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Physio-Chemical and Sensory Characteristics of Pasta Fortified With Chickpea Flour and Defatted Soy Flour

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***Abstract: Pasta** is a popular carbohydrate based food because of its low glycaemic index (GI) and ease of preparation, its low GI can be attributed to its specific structure. Effects of fortification of pasta with the combination of chickpea flourand defatted soy flour at different levels were assessed on the nutritional, sensory and cooking quality of the pasta. The fortification of durum wheat semolina was done by the combination of chickpea flour and defatted soy flour at levels (0,0)% containing only semolina as control, (10,6)%, (14,10)%, (18,14)% respectively. A novel legume fortified pasta product was successfully produced and it was observed as the concentration of legumes was increased the cooking time also increased. The cooking quality of the pasta was enhanced by steaming. On the basis of cooking and sensory quality, pasta containing 14% chickpea flour and 10% defatted soy flour resulted in better quality and nutritious pasta.*
***Keywords: Pasta**, Cooking quality, Sensory quality, Protein supplementation*

I. Introduction

Pasta is a staple food of traditional Italian cuisine, now renowned worldwide. It takes the form of unleavened dough, mostly of durum wheat, rarely buckwheat flour, water and sometimes eggs. Pasta comes in a variety of different shapes that serve for both decoration and to act as a carrier for the different types of sauce. Pasta also include varieties, such as ravioli and tortellini that are filled with other ingredients, such as ground meat or cheese (Serventi and Sabban 2002). Pasta products, traditionally manufactured from durum wheat semolina, known to be the best raw material suitable for pasta production (Feillet and Dexter 1996). Pasta is a source of carbohydrates (74–77%, dry basis) whose interest is increasing due to its nutritional properties, particularly its low glycaemic index (GI) (Monge et al 1990). Pasta also contains 11–15% (db) proteins but is deficient in lysine and threonine (the first and second limiting amino acids), common to most cereal products (Abdel-Aal and Hucl 2002; Kies and Fox 1970). This provides an opportunity for the use of non-traditional raw materials to increase the nutritional quality of pasta (Del Nobile et al. 2008). Among these non-traditional raw materials, legumes represent an interesting source of proteins, fibres, vitamins and minerals. Legume proteins are relatively low in sulphur-containing amino acids, methionine, cysteine and tryptophan, but high in lysine. Consequently, legumes and cereals are nutritionally complementary (Duranti 2006).

Although pasta products were first introduced in Italy in the 13th century, efficient manufacturing equipment and high-quality ingredients have been available only since the 20th century (Agnesi E. 1996). Prior to the industrial revolution, most pasta products were made by hand in small shops. Today, mostly pasta is manufactured by continuous, high capacity extruders, which operate on the auger extrusion principle in which kneading and extrusion are performed in a single operation. Due to the nutritional advantages and along with the appeal of pasta amongst consumers, have made this food product a potential vehicle for neutraceuticals, such as vitamins or polyunsaturated fatty acids (Verardo V. et al. 2009). In fact, pasta was one of the first foods for which USFDA permitted vitamin and iron enrichment in 1940's (Marconi E. and Carcea M. 2001). AmudhaSenthil, Bhat et al. (2002), blended wheat flour and defatted soya flour in the ratio of 65:20, 60:25, 55:30 and 45:40, were studied in respect of dough characteristics and quality of fried savoury and sweet snacks prepared from them. Farinograph characteristics of flour blends showed that as the proportion of soya flour increased there was a slight increase in water absorption and decrease in dough stability.Prabhashankar et al. (2007) studied the influence of whey protein concentrate on the quality of vermicelli and found that addition of WPC at 5% level increased the protein valve of pasta. Limroongreungrat and Huang (2007) studied that alkaline treated sweet potato flour could be used as an alternative ingredient in the preparation of nutritious pasta. Depigmentation of pearl millet was carried out by Rathi et al. (2004) to use in the preparation of pasta. Their results indicate that depigmentation was an effective process technique to develop acceptable pearl millet products having improved invitro protein and starch digestibility. A number of research studies have been reported on baked products, extruded products and deep fat fried snacks made from cereal and legume flours supplemented with soya flour. Singh, and Chauhan (1996) showed that a maximum of 20% soya flour can be incorporated to prepare acceptable quality biscuits. Cookies, macaroni and burger prepared from flour mixtures using wheat, soya and defatted sesame flour blends in various proportions were sensorily evaluated and the results revealed that products had good acceptance (Marques, Bora, &Narain, 2000).

