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Development of Gluten-Free Pasta *(Sevaiya)* Using Grape Pomace and Assessing its Quality And Acceptability

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Abstract. An increasing number of people is suffering from celiac disease world over including India which results in avoidance of gluten containing i.e. mainly wheat based products. In order to prevent nutritional problems resulting from that an urgent need was felt to develop suitable alternatives and enhance nutritional value of gluten free products which are likely to be deficient in fibre and micronutrients. The present study, therefore, aimed to develop gluten free pasta (GFP) using Grape Pomace (GP), solid remains of grape after extracting juice and to assess its quality and acceptability. Two variations of Indian Pasta-*sevaiya* were developed. Variation 1 and Variation 2 were made using rice flour and rice flour with Bengal gram flour respectively. Both were evaluated for sensory properties. The product made with rice flour had a higher score for acceptability and was selected for further study. Green and purple grape pomace was incorporated in the selected pasta. On the basis of higher acceptability score Pasta with Green Grape Pomace was used for further study. It was evaluated for the sensory properties, gluten content, nutritional properties, presence of flavonoids, microbial quality and shelf life in comparison with Gluten Free Pasta without addition of grape pomace. Pasta with and without Green pomace had comparable score for sensory evaluation. Nutritionally and microbiologically pasta with grape pomace showed better results. In conclusion, it can be said that Grape pomace, a waste by-product can be a good source of value addition for the gluten free products like pastas.

Keywords: celiac disease, Gluten Free Pasta, Pasta with Green Pomace, value addition.

1. Introduction

Pasta, a staple food of traditional Italian cuisine is an extruded product made up of wheat. Global food survey (2011) revealed that pasta is among the world's three favourite foods. Italian cuisine is gaining popularity in India. [1] Gluten is a protein found in wheat (80percent of total protein), barley, rye and spelt. It consists of 2 fractions- gliadin and glutenin. [2] However, consumption of gluten affects approximately 1 percent of individuals worldwide and 1 in 310 suffers from celiac disease in India. Gluten sensitivity (gluten intolerance) is a spectrum of disorders including celiac disease in which gluten has an adverse effect on the body. Symptoms include bloating, abdominal discomfort or pain, diarrhoea, constipation, muscular disturbances, headaches, migraines, severe acne, fatigue, and bone or joint pain. There is no cure for gluten sensitivity and the only treatment is to follow a gluten-free diet. [3]

Celiac disease is not only frequent in developed countries, but it is increasingly found in India. People with a gluten allergy should avoid wheat and related grains. Meat, fruits, vegetables, potato, and rice are some of the gluten-free foods. The enrichment of gluten-free products with dietary fibre seems to be necessary since it has been reported that celiac patients have generally a low intake of fibre due to their gluten-free diet. [4] Gluten free products generally lack fibre as compared to their wheat counterparts as they are made up of mostly starches. Therefore, fortification with dietary fibre is essential.

Grape pomace is the solid remains (waste by-product) of grapes after pressing for juice or oil. Over 60percent of the grape pomace dry matter is indigestible in vitro. This indigestible fraction is composed

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of dietary fiber (Non Starch Polysaccharides and lignin) as well as Condensed Tannins and Resistant Proteins. [5] These by- products can also be considered a cheap source for the extraction of antioxidant flavanols. Pomace also acts as a natural food preservative that possibly interferes with bacterial growth. It, therefore, may be used as a functional food ingredient for promoting human health and extending shelf-life of food products. [6] Extrusion processing can be used to increase procyanidin monomer and dimer contents in grape seed and pomace.

Extrusion products like pasta appear to be promising to increase levels of the bioactive low molecular weight procyanidins. [7] Hence, considering these benefits, in the present study an attempt was made to develop Gluten Free Pasta (GFP) to which grape pomace (GP) was incorporated in to enhance its nutritive value.

2. Methodology

2.1. Phase 1: Procurement of the Raw Ingredients and Testing

Materials: Rice flour (made from"Basmati" long grain variety of rice), Bengal Gram flour, Sodium alginate (KIMICA ALGIN I-3), Propylene glycol alginate (KIMILOID HVC) of good quality were obtained. Grape pomace (GP) was prepared by grinding grapes along with pulp, straining the juice and collecting the residue to be incorporated as Grape Pomace. The residue was kept in "KANDEE" dehydrator at 40 degree Celsius for 72 hours as described in the standardized method. [7]The dehydrated grape pomace was then scraped out and powdered in a grinder, weighed and was stored at -20 degree Celsius in the deep freezer, until further use. Grape pomace was made fresh as per the requirement. Approximately 1percent yield was obtained. A Standard Qualitative Test for presence of flavonoids in grape pomace was conducted.

