**Study on the Functional Properties of Pasta Incorporated with Corn Flour and Jackfruit Seed Flour**

**ABSTRACT**

Pasta is a cold extruded staple food of Italian origin. In the present study trials were conducted to develop a functional pasta by partial substitution of refined wheat flour with 10% corn flour and 10 to 20 percent jackfruit seed flour. The study examined the impact of replacing refined wheat flour with jackfruit seed flour on the functional properties of pasta. Cooking characteristics such as optimum cooking time, cooking loss, swelling index and functional properties such as water solubility index, water absorption capacity, bulk density was observed. Addition of jackfruit seed flour to the sample significantly changed the functional characteristics of the pasta. Cooking loss, swelling index, water solubility index and water absorption capacity were increased while optimum cooking time decreased. In case of bulk density, no significant difference was noted. Therefore, incorporation of jackfruit seed flour into pasta could be a promising way for developing protein-rich, high-quality pasta with improved nutritional and functional properties.

***Key words:*** *Jackfruit Seed Flour, Functional pasta, Cooking characteristics, Functional properties*

**INTRODUCTION**

According to Sudha *et al*. (2014) pasta is a type of noodle and staple food of traditional Italian cuisine. It is produced from unleavened dough of a durum wheat flour mixed with water and can be consumed after processing as fresh pasta or dried for future use (Fernandes *et al*., 2013). The pastas besides being good energy source due to high starch content provide dietary fiber, protein and lipids as essential fatty acids along with important micronutrients like vitamins, minerals, antioxidants and phytochemicals (Merina *et al*., 2020).

Replacement of wheat flour with other cereal flours and various functional ingredients improve the nutritional and functional properties of pasta. Wheat flour can be replaced by using corn flour. Corn flour has the potential to provide all needed amounts of vitamins and minerals. The low-fat content of corn flour reduces the chances of heart disease and obesity (Seema *et al*., 2016).

According to Roy *et al*. (2012) jackfruit seed flour can be blended with wheat flour to explore the potential of low-cost flour from jackfruit seed as an alternative raw material for bakery and confectionary products. It is not only a rich source of protein, starch and dietary fibres but also be regarded as an abundant yet cheap source of the said nutrients (Burkill, 1997). It also possesses phenolic compounds such as flavonoids and phenolic acids which exhibit strong antioxidant capacity (Soong and Barlow, 2004). Jackfruit seed flour acquire good functional property and hence can be used for domestic, commercial and industrial purposes.

The functional properties of extruded product vary with types of ingredients used for the preparation. The enrichment with 10% of red amaranthus as paste to jackfruit pasta formulations reduced cooking loss, improved the cooking quality characters, nutritional quality, and sensory attributes and produced naturally coloured pasta with higher consumer acceptability (Swathi *et al*., 2019). Hence, this study was taken up to investigate the changes in functional properties of corn flour and jackfruit seed flour incorporated pasta with refined wheat flour pasta.

**MATERIALS AND METHODS**

**Raw Materials**

The present study was carried out at the College of Food and Dairy Technology, Koduveli, Chennai, Tamilnadu. The raw materials selected for this study were refined wheat flour, corn flour and roasted jackfruit seed powder. The former two were procured from the local market in Chennai and the latter one from Valley Spices, Kerala. The other ingredients like Xanthan gum, salt and rice bran oil were purchased from the local market in Chennai.

**Formulation of Pasta**

Two combinations of pasta were formulated by incorporating the refined wheat flour, corn flour and jackfruit seed powder. For the preparation of pasta, the flours were mixed at different ratios as mentioned in Table1. The flour was supplemented with 1% xanthan gum, 45-50% water, 2% salt and 10% rice bran oil were also added. The mixture was kneaded for 15 minutes. The moist flour aggregate was placed in a metal extruder attachment of the pasta extruder machine (Model: La Monferrina- Mini Pasta Making machine) fitted with an adjustable die followed by cutting. After extrusion, steaming process carried out for 15 minutes for complete starch gelatinization. Then drying of steamed pasta was carried out in a solar dryer for about 5 hours (Raghu *et al*, 2022).

**Table 1:** Combination of ingredients used for the formulation of jackfruit seed flour incorporated pasta

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Sample** | **Refined Wheat Flour (g)** | **Corn Flour (g)** | **Jackfruit Seed Flour (g)** | **Xanthan Gum (g)** | **Water (ml)** | **Salt (g)** | **Rice Bran Oil (ml)** |
| Control | 100 | - | - | - | 35 | 2 | 8 |
| T1 | 80 | 10 | 10 | 1 | 48 | 2 | 10 |
| T2 | 70 | 10 | 20 | 1 | 50 | 2 | 10 |

**Functional Properties of Pasta**

**Cooking Characteristics**

The cooking quality of pasta in terms of optimal cooking time, swelling power and cooking loss were determined (AACC, 2000).

**Optimum Cooking Time**

Optimum cooking time was determined by cooking the pasta of 25 g in 100 ml of water. The product was cooked until the white line disappears and the time taken was noted. Pressing the cooked product in between two glass slides will test the end point (Gull *et al*., 2015).