Osorio et al. (2008), prepared chickpea supplemented pasta, a dietetic alternative for people with low calorie requirements. Young- Soo- Kim (1998) prepared wet noodles from wheat flour with 3, 5 and 7 % oyster mushroom and oak mushroom with improved protein and fibre contents having better acceptability. Alonso et al (2001) reported that thermal treatments of peas improved their nutritional quality without reducing the hyper cholesteromic properties. To retain the vitamin C and chlorophyll pigments in peas, blanching for 2 min at 800C inactivated 90% of peroxidase (Gokmen et al. 2005). Pea products increased the protein content by about 23% and also the textural quality of spaghetti produced was similar to durum spaghetti (Nielsen et al. 1980).

ZanetaUgaric-Hardi, Marko Jukic et al. (2008) studied the quality parameters of noodles made with various supplements (extruded maize, maize, defatted soy flour and maize/soy flour blends, lecithin and wheat straw). The noodles made with extruded maize flour, maize flour, and wheat straw supplements had the highest total sensory score. Cooking losses of these samples were below 10%.Maud Petiot et al. (2010) investigated the impact of legume flour addition on pasta structure and the inherent consequences on the in vitro digestibility of starch. The addition of high level 35% w/w) of legume flour, split pea flour, induced some minor structural changes in pasta.M. L. Sudha, K. Leelavathi (2010), effect of dehydrated green pea flour (DGPF) and additives like glycerol mono stearate (GMS), sodium stearoyl lactylate (STL) and dry gluten on the rheological characteristics and pasta making quality made from Indian Triticum aestivum was studied, 5-10% of amaranth seed flour was used in the formulation to enhance the protein and fibre of the product.

GurpreetKaur, Savita Sharma et al. (2011), produced pasta enriched with different plant proteins (mushroom, defatted soy flour). The pasta containing 8% mushroom powder increased the cooking time. Keeping in view the nutritive aspects of the plant proteins, the main objectives of the present investigation was to improve the nutritional, cooking and sensory qualities of the pasta.

II. Materials And Methods

Semolina (*Triticum durum*), chickpea flour (*Cicerarietinum*) and defatted soy flour (*Glycine max*) were procured from the local market.

Sample preparation Four samples were prepared using sample one as Control containing only durum semolina, sample two containedSemolina (84%), chickpea flour (10%) and Defatted soy flour (6%), sample three contained Semolina (76%), chickpeaflour (14%) and Defatted soy flour (10%) and the fourth sample contained Semolina (68%), Gram flour (18%) and Defatted soy flour (14%). All the samples were passed through sieve (10 mesh) thrice to improve mixing.

Chemical characteristics Moisture, ash and fat content were determined according to AOAC 2000 methods. Protein content was determined as per (IS: 7219:1973): Kjeldhal Method, protein content was obtained by using the conversion factor of 6.25,Dietary fibre was determined by (IS: 11062).

Table 1: Alverograph readings of Semolina.

P was calculated from the maximum height reached by the curve, L was taken from the total length from the

S. No.	Resistance (P) cm	Extensibility (L) cm	Strength (W) cm^2	P/L
1	108	135	251	0.80
2	109	135	252	0.807
3	109	135	252	0.807
4	110	134	252	0.82
Mean	109	134.75	251.75	0.8087

time it starts to blow up until the bubble breaks and W was taken from the area under the alveogram (curve).

Table 2: Proximate composition[a] of raw materials.

Raw materials	Moisture, %	Ash, %	Fat, %		Dietary fibre, %	Carbohydrate, %
Semolina	11.66 ± 0.31	0.80 ± 0.01	1.02 ± 0.02	12.99 ± 0.25	2.90 ± 0.24	73.92 ± 0.19
Chickpea flour	10.99 ± 0.39	2.59 ± 0.25	4.57 ± 0.26	21.61 ± 0.37	9.71 ± 0.23	59.0 ± 0.08
Defatted soy flour	7.14 ± 0.11	5.93 ± 0.09	0.77 ± 0.05	49.90 ± 0.37	6.94 0.17	35.84 ± 0.18

[a]Mean Value ± standard deviation

III. Pasta Preparation

Semolina, chickpea flour and defatted soy flour blends were prepared in the ratio of 100:0:0, 84:10:6, 76:14:10, 68:18:14 respectively. In each case an amount of 700g was taken. Required amount of water was then added (31%) in the mixing chamber of the double screw extruder (Le monferrina,Masoero Arturo, Italy) for 10 min to distribute the water uniformly throughout the flour. the flour was extruded through an adjustable die(No. 225). The speed of the revolving sharp blade cutter in front of the die was adjusted so that the length of the pasta finished at 1.5cm and the thickness of 1mm for each sample.Prior to drying each sample was steamed for 30 min, steaming results in the partial gelatinization of the starch thereby preventing the cooking loss. The drying of pasta was carried out in Hot Air oven at 75^0C for 3hrs (as per DWR Karnal).The dried products were packed in polyethylene. The main objective of the drying was to reduce the moisture content of the samples below 10%. The samples were then subjected to various chemical and sensory analyses.

