▼ Journal of Research (Science), Vol. 33, No. 1, Apr 2022, pp. 21-29
ISSN 1021-1012

Chemical and Functional Properties of Pasta Formulated by Blend of Soybean Flour, Wheat Flour and Semolina Flour

Rashid Raza, Maida Jawed, Hira Javaid Khan, Ayesha Ansari, Faiqa Fatima and Areeba Hassan

Department of Food Science and Technology, Jinnah University for Women, Karachi, Pakistan, Postal code-74600

Abstract

Pasta has become favorite food among young people, but due to gluten allergy, a few of the people do not like to take it. Current study was aimed to develop a gluten free nutritive pasta by replacing wheat flour with soy flour. Standard methods were applied for sensory analysis and physicochemical (proximate) analysis. Among the various combinations, the newly developed pasta sample containing soy flour in a ratio of 65% was found to be better for its nutritional quality and sensory evaluation. Both of the products; control and newly established pasta have been found highly acceptable according to sensory evaluation. The bulk density, moisture, pH, ash, protein, fat, fiber, carbohydrate, and energy content of newly developed pasta were found to be 0.274kg/m^3, 2.5%, 6.7%, 0.75%, 10.7%, 4.0%, 48.25 and 384.4kcal/100g respectively. The significant improvement in color of pasta produced by replacing wheat flour with soy flour was found. Replacement of wheat flour with soy flour reduces the cooking time to 15.42 min and a very little increase in cooking loss 7.4% has been observed as compared to cooking time (15.59 min) and cooking loss (7.30%) of the control pasta. Pasta produced in this study can be a nutraceutical food for the celiac disease as well as an alternative to the wheat pasta.

Keywords: Pasta, nutrition, gluten free pasta, health conscious peoples.

Introduction

Awareness about the nutritional value of foods has increased among consumers in recent years. According to today's modern life about food point of view public attraction towards food is depend on many factors like nutrition value, structure, texture, physical properties and functional properties. There are many value added product are available in market which is made from cereals and soybean. Pasta is believed to be consumed largely throughout the world. The major raw material for pasta production is wheat flour (Feillet and Dexter 1996). Attempts has been made for the fortification of pasta by adding protein, vitamins, fiber, and minerals sources such as legumes in a cheaper way (Duranti 2006). Soy protein has been found to reduce the risk of coronary heart disease when consumed as part of a diet low in saturated fat and cholesterol (Tripathi and Misra 2005). Soya grain contains a lot of vitamins and minerals such as zinc, phosphorus, potassium, Calcium, iron, vitamin B and vitamin A, C, E. Some studies have shown that pastas with as little as 15 % to 20% soy flour have significantly lower taste scores than the control pasta (Singh, Raina *et al.* 2004) but it is beneficial to in concern of health to produce pasta by blending of soya flour with wheat flour. Semolina consists protein, bran, enzyme and endosperm which can be used for highly nutritive pasta production. Addition of semolina improves the characteristics of pasta such as

Received 09 December 2021; Revised 10 February 2022; Accepted 15 March 2022

high water absorption index, less cooking time, appropriate color and appearances etc. (Fuad and Prabhasankar 2010).

Different components of soybeans such as genistein, isoflavones, sterols, saponins and phytic acid have been reported to have anti-cancer properties against prostate cancer, breast cancer and colon cancer (Wu, Ziegler *et al.* 1998). Pasta was produced by incorporating ginger powder with different concentration of quantities. According to the sensory properties, physiochemical properties and nutritional properties of pasta, the newly produced samples were found to be of good quality and overall acceptability (Mishra and Bhatt 2016). Effect of pasta fortified with defatted soy flour and chick pea flour was explored. Fortification has increased the water absorption index, cooking time, hardness and overall sensory acceptability (Bashir, Aeri *et al.* 2012). The replacement of semolina with raw:popped amaranth flour blend in pasta results in acceptable cooking quality and texture (Islas-Rubio, de la Barca *et al.* 2014).

Glutin allergic people do not like to use pasta as their diet. On the other hand, a few of the people think that it is not a healthy diet. Keeping in view the common perception about pasta, this study was aimed to make a nutritive and gluten free pasta by replacing wheat flour with soy flour. The pasta developed in this study will be bifacial for health. Pasta produced in this study can be a nutraceutical food for the celiac disease as well as an alternative to the wheat pasta.

Materials and Methods

Chemicals and Glassware

Analytical grade chemicals were used for analysis. All glassware was pre-rinsed with 10% HCl followed by deionized water.