**Cooking Loss**

Cooking loss is determined by evaporating the pasta water to dryness in hot air oven at 100°C. The initial weight and the dried weight were noted (Giuberti *et al*., 2015).

$$Cooking Loss \%= Dried residue in cooking water \left(g\right)$$

$$ Pasta weight before cooking \left(g\right) x 100$$

**Swelling Index**

One gram of the sample was dispensed into a calibrated 50 ml measuring cylinder. To the sample, 10 ml of distilled water was added and the volume was noted. The cylinder was left to stand undisturbed for about 1 hour. Volume occupied by the sample was recorded and the swelling capacity was calculated as outlined by Nwabueze and Anoruoh (2011).

$$Swelling Index= Volume occupied by the sample after swelling $$

$$Initial value occupied by the sample$$

**Water Solubility Index**

The Water solubility index was the weight of dry solids in the supernatant expressed as a percentage of the original weight of sample (Sharma *et al*., 2017).

$$Water Solubility Index \left(\%\right)= Weight of dry solids in supernatant x 100$$

$$Dry weight of extrudate$$

**Water Absorption Capacity**

It indicates the quantity of water absorbed by a known amount of sample while cooking. 300 ml of distilled water was boiled in a cooking pan and 30 g pasta sample was cooked in it for 4 min. The cooked pasta was drained and after 5 min, the surface moisture was removed with a blotting paper and the final weight of pasta was measured (Pakhare *et al*., 2017).

$$Water Absorption Capacity \left(g/g\right)= Weight of gel after removal of supernatant $$

$$Weight of the sample$$

**Bulk Density**

The bulk density was determined using the method by Park *et al*. (1993). A measuring cylinder was taken and completely filled with extruded product exactly to 100 ml marking. The weight of the product required to fill the measuring cylinder was recorded and the bulk density was determined using the following relationship.

$$Bulk Density \left(g/cm³\right)= Mass of extrudate $$

$$ Volume of extrudate $$

**Statistical Analysis**

Two treatments with a total of three trails were conducted and the data is subjected to statistical analysis. The means were compared using VETSTAT by Analysis of Variance (ANOVA).

**RESULTS AND DISCUSSION**



**Control Sample T1 Sample T2**

**Figure 1**: The functional dried pasta samples incorporated with jackfruit seed flour

**Table 2.** Functional properties of the cooked formulated pasta samples

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Properties** | **Control** | **T1** | **T2** | **F value** |
| Optimal Cooking Time (min) | 7.16 | 6.00 | 5.03 | 2066.88\*\* |
| Cooking Loss (%) | 5.64 | 7.83 | 9.28 | 1549.31\*\* |
| Swelling Index (%) | 2.67 | 3.71 | 4.95 | 3257.33\*\* |
| Water Solubility Index (%) | 3.42 | 4.01 | 4.79 | 654.73\*\* |
| Water Absorption Capacity (g/g) | 2.15 | 2.34 | 2.61 | 41.74\*\* |
| Bulk Density (g/ml) | 0.328 | 0.310 | 0.318 | 2.14NS |

**Optimal cooking time:** The results showed with an increase in the addition of jackfruit seed powder in noodles caused a highly significant reduction inthe optimal cooking time. The control sample takes a longer time to cook i.e., 7.16 min. This might be due to the high gelatinization temperature of the flours due to the possibility of lower starch content in the flours. Harmeet *et al*. (2023) also reported that the addition of JFSF from 6 to 24% caused a significant (p < 0.05) decline in the minimum cooking time.

**Cooking loss (%):** Cooking loss is recorded highest for T2 sample and a declining trend is observed with the least being in the case of the control sample i.e., 5.64%. This might be due to a reduction in flour binding agents (gluten) with increasing incorporation of the jackfruit seed powder. Additionally, there might be leaching of the soluble starch as well as other solid components that have caused a rise in the solid loss (or) cooking loss. Similar results were reported by Saha *et al.* (2021) in *Pithecellobium dulce* (Camachile) fruit powder in multi-grain pasta.

**Swelling Index**: As the addition of jackfruit seed powder increased, the swelling index also increased significantly high. Omeire *et al.* (2014) reported an increased swelling index in the noodles developed from wheat, acha and soybean flours. A high swelling index in the noodles has been reported as part of the criteria for a good quality product ([Achinewhu et al., 1998](https://www.sciencedirect.com/science/article/pii/S018972411530093X%22%20%5Cl%20%22bb0005)).

**Water solubility Index:** Addition of jackfruit seed flour increased the water solubility index of the pasta significantly and more value is observed in the T2 sample (4.79%). The increase in the values may be due to the high conversion rate of starch during processing. These results are par with the research done by Harmeet *et al*. (2023) using semolina and jackfruit seed flour.

**Water absorption capacity**: High significant differences (p > 0.05) were absorbed in the samples’ water absorption capacity. The T2 sample had the highest water absorption capacity (2.61 g/g) while the control sample recorded the lowest score (2.15 g/g). The water absorption capacity increased as the incorporation of jackfruit seed powder increased. This could be attributed to the protein content of the powder that denatured during heat processing which significantly influences the amount of water it can absorb. This is agreed with the findings of Timilsena *et al*. (2016) that increased porosity and also due to protein denaturation, starch gelatinization and raw fiber swelling during drying changes the orientation of residual amino acids. [Bhattachyra and Brakash (1994](https://www.sciencedirect.com/science/article/pii/S018972411530093X%22%20%5Cl%20%22bb0020)) also reported that denatured proteins bind more water.

**Bulk density**: The values of density ranged between 0.310 – 0.328 g/ml. No significant difference was noted among the bulk density values of the samples. Bulk density was lower in the noodle samples incorporated with jackfruit seed flour than in the control sample. The lower bulk density of these samples could result from the lower bulk density of jackfruit seed flour. Low bulk density is desirable in infant feeding (Iwe and Onadipe, 2001).

**CONCLUSION**

Pasta is a widely accepted convenience food around the world. In the present study, pasta was supplemented with corn flour and jackfruit seed flour which meets the nutritional requirements. Replacement of wheat flour with these ingredients improved the functional characteristics of pasta. The study revealed that incorporation of jackfruit seed flour affects both cooking characteristics and functional properties of pasta.

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