Cooking quality The cooking quality was determined by minimum cooking time as per AACC 2000.

*Sensory evaluation*Pasta was evaluated for overall acceptability (colour, texture, aroma and taste)and was carried out as per 9 point Hedonic scale, by the help of ten semi trained judges.

Statistical analysis ANOVA - post hoc compariso- ns. The means were compared using Duncan's multiple range test (2007).

Results and Discussion

*Alverograph characteristics of semolina*The mean resistance (P), of the semolina was found to be 109, which was calculated from the maximum height reached by the curve, the mean extensibility (L) was found to be 134.7, which was taken from the total length from the time it starts to blow up until the bubble breaks and the strength (W) was taken from the area under the alveogram (curve), Table 1. As per the IS the values of W and P/L should be greater than or equal to 250 and 0.8 respectively for pasta making.

*Proximate composition of raw materials*Defatted soy flour had highest protein and ash content followed by chickpea flour and semolina, Table 2. Chickpea flour had highest fat and dietary fibre while semolina contained higher carbohydrate content.

Proximate composition of pasta samples Fortification of pasta resulted in increased protein, fat, ash and dietary fibre content, while as carbohydrate content was decreased, as compared to control.The results agreed with other research workers, Gurpreet et al. 2011, Young-Soo-Kim 1998, Osorio et al. 2008, Bahnassey and Khan1986, who reported the incorporation of plant proteins, oyster, oak mushroom, bengal gram flour increased the protein content, fibre content, moisture content and ash content of the final products The results showed a significant difference as the fortification was increased ($p \leq 0.05$), Table 3.

Cooking quality of pasta samples The cooking time of pasta samples was significantly increased as compared to the control sample, in each case 10g of sample was taken and cooked, Table 4. Oh et al. (1985) observed that cooking time of the noodles increased linearly with protein content. The water absorption also increased when the fortification was increased as compared to the control.

Sensory characteristics of pasta samples Sensory evaluation was carried out as per 9 point Hedonic scale, Table 5. The values are the means of ten readings. Among the three fortified samples, the second sample had highest overall acceptability, compared to the control.

Fig. 1. Fortified sample 1

Fig. 2. Fortified sample 2

Fig.3 Fortified sample 3

Fig. 4 Cooked pasta (sample 2)

Table 3: Proximate composition[a,b] of pasta samples

S. No.	Moisture, %	Ash, %	Fat, %	Protein, %	Dietary fibre, %	Carbohydrate, %
Control	9.17 ± 0.29^{a}	1.20 ± 0.01^{a}	0.93 ± 0.06^{a}	11.97 ± 0.50^{a}	2.76 ± 0.13^{a}	76.29 ± 0.39^{d}
Sample 1	10.55 ± 0.48^{b}	1.28 ± 0.02^{a}	1.23 ± 0.11^{b}	14.50 ± 0.50^{b}	4.04 ± 0.21^{b}	72.30 ± 0.82^{c}
Sample 2	10.65 ± 0.26^{b}	1.35 ± 0.07^{a}	1.40 ± 0.01^{c}	17.99 ± 0.50^{c}	4.19 ± 0.04^{bc}	68.55 ± 0.22^{b}
Sample 3	11.33 ± 0.29^{c}	1.70 ± 0.21^{b}	1.53 ± 0.01^{d}	18.13 ± 0.50^{c}	4.30 ± 0.02^{c}	67.31 ± 0.58^{a}

[a]mean value ± standard deviation (n = 3)

[b]Mean values marked with different superscripts in the same column are significantly different-Duncan ($p \leq 0.05$).

Table 4: Cooking time[a,b] of pasta samples.

S. No.	Cooking time (min)
Control	7.32 ± 0.22^{a}
Sample 1	8.32 ± 0.10^{b}
Sample 2	8.62 ± 0.06^{b}
Sample3	9.07 ± 0.17^{c}

[a]Mean values ± standard deviation (n = 3)

[b]Mean values marked with different superscripts in the same column are significantly different-Duncan ($p \leq 0.05$).

Table 5: Sensory scores[a, b] of pasta samples.