Raw Materials

Soy flour (Watataa Foods), Semolina (KGS Foods), wheat flour (Sunridge Foods), Salt (Shan Foods Pvt. Ltd.), Black pepper (Shan Foods Pvt. Ltd.), processed vegetable Oil (Habib Oil Mills), broiler egg (locally available) and food grade color (Bush Boak Allen Pakistan (Pvt.) Ltd) were purchased from local grocery market.

Preparation of Pasta

Dough was prepared from blend of soybean flour, all-purpose flour and semolina. The composition is recorded in Table-1. All the flour is added into a bowl, add water and mix them evenly, now add salt, black pepper and pinch of food grade color and mix all of them, then add oil and beaten eggs, knead the dough well. Pre sheeting the dough by hand then sheet the dough with the help of dough sheeter of desired length and breadth then cut into desired shape (Figure-1).

Preparation of Ready-to-Eat Alfredo Pasta:

Bring a large pot of water to boil over high heat, add pinch salt into it then add the pasta into it. Boil it for 20 to 24 minutes. Stir the pasta occasionally as they cook to prevent them from clumping together. Prepare Alfredo sauce and chicken, drained the pasta into the sauce then mix it add chicken into it, add

cheese layer on the top then bake in oven for 5 minutes. Serve the pasta with seasoning (Figure-2).

Table 1: Formulation of Newly developed Pasta

S.No	Ingredients (g)	Control	Sample1	Sample2	Sample3
1.	Soy flour	Nil	75gm	55gm	65gm
2.	Semolina flour	20gm	20gm	20gm	20gm
3.	Wheat flour	80gm	5gm	25gm	15gm
4.	Salt	1.5gm	1.5gm	1.5gm	1.5gm
5.	Black pepper	3gm	3gm	3gm	3gm
6.	Broiler egg	20gm	20gm	20gm	20gm
7.	Processed vegetable oil	6gm	6gm	6gm	6gm
8.	Food grade colour	Traces	Traces	Traces	Traces

