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DEVELOPMENT AND QUALITY CHARACTERIZATION OF PASTA CONTAINING AMARANTH FLOUR

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Development of nutritionally superior inexpensive food and acceptable to intended consumer is the biggest challenge of the present time. The present investigation was designed to develop high protein product by incorporation of amaranth flour. Amaranth flour was incorporate in the ratio of 10, 20 and 30% in the wheat flour. The higher score of overall acceptability was 7.74 for 10% sample after control and the minimum as 7.32 for the 30% amaranth flour pasta. Considering the results obtained and characteristics of flour used, the amaranth flour addition up to 30% is evident to improve some nutritional properties and 10% for sensory characteristic. Results also showed significant increase ($P<0.05$) in the pasta firmness (1469.5 g to1721.7 g) when compared with control (1389.8). In this research it was analyzed that the different amount of amaranth flour plays an important role in pasta making by enhancing nutritional parameters and overall product quality.

Keywords: Amaranth, Physico-chemical properties, Quality parameter, Sensory characteristics, Texture profile analysis

INTRODUCTION

In the present scenario the demand of nutritionally enriched foods are increasing day by day which is not only to satisfy hunger but also prevent nutrition related diseases and improve mental and physical health of human beings (Menrad, 2003). Pasta is a versatile, nutritious, economical, and increasingly internationally accepted food. Made from durum wheat semolina or from the flour of other grains mixed with water and/ or eggs, pasta is nutritious by itself, mixed with other healthful foods like olive oil, tomato sauce, vegetables, beans and lean meats. It is a key ingredient of healthy traditional eating plans around the world. Pasta has a good nutritional profile providing a source of complex carbohydrates and it has a good consumer value. Pasta provides complex carbohydrates that is digested slowly and provides a slower release of energy throughout the day to keep you going. It is easy to cook and can be used in variety of meals (Marchylo and Dexter, 2001). Pasta has a high rate of acceptability because it is a readily available, versatile, and inexpensive food. The simplicity of the pasta production, in addition to its ease of handling and storage stability, facilitated its popularity and wide consumption around the world (Chillo *et al.,* 2008). According to Kill (2001a), creating good quality pasta relies on three crucial factors: raw material, mixing and production, and drying. The drying is carefully regulated, as very rapid drying may result in cracking and very slow drying may produce stretching or encourage the growth of mold or of organisms that produce souring. The two key components in pasta manufacturing are the gluten proteins and starch (Johnston, 2001). Wheat semolina is highly suitable for making pasta because its proteins are ideal for dough development and for preventing pasta disintegration during cooking. However, wheat pasta is nutritionally unbalanced due to its

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low protein content (<15%) and relatively deficient levels of the essential amino acid lysine (Shogren *et al.*, 2006). The objective of this study was to determine physio-chemical properties and sensory attributes of multigrain pasta made with wheat flours and semolina partially replaced by amaranth flours. Amaranth has recently become a focus of interest for its high nutritive values. Nutritionally, amaranth grains have higher protein content, higher digestibility, higher protein utilization, and a higher protein efficiency ratio than traditional cereals such as corn and wheat (Salcedo Chavez *et al.*, 2002). The amaranth flour was added to increase the nutritional properties of pasta.

MATERIALS AND METHODS

Raw material required for making pasta like, edible grade whole wheat flour, semolina and amaranth flour were purchased from local market. All the experiments were carried out in the laboratories of Institute of Food Technology (A Center of Excellence), Bundelkhand University, Jhansi (UP) India. On the basis of trials, experiments were conducted on pasta with fortification of wheat flour, samolina with amaranth flour in different proportion (10, 20 and 30%).

Preparation of Amaranth Fortified Pasta

Pasta was made with whole wheat flour and amaranth flour in combinations. First ingredients of first combination were put in the mixing of pasta machine and desired amount of water was added and mix properly till the dough was formed. For proper formation of dough mixing was continuous around 20 to 25 minutes for various blends. Then the operation mode was shifting from kneaded position to extruded position. During this step the kneaded material was forced exit through a die having holes desired shapes. The length of extruded pasta was adjusted by a cutting blades attached to the machine. As fresh extruded pasta were having high moisture. They were dried in a hot air oven set at 65 ºC which took 4 hours for proper drying. The dried pasta sample were packed in air tight polythene for further analysis.

