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Nutritional Quality of Rice Based Noodles Supplemented with Germinated Chickpea Flour

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Abstract

The rice based noodles were prepared by incorporating germinated chickpea flour of 5, 10, 15 and 20 per cent from 36 hours of GNG 469 and GNG 1581 chickpea cultivars. With the incorporation of germinated chickpea flour, the highest mean moisture content of 11.47 percent was recorded in treatment T_1 (100:00::RF), crude protein (10.14 per cent), crude fat (1.10 per cent), crude fiber (4.14 per cent) in treatment T_5(80:20::RF:GNG1581CF), ash content of 1.53 per cent in treatment T_5(80:20::RF:GNG1581CF) and T_9(80:20::RF:GNG 469CF) and total carbohydrates (78.34 per cent) in treatment T_1 (100:00::RF). The minimum cooking time of 09.51 minutes was observed in treatment T_5(80:20::RF:GNG1581CF) and gruel solid loss of 9.20 per cent in treatment T_7(90:10::RF:GNG469CF). Sensory evaluation of chickpea flour based rice noodles revealed that highest overall acceptability score of 7.20 was recorded in treatment T_4 (85:15::RF:GNG 1581CF).

Keywords: Noodle, germination, chickpea, protein, sensory evaluation

Rice (*Oryza sativa* L.) is the principal staple food for half the world's population. Starch is the major chemical component of cereal grains, comprising 90% of the dry weight of rice grain, so that starch properties determine various aspects of rice quality, especially eating and cooking quality (Bao *et al*. 2004). It is an important source of energy, hypoallergenic, easily digested, providing protein with higher nutritional quality and has versatile functional properties. Rice is usually consumed as a whole grain after cooking, and in a regular Asian diet, can contribute for 40 to 80 per cent of the total calorie intake. In western countries, rice is widely used to manufacture products such as noodles, puddings, infant foods, puffed grains and breakfast cereals (Wang *et al*. 2000).

Chickpea (*Cicer arietinum L.),* also called Bengal gram or Garbanzo, is an old-world pulse consumed all over the world, especially in the Afro-Asian countries (Lev-Yadun *et al*. 2000). India contributes over 76% chickpea production in the world and total production of chickpea in India was 9.04 million tons in the year 2016-17 (Anonymous, 2016). Chickpea is a good source of carbohydrates and protein, together constituting about 80% of the total dry seed mass (Chibbar *et al*. 2010) in comparison with other pulses. Chickpea is cholesterol free and is a good source of dietary fibre, vitamins and minerals with better protein quality than other pulses (Wood and Grusak, 2007). This process results in structural modification, synthesis of new compounds with high bioactivity and leads to the formation of soft kernel with improved nutritional value, digestibility, reduced anti-nutritional factors and increased stability of grains (Kaukovirta-Norja *et al*. 2004). Germinated pulses are believed to have greater nutritive and physiological value than their corresponding un-germinated forms and products (Rozan *et al*. 2000). Rice noodles are a very popular food in Asian

countries due to its simple preparation, desirable sensory attributes, long shelf life augmented with product diversity and nutritive value (Hormdok and Noomhorm, 2007). As the world market is expanding, studies for the development and improvement of noodles qualities satisfying consumer demands is of immense importance (Yadav *et al*. 2014). Noodles are regarded as a part of the main diets in many Asian countries and also become popular in other countries outside of Asia (Fu, 2008). Noodle quality is assessed as a combination of appearance, texture, eating quality, and cooking properties among which texture is generally considered as the most important quality parameter. Thus, the enrichment of the rice noodle with chickpea pulse ingredients will lead to beneficial outcomes with superior balanced amino acid profile, potentially benefit people against celiac disease and Type II diabetes and also reduce glycemic index (Marinangeli and Jones, 2012). Thus, Overall fortification of rice noodles with chickpea flour will enrich the nutritional values in comparison to rice noodle and will expedite the new market potential for chickpea pulse seeds.

MATERIALS AND METHODS

The two chickpea cultivars (GNG 469 and GNG 1581) were procured from Pulse Research Sub-Station, Samba, Sher-e-Kashmir University of Agricultural Sciences and Technology, Jammu and rice sample (K 39) from local market of Jammu. Chickpea seeds were cleaned from the dirt, foreign materials, soaked in 0.7 g/100 L of sodium hypochlorite solution for 30 min at room temperature, washed thoroughly and soaked again in distilled water (seeds to water ratio is 1:5 w/v) for 12 hours at ambient temperature. The soaked chickpea seeds were germinate in an incubator at 30°C for 36 hours. The germinated seeds were drained and oven dried at 40 °C for 4 hours. The dried germinated seeds for development of flours were dehusked, milled into flour by using laboratory mill (Perten-3303 Labortory Mill), passed through 60-mesh and packed in polypropylene packaging materials until used.