2.2. Phase 2: Development of Gluten Free Pasta (GPF) and Testing

Two variations were developed. Variation 1 had Rice flour, Sodium alginate (1%) Propylene Glycol Alginate: (1 %), water (twice the proportion of rice), salt, and Rice Bran oil. (1.25%). Variation 2 had Rice and Bengal gram flour (75: 25) while all other ingredients were the same.

Method for development of Pasta.

- Raw ingredients were weighed. The rice flour, sodium alginate, propylene glycol alginate and salt were mixed in a vessel. For Variation 2, gram flour was mixed with the above mixture.
- Double the amount of water was added and the mixture was cooked on a slow flame until thickened.
- This mixture was kept in a steamer and steamed for 10 minutes.
- A steel plate was greased with oil and the mixture was extruded.
- The plate was then kept in "KANDEE" dehydrator at 50 degree Celsius for 6 hours.
- The weight of pasta after dehydration was recorded.
- Yield: 100 grams of rice flour gave 100 grams of dehydrated GFP.

Sensory Evaluation: Both Variation 1 and Variation 2 of GFP were cooked and evaluated. The sensory evaluation was conducted with 5- member trained panel using 7 point hedonic scale. The product was evaluated on variables such as overall appearance, taste, texture (firmness), odour and colour. A written consent was obtained from each panelist. A score card was used to assess the product. The most acceptable GFP was taken further for the following analysis.

Gluten Allergen Test: Gluten allergen testing of the GFP for the quantitative analysis of gluten was done by ELISA method.

Proximate Analysis: Moisture (Oven drying), fat (Soxhlet: IS: 7874-Part-I), protein (NX6.25: IS: 7874-Part-I) crude fibre (Acid-Alkali digestion), ash (muffle furnace), carbohydrates (by difference, IS: 7874 Part-I) and Kilocalories (Calculation: IS: 7874-Part –I) of the GFP were estimated using standard laboratory procedures.

Microbial Analysis: Yeast & Mold Count [YMC] and Total Plate Count [TPC] of the GFP were estimated using standard microbiological procedures.

Shelf Life Study: YMC and TPC were conducted on 1st and 5th day with GPF stored at room temperature in 2 packets made of two different packaging materials i.e. polyethylene and Triple aluminium laminate.

2.3. Phase 3: Optimizing the Level of Grape Pomace (GP) in the Gluten Free Pasta (GFP) and Conducting Various Tests

GFP was incorporated with green grape pomace (GFP-G) and purple grape pomace (GFP-P) at 15% and 5% level respectively. The better accepted product was used for further analytical procedures mentioned earlier.

2.4. Phase 4: Comparison of the Various Test Results of GFP with GFP-G or GFP-P

The GFP with and without GP were compared for sensory attributes, proximate principles, microbial test and shelf life study.

3. Results

3.1. Sensory Evaluation of Variation 1 and Variation 2

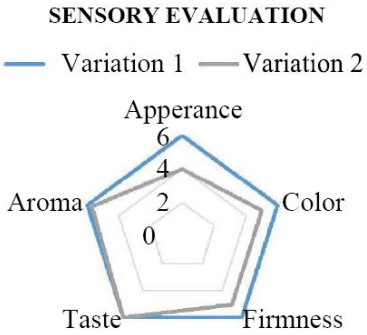

Fig. 1**:** Comparision of mean sensory evaluation scores of Variation 1 and Variation 2

As can be observed from the Fig. 1 Variation1 (Pasta with Rice flour) had a higher acceptability score than Variation 2(Pasta with Rice and Gram Flour) for most of the sensory parameters hence it was used for further analysis.

3.2. Gluten Test

Table 1: Gluten content in GFP

Test	Result	Standard (FDA)
Gluten Allergen Test	<10 ppm	<20 ppm

As observed from the Table 1 the gluten content in the GFP –Variation 1 was less than 10 ppm. Hence it could be labelled as a Gluten Free Product. [8]

3.3. Qualitative Test for Presence of Flavonoids in GFP

The qualitative test used to detect the presence of Flavonoids did not show presence of pale yellow colour which indicated the absence of flavonoids or flavonoids below the detectable level possibly due to heat related losses.

3.4. Sensory Evaluation of GFP-G and GFP-P

Overall, both the samples were given similar rating by the sensory panel for all the attributes. However, the acceptability score for GFP- G was higher as compared to GFP- P as observed in the Fig. 2 and higher amounts of GP (15%) could be incorporated in it Hence GFP- G was considered for further analysis.

Fig. 2: Comparison of mean sensory evaluation scores of GFP-G and GFP-P using 7 point hedonic scale

3.5. Gluten Test

Table 2: Gluten Content in GFP-G

Test	Result	Standard (FDA)
Gluten Allergen Test	<10 ppm	<20 ppm

As observed from the Table 2 even after addition of green grape pomace the gluten content of the pasta remained same and was less than 10 ppm.