MANUFACTURE OF PASTA THROUGH EXTRUSION METHOD

Table 1: xxxxxxxxxxxxxxxxx

Samples	Ranking for Further Study
Control	A1
10% amaranth flour	A2
20% amaranth flour	A3
30% amaranth flour	A4

Figure 1: Flow Chart of Pasta Making Process

Weighting of 700 g of whole wheat flour and 300 g of semolina
↓
Kneading of flour in the pasta maker
↓
Add 300 m1 of water within 2 minutes of mixing
↓
After 20 to 25 minutes of kneading changes the mode to extrusion
↓
pasta comes out of die and cut through the blades inside the die
↓
Keep the wet pasta for drying at 65º to 70 ºC
↓
After 3 to 4 hour pasta becomes crispier than before
↓
Packed in high density polyethylene bags for storage

Figure 2: Control Sample

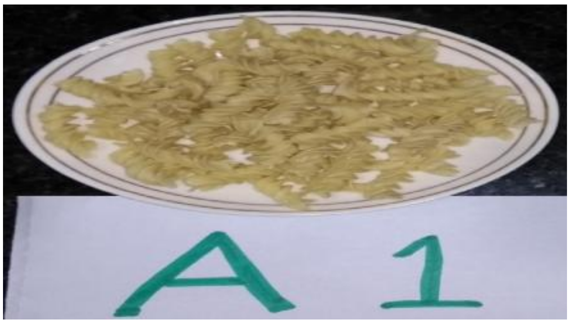


Figure 3: 10% Amaranth Flour Sample

Figure 4: 20% Amaranth Flour

Figure 5: 30% Amaranth Flour

Determination of the Physico-Chemical Composition

The moisture content was determined by **I.S.I. 1984** method. The crude protein content in raw material and pasta samples were determined by the kjeldahl method. Fat levels were determined by soxhlet apparatus and ash by incineration in muffle at 550°C. Carbohydrates were determined by calculating the difference (AOAC, 1984). All the determinations were performed in triplicate.

Texture Analysis

Texture was analyzed objectively with a stable Micro-system Texture Analyzer (model TAXT2i). A cutting probe was used in conjunction with a texture analyzer (Bourne, 1982). Pasta samples were cut at 5 mm distance. Pre-test speed was set to 2 mm/s, a test speed of 2 mm/s, and post-test speed of 5 mm/s. The absolute peak force was considered as the hardness of the product. Three samples were used for texture analysis and the results were recorded as an average.

Cooking Time

10 grams of pasta were added to the 150 ml boiling water. Cooking water was stirred occasionally and after each 30 seconds pasta was removed from water than squeezed between two pieces of clear, clean plastic. The pasta considered cooked when the observed white core had disappeared after the pasta pressed between two plastic. Cooking time was determined by using Approved Method 66-50 (AACC, 1992).

Pasta Diameter

10 random uncooked pasta samples were measured as diameter and the result averaged. Cooked pasta diameter was measured as above with measurements and calculations made for samples taken at optimum cooking time and after 5 min of over cooking (Del Nobile *et al.*, 2005).

Cooking Loss

Cooking loss is weight of total solids recovered after evaporating the water used for cooking pasta. 20 g of pasta sample was weighed and placed in boiling water at a 1:10 (W/V) ratio (Del Nobile *et al.*, 2005). After cooking, samples were drained and washed three times with 20 ml water at 20 °C. All the water utilized (cooking and wash water) was combined and placed in an oven at 105 °C for drying.

Water Sorption Test

10 g pasta sample was hydrated in 500 ml hot water for 10 min in a covered container, drained for 10 min and weighed. Absorbed water was calculated as product weight increase and expressed as a percentage of dry sample weight (Sadegui and Bhagya, 2008).