Preparation of noodle as extruded product

The noodles were prepared by standard method Fari *et al*. (2011). Noodles were prepared by using rice flour and germinated chichpea flour for development of chickpea flour based noodles. Guar gum 0.5 per cent as binding agent were added to all treatment. The rice flour with germinated chickpea flour mixed with water to form a dough in the dough mixer (Hobart CE 100, Germany). The dough was gelatinized by placing in a kitchen steamer and steamed for 30 min. The dough was kneaded for 15 min to distribute the gelatinized starch. The dough was then sheeted and placed in a motor driven noodle machine (KSC Biogen Noodle Machine, India), to get noodle strands. These strands were steamed for 15 min and dried at 40 °C for 4 hour in an hot air dryer (Pama Roma MODPR/12, Pama Parsi, Rome, Italy).

Methods

The proximate composition (moisture, protein, crude fat, crude fibre, ash) were determined according to the procedure of AOAC, 2002 method and total carbohydrates by difference method. Sensory evaluation of noodles were done on the basis of 9 point hedonic scale. Cooking properties (cooking time and gruel solid loss) were determined by Galvez and Resurreccion (1992).

Statistical Analysis

The data obtained were analysed statistically (Gomez and Gomez, 1984) using Factorial randomized design (CRD) for interpretation of results through analysis of variance at $p<0.05$.

RESULTS AND DISCUSSION

Proximate composition of germinated chickpea flour based rice noodle

With the incorporation of germinated chickpea flour of 36 hours, lowest moisture content of 8.96 percent was recorded in treatment T_9 (80:20::RF:GNG 469CF) and highest moisture content of 9.54 per cent in treatment T_1 (100::RF). The decreased moisture content of noodles might be due to the incorporation

Table 1: Proximate composition of germinated chickpea flour based rice noodle

Treatments	Moisture	Crude Protein	Crude fat	Crude fibre	Ash	Total carbohydrates
T_1(100:00::RF)	9.54	7.52	1.05	1.34	0.78	79.77
T_2(95:05::RF:GNG1581CF)	9.43	7.84	1.10	1.81	1.13	78.69
T_3(90:10::RF:GNG1581CF)	9.32	8.53	1.17	2.57	1.27	77.14
T_4(85:15::RF:GNG1581CF)	9.18	9.26	1.23	3.48	1.45	75.40
T_5(80:20::RF:GNG1581CF)	9.07	10.35	1.34	4.37	1.73	73.14
T_6(95:05::RF:GNG469CF)	9.39	7.92	1.09	1.68	1.07	78.85
T_7(90:10::RF:GNG469CF)	9.27	8.63	1.12	2.39	1.25	77.34
T_8(85:15::RF:GNG469CF)	9.15	9.35	1.20	3.28	138	75.64
T_9(80:20::RF:GNG469CF)	8.96	10.45	1.27	4.23	1.71	73.38
$C.D_{0.05}$	0.12	0.19	0.07	0.02	0.02	1.73

Table 2: Cooking property and overall acceptability of germinated chickpea flour based noodle

Treatments	Cooking time (min)	Gruel solid loss (%)	Overall acceptability
T_1(100:00::RF)	13.35	7.38	6.83
T_2(95:05::RF:GNG1581CF)	12.53	7.92	7.06
T_3(90:10::RF:GNG1581CF)	11.24	8.25	7.36
T_4(85:15::RF:GNG1581CF)	11.05	8.71	7.58
T_5(80:20::RF:GNG1581CF)	10.13	8.84	6.64
T_6(95:05::RF:GNG469CF)	13.19	7.89	7.13
T_7(90:10::RF:GNG469CF)	11.48	8.13	7.48
T_8(85:15::RF:GNG469CF)	11.31	8.36	7.35
T_9(80:20::RF:GNG469CF)	10.37	8.59	6.52
$C.D_{0.05}$	0.54	0.39	0.97