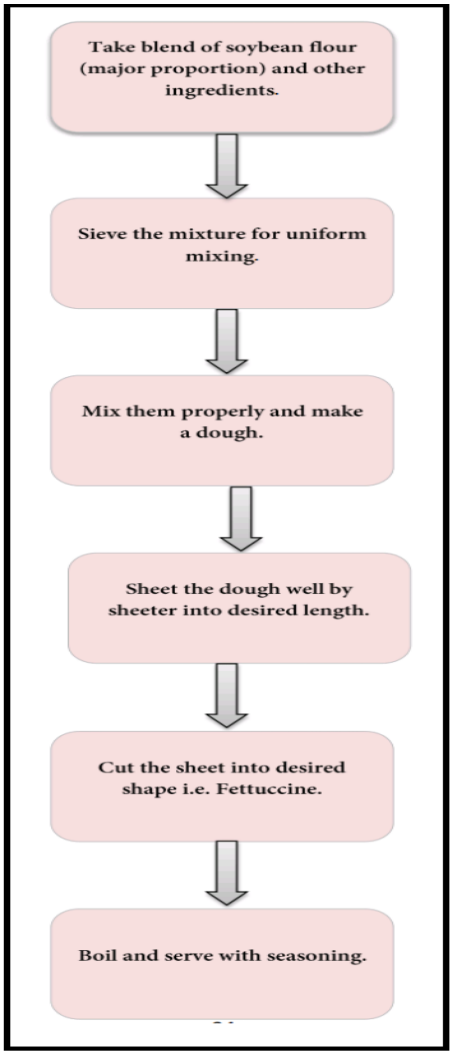

Figure 1: Preparation of Pasta

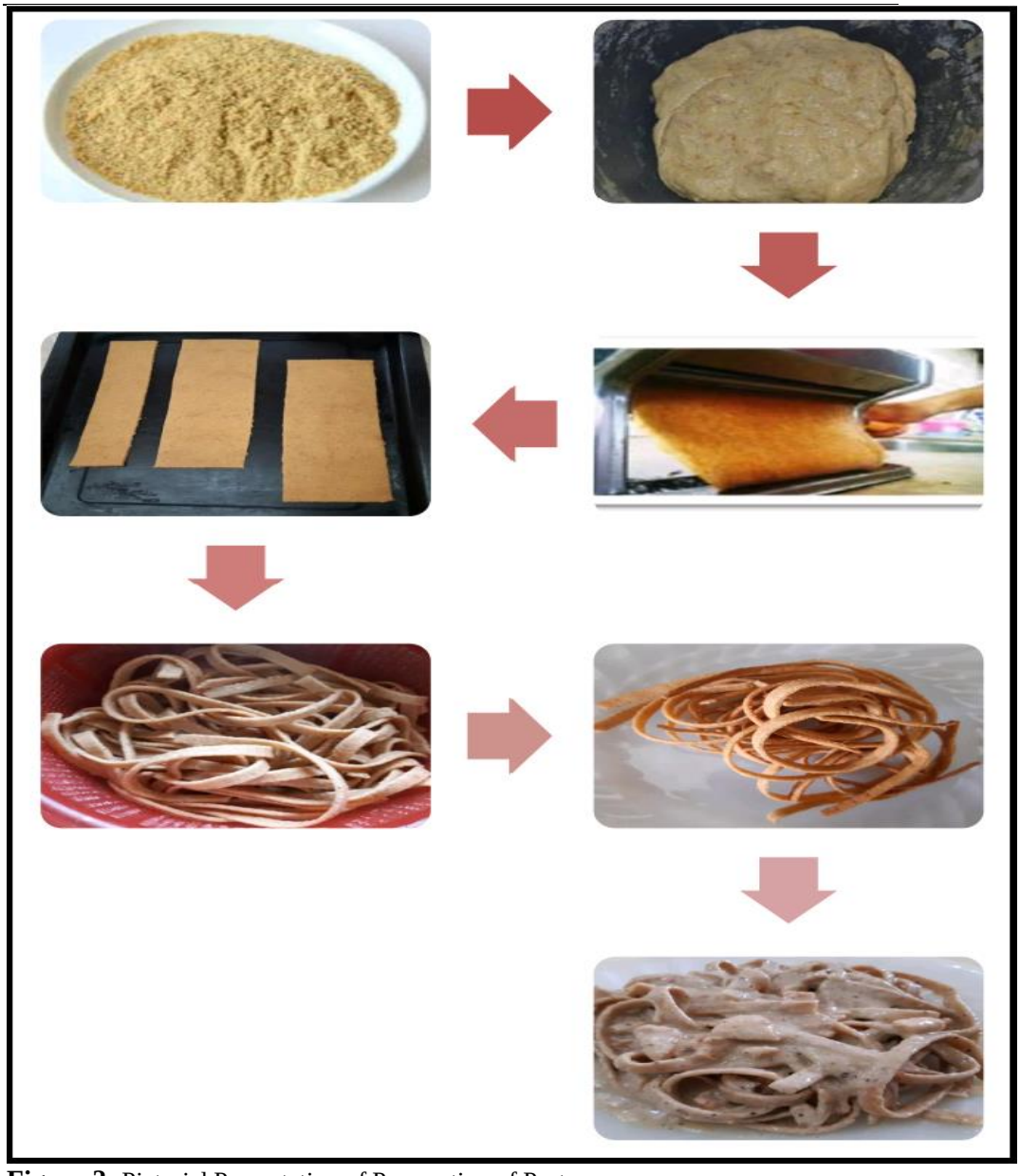

Figure 2: Pictorial Presentation of Preparation of Pasta

Organoleptic Evaluation

Standard 9-point hedonic scale procedure was used to carry out the sensory (organoleptic) evaluation. Pasta samples cooked in salted cooking water were served to 20 trained/and semi trained panelist to analyze the organoleptic score of each parameter (Amerine, Pangborn *et al.* 1965).

Proximate Analysis

Physical tests of the final product such as moisture, ash, pH, colour, bulk density and chemical analysis such as protein, carbohydrate and fat contents,

titrable acidity, peroxide value, protein, fiber and carbohydrates were carried out according to the standard methods of AOAC (Chemists and Horwitz 1975), whereas the fiber content and cooking time by AACC (Committee 2000). The calorific value was estimated by Bomb Caloriemeter. Antioxidants were analyzed by DPPH method (Amin and Lee 2005). Bulk density, cooking loss, water solubity Index and water absorption Index were also estimated by methods available in literature (Chakraborty, Hareland *et al.* 2003, Semasaka, Kong *et al.* 2010). Color measurement of finely ground samples (0.5mm) in terms of L* (lightness), a* (redness), and b* (yellowness) values was carried out by colorimeter CR-300 (Minolta, Osaka, Japan).

Statistical analysis

Statistical analysis was carried out by ANOVA. All the results were the average of three replicates (Gomez and Gomez 1984).

Results and Discussion

The sensory score of freshly prepared pasta has been summarized in Table 2. The sensory analysts recommended the sample3 on the basis of overall acceptability, which was found to be above average. The sample3 contains the highest amount i.e 65%w/w of soy flour replaces wheat flour. The colour was observed to be 8.0 and 8.15 for control and sample3 (the selected sample). The score for mouth feel for control and sample3 was similar as 7.8. Flavour score for control and sample3 was found to be 8.15 to 8.1. The texture scores for control and sample3 was observed as 7.68 and 7.75. Sample3 was found to be more consistent then the corn based control sample. Both of the products, control and sample3 were found to be highly acceptable.