Sensory and Statistical Analysis

Sensory analysis was carried out by ten semi-trained and un-trained panelists. All the pasta samples were coded with random three digit number. The panelists evaluated all four samples using a 9-point hedonic scale with 1 being "disliked extremely" and 9 being "liked extremely". Based on 9-point hedonic scale, the panel members were asked to give their scores on 5 attributes namely, colour, flavour, texture, taste and overall acceptability (Srilakshami, 2007). The statistical analyses were performed using the SPSS version 16.0. For the nutritive composition and physical properties, descriptive statistics (means and standard deviations), and analysis of variance (ANOVA) were used to determine differences among the samples.

RESULTS AND DISCUSSION

The present investigation was envisaged to develop highly nutritious pasta. Raw material and the blends of whole wheat flour, semolina and amaranth were analyzed for physico-chemical characteristic and sensory attributes.

Proximate Analysis of Raw Materials and Pasta Products

The results obtained from the analysis of the materials and products are shown in Table 2. The value for moisture content in whole wheat flour and semolina in the investigation were 8.04 and 12.5, respectively. The moisture content in wheat flour was found in the similar range (6.6 to 11.30%) as reported by Bain and Irvin (1965). The moisture content in the amaranth flour was 8.7%. Result presented in Table 2 showed that the carbohydrate content in amaranth flour is minimum that is 69.93%. The similar results (69-70.6%) were reported by Nazni and Durgadevi (2012) in amaranth brains flour incorporated chapattis. The protein content in whole wheat flour and semolina in the present investigation were 9.3 and 11.6%, respectively. Finney *et al.* (1949) reported protein content in wheat flour in the range of 8.0 to 15.6%. The results in the table indicate that protein, fat and ash content in amaranth flour were 13.36, 5.47 and 2.45%, respectively. All these values were close to the values reported by Bressani (1990).

Addition of amaranth flour on wheat flour with semolina significantly increased the amount of protein, fat and ash. On the contrary it decreased the amount of moisture and carbohydrates. Similar result reported by Bahnassey and Khan (1986), Shimelis and Martha (2012) and Kaur *et al.* (2013). There was significant difference in the moisture contents of the pasta samples which ranged from 6.13 to 8.63 (Table 3). The mean observed values of protein for pasta products ranged from 8.03 to 11.57% indicating an increase in protein content with the increased amount of amaranth flour. Similar protein results were found by Chillo *et al.* (2008) on fresh pasta made from amaranth flour (12.2%), and pasta with amaranth flour and chickpea flour (13.86).

Table 2: Physio-Chemical Composition of Raw Materials

Sample	Moisture	Ash	Fat	Protein	Carbohydrate
Wheat flour	8.40±0.26	1.47±0.58	1.83±0.06	9.03±0.30	79.27±0.25
Semolina	12.93±0.35	0.67±0.46	0.67±0.06	11.60±0.36	74.13±0.90
Amaranth flour	8.77±0.58	2.45±0.06	5.47±0.25	13.36±0.41	69.93±0.90
SE±	0.74	0.27	0.72	0.64	1.37
F ratio	108.36*	33.27*	805.76*	107.72*	115.68*

Note: All value were represented as Mean±SD (standard deviation) n = 3; * means Significant; and ** means non-significant; data were analyzed by mean using SPSS 16.0 software.

Table 3: Proximate Composition of Prepared Pasta Containing Amaranth Flour

Sample	Moisture	Ash	Fat	Protein	Carbohydrate
A1	8.63±0.25	0.70±0.10	0.13±0.06	8.03±0.20	82.50±0.44
A2	6.60±0.17	1.37±0.15	0.33±0.06	9.33±0.23	82.37±0.47
A3	6.60±0.17	1.83±0.23	0.40±0.00	10.30±0.20	81.00±0.17
A4	6.13±0.31	2.24±0.10	0.43±0.56	11.57±0.21	76.53±0.23
SE±	0.3	0.18	0.04	0.39	0.73
F ratio	69.02*	54.11*	21.67*	149.11*	188.69*

Note: All value were represented as Mean±SD (standard deviation) n = 3; * means Significant; data were analyzed by mean using SPSS 16.0 software.

The fat and ash content also assumed the same trend as the protein, due to the same reason while the carbohydrate decreased with the increasing level of amaranth flour. Nutritionally, amaranth grains have higher protein content, higher digestibility, higher protein utilization and a higher protein efficiency ratio than traditional cereals such as corn and wheat (Salecolwchavez *et al.*, 2002).