S. No.	Color	Texture	Aroma	Taste	Overall acceptability	Rank
Control	8.40 ± 0.52^{b}	8.30 ± 0.48^{b}	8.00 ± 0.67^{b}	8.20 ± 0.42^{a}	8.60 ± 0.57^{ab}	8.20 ± 0.42$_{b}$
Sample 1	7.9 ± 0.74^{ab}	7.6 ± 0.52^{a}	7.00 ± 0.82^{a}	7.8 ± 0.63^{a}	7.5 ±0.71^{a}	7.5 ± 0.71^{a}
Sample2	8.2 ± 0.42^{b}	8.0 ± 0.47^{ab}	8.1 ± 0.57^{b}	8.1 ± 0.32^{a}	8.2 ± 0.03^{a}	8.1 ± 0.32^{b}
Sample3	7.4 ± 0.84^{a}	7.7 ± 0.48^{a}	7 ± 0.94^{a}	7.7 ± 0.67^{a}	7.5 ± 0.71^{a}	7.3 ± 0.67^{a}

[a]Mean values ± standard deviation (n = 10)

[b]Mean values marked with different superscripts in the same column are significantly different-Duncan ($p \leq 0.05$).

IV. Conclusion

Defatted soy flour and chickpea flour increased the protein, fibre and ash content of the pasta keeping the fat at optimum level. Fortification increased the cooking time, water absorption and stiffness of the samples than control. Fortified pasta was highly acceptable with respect to sensory attributes and cooking time. On the basis of cooking and sensory quality, pasta when fortified with blends of 10% Chickpea flour and 6% defatted soy flour resulted in better quality and nutritious pasta (carbohydrate content 68.61%, protein content 17.99%, fat content 1.40% and fibre content 4.19%). Resultant pasta can be used as a nutritious food for low income group in developing countries and for patients suffering with life style diseases.

References

[1] 2000 AOAC (2000) (Association of Official Analytical Chemists), Approved methods of the AOAC, William Horwitz.

[2] 2008 Census Of Manufactures: Miscellaneous Food And Kindred Products, Preliminary Report Industry Series, U. S. Department of Commerce, Bureau of Census, Issued August 2009.

[3] AACC (2000) Approved laboratory methods , American Association of Cereal Chemists, Minnesota,USA

[4] Abdel-Aal E. S. M., Hucl P. (2002) Amino acid composition and in vitro protein digestibility of selected ancient wheats and their end products. Journal of Food Composition and Analysis, 15(6), 737–747.

[5] Agnesi E. (1996) The history of pasta, in pasta and noodle technology, ed by Kreuger J. E., Matsuo R. B., Dick J. W.

[6] Alonso R., Grant G., (2001) Thermal treatment improves nutritional quality of pea seeds without reducing their hypocholesterolemic properties.

[7] AmudhaSenthil, R. Ravi, K. K. Bhat, M. K. Seethalakshmi (2002) Studies on the quality of fried snacks based on blends of wheat flour and soya flour.

[8] Anderson, James W., Johnstone, Bryan M., Cook-Newell, Margaret E. (1995). Meta-Analysis of the Effects of Soy Protein Intake on Serum Lipids. New England Journal of Medicine (Massachusetts Medical Society) 333 (5): 276–282.

[9] Bahnassey Y., Khan K. (1986) Fortification of Spaghetti with edible legumes. II Rheological, processing and quality evaluation studies, Cereal Chem. 63:216-219

[10] D. E. Walsh and K. A. Gilles (1977) Pasta Technology, Elements of Food Technology, N. W. Desrosier, Editor, AVI Publishing Company, Inc.

[11] Del Nobile M. A., Baiano A., Conte A., Mocci G. (2005) Influence of protein content on spaghetti cooking quality. Journal of Cereal Science, 41, 347–356

[12] Duranti M. (2006) Grain legume proteins and nutraceutical properties. Fitoterapia, 77(2), 67–82.

[13] Feilet P., Dexter J. E. (1998) Quality requirements of durum wheat for semolina milling and pasta production.

[14] Fiellet P., Abecassis J., Autran J. C., Laignelet T. (1996) Past and future Trends of academic research on pasta and durum wheat, Cereal Food World 41:205-206.

[15] Gokmen V., Bahceci K. S., Serpen A., (2005) Study of lipoxygenase and peroxidase blanching indicator enzymes in peas, change of enzyme activity, ascorbic activity and chlorophyll during frozen storage.

[16] Gurpreet Kour, Savita Sharma, H. P. S. Nagi (2011) Enrichment of pasta with different plant proteins.