of germinated chickpea flour which altered the water holding capacity of protein and starch content of rice in the noodle. Similar observations of decreasing moisture content have been reported by Kumar and Prabhasankar (2013) in noodle fortified with pea flour. As perusal data in Table 1 indicated that the germinated chickpea flour significantly increased the crude protein content of chickpea flour based rice noodles. The germinated chickpea flour incorporated in rice flour for noodle increased the protein content of chickpea flour based rice noodles. The maximum mean crude protein content of 10.14 per cent was observed in treatment T_5 (80:20::RF:GNG 1581CF) and minimum crude protein of 7.38 per cent in treatment T_1(100::RF). These results were correlated with that of Kumar and Prabhasankar (2013) in noodle fortified with pea flour. The minimum mean crude fat content of 0.89 per cent was recorded in treatment T_1 (100::RF) and maximum value of 1.10 per cent fin treatment T_5(80:20::RF:GNG 1581CF). The increased fat content of chickpea flour based rice noodles might be due to increase in germinated chickpea flour which have higher fat content than rice flour. These findings are in conformity with those of Kumar and Prabhasankar (2013) in noodle from durum wheat fortified with pea flour. The crude fibre content of chickpea flour based rice noodles significantly increased with increase in germinated chickpea flour with minimum mean crude fibre of 1.24 per cent in treatment T_1 (100::RF) and 4.14 per cent in treatment T_5(80:20::RF:GNG 1581CF). The increased crude fibre of noodles with incorporation of chickpea flour might be due to the higher content of crude fiber in germinated chickpea flour. Similar observations

have been observed by Choo and Aziz (2010) in noodles from banana flour and b-glucan. The lowest mean ash content of 0.66 per cent was recorded in treatment T_1 (100::RF) and highest mean ash content of 1.53 per cent in treatment T_5 (80:20::RF:GNG 1581CF) and T_9(80:20::RF:GNG 469CF). The increased ash content of chickpea based rice noodles might be due to increased level of germinated chickpea flour which had higher ash content than rice flour. These findings are in conformity with those of Bhise *et al*. (2014) in protein enriched noodles using texturized defatted meal from sunflower, flaxseed and soybean. Total carbohydrates content in chickpea flour based rice noodles decreased significantly with increase in germinated chickpea flour with highest mean value of 78.34 per cent in treatment T_1(100::RF) and lowest mean value of 72.62 per cent recorded in treatment T_5(80:20::RF:GNG1581CF). The decrease in carbohydrate content might be due to the increase in protein, ash, fat and fibre content of noodles by germinated chickpea flour. Similar results were reported by Abou Arab *et al*. (2010) in chickpea flour based spaghetti.

Cooking and Sensory property of germinated chickpea flour based rice noodle

The cooking time of chickpea flour based rice noodles significantly decreased with increase in germinated chickpea flour with lowest mean cooking time of 9.51 minutes in treatment T_5 (80:20::RF:GNG 1581 CF) and highest mean cooking time of 12.93 minutes in treatment T_1 (100::RF). The decreased cooking time of chickpea flour based rice noodles which might be due to loosely bound of starch protein matrix in the noodles due to endogenous enzymes associated with germinated chickpea flour. Similar observations were observed by Mahmoud e*t al*. (2012) in noodles from lupine and wheat flour fortified.

Cooking loss defined as a weight of the total solids lost in the cooking water. The gruel solid loss significantly decreased for chickpea flour based rice noodles with the replacement of 5 and 10 percent of rice flour by germinated chickpea flour and increased significantly for 15 and 20 per cent of germinated chickpea flour. The minimum mean gruel solid loss of 9.20 per cent was observed in treatment T_7 (90:10::RF:GNG 469CF) and maximum mean gruel solid loss of 10.02 per cent in treatment T_5 (80:20::RF:GNG 1581CF). The variations in gruel solid loss might be due to protein–polysaccharide matrix formation in chickpea flour based rice noodles for the retention of amylose during cooking by incorporated germinated chickpea flour (Sissons *et al*. 2005). The results of gruel solid loss showed similarities with the findings of Mahmoud e*t al*. (2012) in noodles from lupine and wheat flour fortified.

Overall acceptability of chickpea flour based rice noodles differed significantly with highest mean score of 7.20 in treatment T_4 (85:15::RF:GNG 1581CF) and lowest score of 6.08 in treatment T_9 (80:20::RF:GNG 469CF). The variation of overall acceptability score on chickpea flour based rice noodles might be due to colour, taste and texture associated with germinated chickpea flour.

CONCLUSION

Thus, the development of noodle as extruded product from germinated chickpea flour with rice flour can reduce protein related malnutrition, gluten free noodle, balanced nutrients, low glycemic index and with better digestibility. The proximate composition of chickpea flour based rice noodle, moisture content total carbohydrates decreased with incorporation of germinated chickpea flour whereas crude protein crude fat, crude fiber and ash content increased. Cooking properties such as cooking time decreased and whereas gruel solid loss increased significantly with incorporation of germinated chickpea flour. Sensory evaluation of chickpea flour based rice noodles on the basis of overall acceptability (appearance, colour, texture, stickiness and flavour) revealed that 15 per cent of germinated chickpea flour be used as with rice flour for noodle making.

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