Texture Profile Analysis of Prepared Pasta Sample

The firmness of pasta samples was measured by using a texture analyzer model (TA-XT2i). The result reported are the averaged of three readings.

Figure 6: [A1]

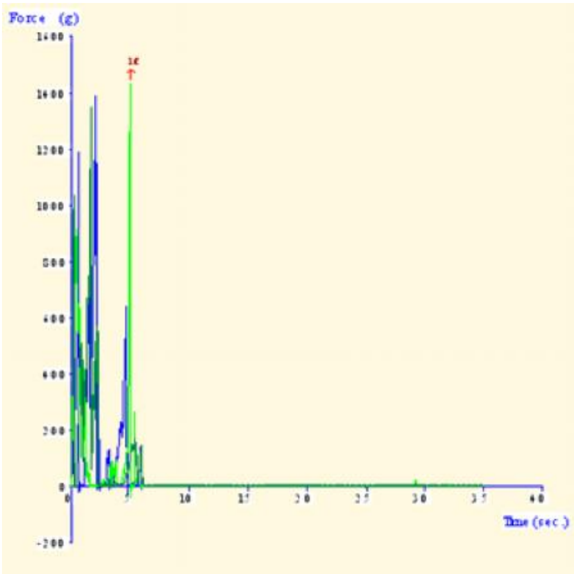


Table 4: TPA Values of Pasta Products

Sample	Pasta Cutting Force
A1	1389.8±42.56
A2	1469.5±33.24
A3	1573.3±121.51
A4	1721.7±193.95
SD±	47.31
F Value	4.458*

Note: All value were represented as Mean±SD (standard deviation) n = 3; * means Significant; data were analyzed by mean using SPSS 16.0 software.

The result showed in these figures (Figures A1, A2, A3 and A4) are the averaged of three readings. The present study reported that addition of amaranth flour results in a significant ($P<0.05$) increase in the pasta firmness (1469.5 to1721.7) when compared with control (1389.8). Bahnassey and Khan (1986) also reported the similar result in pasta fortified by legume flour.

Figure 7: [A2]

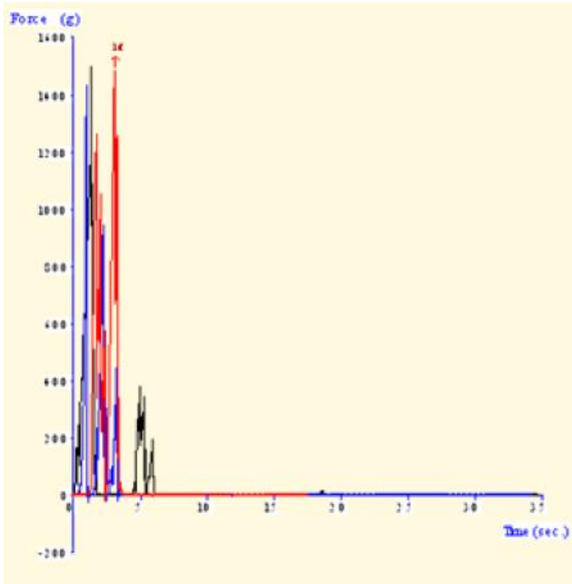


Figure 8: [A3]

