugusu, 2007). This combined approach of curcumin infusion, legume flour properties, and LDPE packaging effectively maintained microbial stability, ensuring the absence of yeast and mould growth and preserving the quality and safety of the curcumin-infused pasta throughout the storage period.

Storage analysis of pasta

Sensory Analysis

Table 8: Sensory analysis of pasta at different concentration for a period of 28 days

Days	Observations
0^{th} day	No change in colour, odour, texture and taste
7^{th} day	No change in colour, odour, texture and taste
14^{th} day	No change in colour, odour, texture and taste
21^{th} day	No change in colour, odour, texture and taste
28^{th} day	Slight change in colour observed. No change in odour, taste and texture.

Conclusions

The sensory attributes (color, odor, texture, and taste) of the curcumin-infused pasta were evaluated over a 28-day storage period. No significant changes were noted in color, odor, texture, or taste up to the 21st day. On the 28th day, a slight change in color was observed, while the other sensory characteristics remained stable. This finding aligns with previous research on pasta enriched with legume flours, which also showed maintained sensory qualities over similar storage durations (Laleg et al., 2017; Vandarkuzhali and Sangeetha, 2015). The stability is attributed to the cohesive structure formed by legume flours in the pasta matrix, which helps preserve sensory attributes. The slight color change on the 28th day may be due to curcumin oxidation, as curcumin is sensitive to environmental factors like light, heat, and oxygen (Kharat et al., 2017). The use of LDPE packaging likely contributed to maintaining sensory stability by protecting the pasta from environmental conditions that could affect its quality (Marsh and Bugusu, 2017).

This investigation aimed to develop and evaluate curcumin-incorporated pasta using chickpea and pigeon pea flour to create a nutritious and visually appealing alternative to traditional pasta. By formulating ten different treatments with varying flour concentrations, the study identified T10 (40% CF + 60% PF) as the most promising, excelling in sensory attributes, nutritional balance, and antioxidant activity. T10 had the highest ash, fat, protein, and energy values but the lowest crude fiber content, while T1, with the highest crude fiber, offered an alternative for those prioritizing fiber intake. Shelf-life studies showed good stability with slight moisture increases and no microbial growth, thanks to LDPE packaging and the antimicrobial properties of the ingredients. Sensory attributes remained stable for up to 21 days, with minor color changes noted on the 28th day. Antioxidant activity increased with higher pigeon pea flour concentrations, with T10 showing the highest value. The gluten-free pasta, suitable for individuals with celiac disease, demonstrates the potential of curcumin, chickpea, and pigeon pea flours to create healthier and sustainable pasta products. Further optimization and alternative packaging solutions could enhance product longevity and maintain its nutritional integrity, contributing to the advancement of functional foods.

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