[17] Limroongreungrat K, Hang Y. W. (2007) Pasta products made from sweet potato fortified with soy proteins.

[18] M. L. Sudha and K. Leelavati (2010) Effects of gehydrated green pea flour and amaranth seed flour on the rheological, microstructure and pasta making quality.

[19] Manthey F. A., Yalla S. R., Dick T. J., Badaruddin M. (2004) Extrusion properties and cooking quality of spaghetti containing buckwheat bran flour. Cereal Chemistry 81, 232-236

[20] Marconi E., Carcea (2001) Pasta from non-traditional materials. Cereal foods World 46: 522-530.

[21] Marques M., Bora, P. S., Narain N. (2000) Development of some high protein conventional foods based on wheat and oilseed flours. Journal of Food Science and Technology, 37(4), 394–399.

[22] Maud Petiot, Cecile Barron, Valerie Micard (2010) Impact of legume flour addition on pasta structure: consequences on its in vitro starch digestibility.

[23] Molina M. R., Gudiel H., Baten M. A., Bressani R. (1982) Production of high protein quality pasta products using semolina/corn/soyflour mixture 3. Effects of cooking on the protein nutritive value of pasta. Cereal Chem 59: 34-37

[24] Monge L., Cortassa G., Fiocchi F., Mussino G., Carta Q. (1990) Glyco-insulinaemic response, digestion and intestinal absorption of the starch contained in two types of spaghetti. Diabetes, Nutrition and Metabolism, 3, 239–246.

[25] Nielsen M. A., Summer A., (1980) Fortification of pasta with pea flour and air classified pea protein concentrate. Cereal Chem 57:203-206.

[26] Osorio D. P., Acevedo A. E., Vinalay M. M. (2008) Pasta added with chickpea flour: Chemical composition, In vitro starch digestibility and predicted glycemic index.

[27] PA, Ward (1985) Noodles IV . Influence of flour proteins , extraction rate, particle size and starch damage on the quality characteristics of dry noodles. Cereal Chem 62:441-446

[28] Prabhashankar P., R. Jyotsna, Indrani, VenkateshwaraRao (2007) Influence of whey protein concentrate, additives, their combinations on the quality and microstructure of vermicelli made from Indian *T. durum* wheat variety.

[29] Ragaee S., Abdel-Aal, El-Sayed M. (2006) Pasting properties of starch and protein in selected cereals and quality of their food products. Food Chemistry 95, 9-18.

[30] Rathi A., Kawatra A., Sehgal (2004) Influence of depigmentation of pearl millet on sensory attributes, nutrient composition, in vitro protein and starch digestibility of pasta. Food Chem 85: 275-280.

[31] Serventi S., Sabban F., (2002) Pasta: The story of universal food.

[32] Shamsuddin, AbulKalam M. (November 2003) Cancer Inhibition by Inositol Hexaphosphate (IP6) and Inositol: From Laboratory to Clinic. The Journal of Nutrition (American Society for Nutrition) 133 (11): 3778S–3784S.

[33] Singh R., Chauhan G. S. (1996) Effect of incorporation of defatted soy flour on the quality of biscuits. Journal of Food Science and Technology, 33(4), 355–357.

[34] T. M. S. Wolever, D. Jenkins, G. S. Wong, Josse (1986) Glycemic response to pasta: effect of surface area, degree of cooking and protein enrichment. Diabetes care 6, 401-404.

[35] Torres A., Frias J., Granito (2007) Germinated Cajanuscajanseedsas ingredients in pasta products: Chemical, biological and sensory evaluation. Food Chem 101: 202-211.

[36] Ugarcic-Hardi Z., Hackenberger D., Subaric D., Hardi J. (2003) Effect of soy, maize and extruded maize flour addition on physical and sensory characteristics of pasta. Italian Journal of Food Science, 2: 277–285.

[37] Verardo V., F. Ferioli, Caboni M. F. (2009) Evaluation of lipid oxidation in spaghetti pasta enriched with long chain n-3 polyunsaturated fatty acids under different storage conditions. Food Chem 114: 472-477.

[38] Weidong Zhang, Cailing Sun, Fengli He, JichunTian (2010) Textural Characteristics and Sensory Evaluation of Cooked Dry Chinese Noodles Based on Wheat-Sweet Potato Composite Flour.

[39] Young-Soo- Kim (1998) Quality of wet noodles prepared with wheat flour and mushroom powder. Korean J Food SciTechnol 30:1373-1380.

[40] Young-Soo- Kim (1998) Quality of wet noodles prepared with wheat flour and mushroom powder. Korean J Food SciTechnol 30:1373-1380.