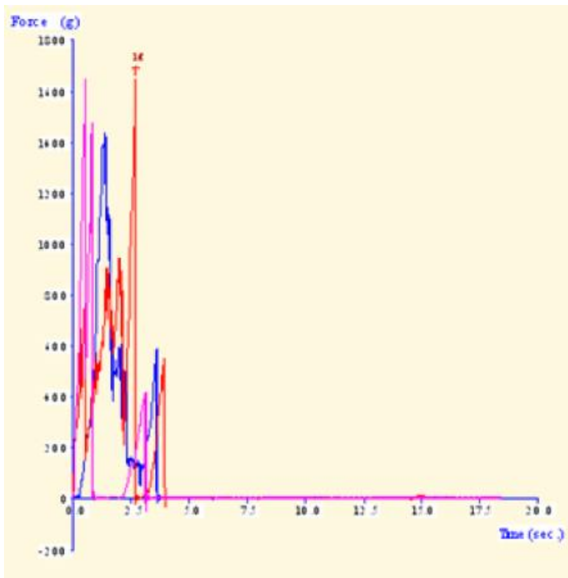
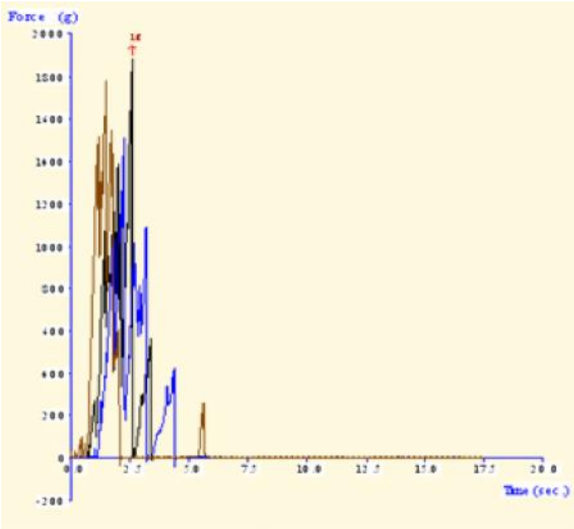


Figure 9: [A4]



Cooking Quality of Pasta

Cooking time of pasta samples were significantly decreased as compare to control sample where the addition of amaranth flour led to decrease in cooking time. Cooking loss is defined as a weight of the total solids lost in the cooking water. It is reported in table 5 that cooking loss is significantly increasing in all the samples. Increasing cooking loss is due to high protein content which cause pasta structure to become more porous and because of this compound such as starches, minerals and protein enter the cooking water leave the pasta that is not desirable (Maira Rubi Segura-Campos *et al.*, 2014). Water absorption and cooked pasta diameter is also increased with the addition of amaranth flour in the samples.

Sensory Characteristics of Prepared Pasta

The four samples were obtained from the different amount

Table 5: Cooking Quality of Pasta

Sample	OCT (min)	Pasta Diameter (mm)		Cooking Loss (%)	Water Absorption (%)
		Uncooked	Cooked		
A1	3.35±0.06	10.50±0.00	11.50±0.00	1.99±0.05	83.57±0.15
A2	2.40±0.03	10.40±0.00	11.70±0.00	2.50±0.10	88.23±1.03
A3	2.28±0.03	10.30±0.00	12.53±0.56	2.97±0.21	89.67±0.12
A4	2.14±0.04	10.23±0.56	13.33±0.56	3.49±0.14	94.23±2.25
SE±	0.14	0.03	0.21	0.17	4.11
F Value	520.7*	49.00*	127.1*	66.08*	37.71*