3.6. Qualitative Test for Presence of Flavonoids in GFP-G

There was no development of pale yellow colour which indicated the absence of flavonoids. Flavonoids are the most abundant and widely studied, and have enjoyed greater attention in recent years among grape researchers in the last century. Research suggests that microwaving causes 97percent loss of flavonoids. Boiling caused 66 percent loss, high pressure boiling 47 percent and steaming had minimal effect. [9] Hence, it can be concluded that the flavonoids could have been lost from the GFP-G resulting in absence of pale yellow coloration in the test.

3.7. Comparing of the various test results of GFP v/s GFP-G

SENSORY EVALUATION

Table 3: Comparison of sensory evaluation scores of GFP and GFP-G

Attribute	**GFP**	**GFP-G**
Appearance	**5**	5.1
Colour	**6**	5.1
Firmness	**5.6**	5.3
Taste	**5**	5.3
Aroma	**5.6**	5.1
Total	**27.2**	25.9

As indicated under Table 3 the GFP-G and GFP were liked by the panelists. Although the total acceptability score was slightly higher for Gluten Free Pasta without grape pomace the difference was not significant. The colour of GFP-G became darker on addition with dehydrated green GP. Hence, as compared to white and clear GFP which was liked moderately by the panel, GFP-G scored lower. In a similar study conducted earlier it was observed that addition of pea fibre lowered the firmness of the cooked spaghetti. [10]Similarly, in the present study too an addition of grape pomace which contained fibre probably had led to a decrease in firmness of GFP-G as compared to GFP which did not contain pomace.The GFP and GFP-G were served with same pasta sauce to the sensory panel. GFP-G did not impart any undesirable odour. The lower scores of odour of GFP-G may be due to the psychological influence of the colour. Almost half of the panelists felt that all the three products, GFP, GFP-G and GFP-P developed were similar to ‘seviyan’- an Indian traditional extruded product.

3.8. Proximate Analysis

Table 4 indicates that the moisture content, protein content, ash content and carbohydrate content and calories were lower in GFP-G although the difference was not significant. The fat content and crude fibre were significantly higher in GFP- G(r=<0.05) as compared to GFP. In a study conducted by Peighambardoust and Aghamirzaei (2014) results indicated that increasing Grape Seed Powder in the flour blends resulted in a lowered moisture content and water activity in the final product resulting in an extended shelf life. [11] This may be the reason for lower moisture content of GFP-G than GFP in the present study. The fat content of GFP- G increased as grape pomace contains 7-12% of its dry matter as fat .The fibre content of GFP- G increased as grape pomace is a rich source of dietary fibre. [12]

Table 4: Comparision of proximate analysis

Test	**GFP**	**GFP-G**
Moisture %	10.35	9.96
Fat %	0.51	0.95
Protein (N x 6.25)%	7.88	7.25
Crude Fibre%	0.10	1.35
Ash%	1.96	1.76
Carbohydrates%	79.2	78.7
Calorific Value Kcal	353 kcal	352 kcal

3.9. Microbiological Analysis

Table 5: Comparision of microbial analysis of GFP and GFP-G on Day 1 and Day 5

Test	**GFP (Day 1)**	**GFP (Day 5)**	**GFP-G(Day1)**	**GFP-G(Day5)**
Yeast & Mould / g	< 100 cfu/g	25 cfu/g	<100 cfu/g	<100 cfu/g
Total Plate Count/ g	900 cfu/g	67000 cfu/g	<100 cfu/g	<100 cfu/g

Table No.5 compares Total Plate Count and Yeast and Mold Count for prepackaged Gluten Free Pasta with and without Grape Pomace on 1st and 5th day respectively.

Day 1: The results showed that YMC for both GFP and GFP-G on day 1 was < 100 cfu/gi.e. within acceptable limit.

Day 5: (polythene package): The TPC was significantly higher in GFP than GFP-G. YMC was <100 for both, GFP and GFP-G. (Aluminium Laminate): The TPC was higher in GFP than GFP-G. YMC was <100 for both, GFP and GFP-G. Both the packages gave similar results. The lower TPC of GFP-G could possibly be due to antimicrobial effects of GP.

Table 6: Microbial Analysis of GFP packed in Polythene and Triple laminate on day 5

Test	**Polythene Package**	**Triple Laminate Package**	**Maximum**
Yeast & Mould count / g	25 cfu/g	<10 cfu/g	10^5 cfu/g (11)
Total Plate Count/ g	67000 cfu/g	2500 cfu/g	10^6 cfu/g (12)

Table 6 shows a comparative result of microbial analysis of Gluten Free Pasta packed in Polyehylene and Triple Laminate bags. The result clearly indicates better barrier properties of Triple Laminate over Polyethylene packaging material.

4. Conclusion

In conclusion it can be said that addition of grape pomace to Gluten Free Pasta is a good way of value addition to Indian pasta and is well accepted organoleptically in comparison with one without addition of the same. In addition, an increase in fibre content and extension of shelf life of GFP was possible by incorporation of Green grape pomace.

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