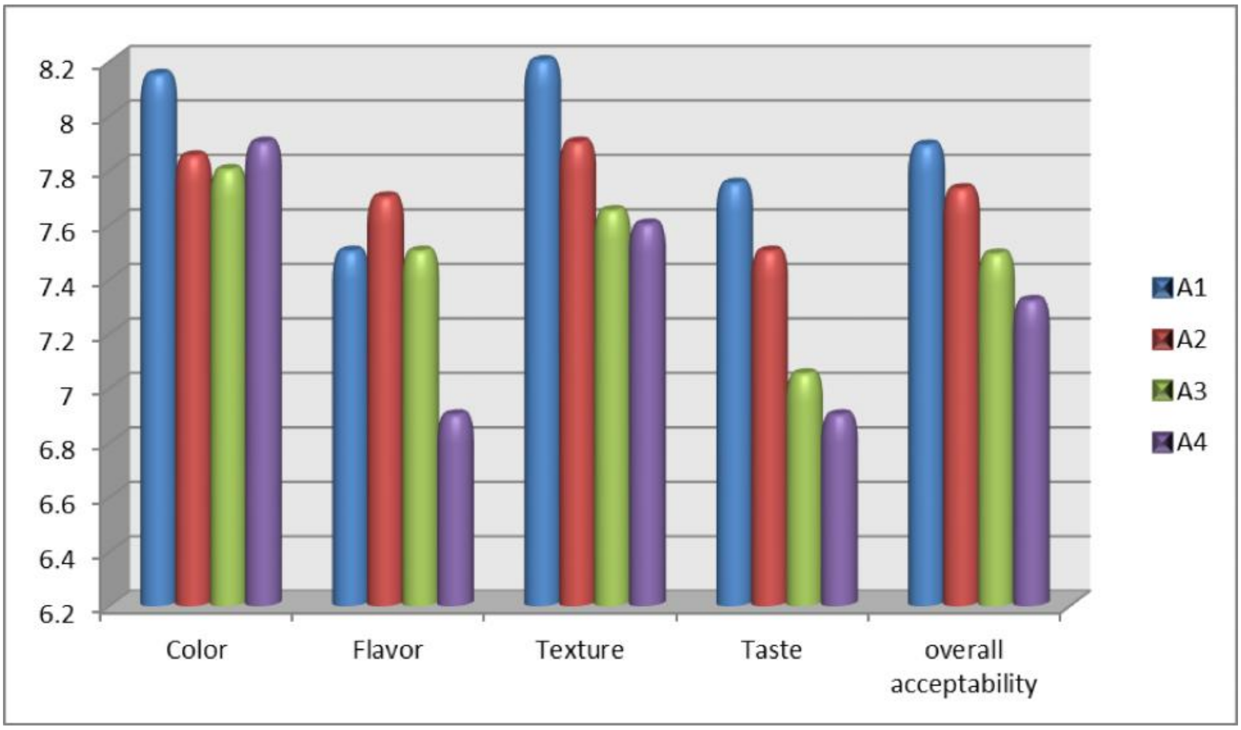
Note: OCT - Optimum cooking time.

Table 6: Mean Sensory Evaluation Values for Prepared Pasta with Amaranth Flour

Sample	Color	Flavor	Texture	Taste	Overall Acceptability
A1	8.15 ±0.67	7.50±0.71	8.20±0.67	7.75±0.42	7.90±0.47
A2	7.85±0.67	7.70±0.98	7.90±0.88	7.50±0.75	7.74±0.47
A3	7.80±1.14	7.50±0.75	7.65±0.58	7.05±0.60	7.50±0.54
A4	7.90±0.70	6.90±0.99	7.60±0.74	6.90±0.99	7.32±0.71
SE±	0.13	0.14	0.12	0.12	0.91
F ratio	0.362**	1.600**	1.439**	2.976*	2.085**

Note: Results are mean±SD of sensory analysis score cards. * The mean difference is significant at the 0.05 (5%) level. ** Non-significant at 5%.

Figure 10: Graphical Representation of Sensory Attributes Values



of amaranth flour, whole wheat flour and semolina. These samples were evaluated for various quality attributes; colour, flavour, texture, taste and overall acceptability using 9 point hedonic rating scale and scores obtained was presented in Table 6.

It could be concluded from the overall results that the overall acceptability decreased with the addition of amaranth flour but it's created a positive influence on product quality and consumer's acceptance. The 10% amaranth flour incorporation was accepted by the panelist as it get highest OAA in compared to other samples, though the 30% incorporated amaranth flour had a better nutritional quality, the two factors can be combined to obtain an acceptable and nutritious product. Moreover, addition of amaranth flour on wheat flour significantly reduced the sensory acceptability of pasta.

CONCLUSION

Normally pasta is considered as less nutritive product since it contains high carbohydrate and lack of protein, minerals in term of both quality and quantity. The present investigation was envisaged to develop standardize process of fortified pasta by substituting normal pasta ingredient with amaranth flour to improve the quality of pasta. Flour analysis revealed that amaranth flour had better nutrients than semolina and wheat flour in physico-chemical composition. Due to which significant increase in protein by addition of amaranth flour was observed. Pasta prepared from amaranth flour contained higher level of protein 9.33, 10.30 and 11.57 and may offer the inherent benefits of amaranth flour to the consumer. Cooking quality of pasta was found acceptable in the samples containing amaranth. The sensory quality of the final products revealed that the use of amaranth as improvement agents is well suited in pasta making and resultant pasta can be used for patients suffering with life style diseases.

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