Table 2: Standardization of Newly Developed Pasta

Parameters (%)	**Control**	**Sample1**	**Sample2**	**Sample3**
Texture	7.68±0.02	7.1±0.01	7.5±0.02	7.75±0.02
Colour	8.0±0.02	8.1±0.01	7.5±0.02	8.15±0.02
Flavour	8.15±0.03	7.9±0.02	7.6±0.03	8.1±0.03
Mouth Feel	7.8±0.04	7.2±0.03	7.7±0.04	7.8±0.02
Overall acceptability	7.7±0.04	7.3±0.03	7.6±0.02	7.98±0.02
Remarks	**Control**	Not Selected	Not Selected	**Selected**

The proximate analysis of newly developed pastas is summarized in Table-3. The bulk density of selected sample of pasta is found to be higher than the control due to replacement of wheat flour with soy flour in the newly developed pasta. The moisture content found in the control and newly developed pastas varied from 2.82 to 2.5%. Food quality can be maintained by maintaining less moisture content in the food commodities; that will reduce the deterioration of food by decreasing microbial growth. For quality of dried products, moisture content <10% is believed to be more appropriate (El Wakeel 2007). The results are found to be in congruence with the results earlier reported in the literature for the pasta produced by sorghum, maiz and watermelon seed powder (Ikujeunlola 2016). pH determination is important to know the nature of the product either it is acidic or basic. The pH values indicate that the soy fortified pasta are less acidic. Ash content of pasta samples of control and pasta developed in the current study is found to be 0.69 to 0.75%

respectively. The replacement of wheat flour with soy flour might be the reason, as soy flour is a good sources of minerals. Ash contents estimated in the current study is found to be lower than a study carried out to produce soy fortified noodles (Omeire, Umeji *et al.* 2014).

The protien content of pasta samples i.e. control and pasta developed in the current study is found to be 7.77 to 10.7% respectively. The replacement of wheat flour with soy flour might be the reason of high protein content in newly developed pasta, as soy flour is a good source of protein (Dhingra and Jood 2002). The results are found to be in congruence with the results earlier reported in the literature for the pasta produced by replacing rice flour with soy flour (Sereewat, Suthipinittham *et al.* 2015). The fat content of the control sample and newly developed pasta is found to be 3.43 and 4.0% respectively. Replacement of wheat flour with soy flour may be the reason of increase in fat content as soy flour is reported to be a better source of fat. The results of current studies show quite good congruence with the finding of (2.80–6.77%) reported earlier (Caperuto, Amaya-Farfan *et al.* 2001). The fiber content of control sample of pasta (0.77%) was found to be lower than newly established pasta (1.02%). Replacement of wheat flour with soy flour may be the reason of increase in fiber content as soy flour is reported to be a better source of fiber (Ribeiro, Bolanho *et al.* 2018, Sparvoli, Bollini *et al.* 2015). The fiber content found in the present study were similar to the results reported earlier (Mishra and Bhatt 2017). In this study, the carbohydrate content of the pastas varied significantly. The lowest carbohydrate content was found in sample3 (48.25%), whereas highest amount in control pasta sample (53.13%). The lower carbohydrate contents of the presently developed pasta is possibly as a result of lower carbohydrate contents of soy flour that are used in the preparation of pasta (Sparvoli, Bollini *et al.* 2015). The results of current studies show quite good congruence with the finding of (82-60%) reported earlier for noodles produced from wheat and soybean flour (Omeire, Umeji *et al.* 2014). The energy value of the controlled pasta sample and sample produce with soy flour were found to be 379.5 and 384.4 kcal/100g respectively. The high value of energy in the newly developed pasta may be owing to higher fat and carbohydrate content of soy flour.

Table 3: Proximate Analysis of Newly Developed Pasta

Parameters	**Control**	**Fresh Pasta**
Bulk Density (kg/m^3)	0.243±0.01	0.274±0.01
Moisture (%)	2.82±0.12	2.5 ±0.05
pH (%)	6.4±0.01	6.7±0.05
Ash (%)	0.69±0.04	0.75±0.02
Protein (%)	7.77±0.05	10.7±0.04
Fat (%)	3.43 ±0.03	4.0±0.01
Fiber (%)	0.77±0.02	1.02±0.03
Carbohydrate	53.13±0.15	48.25±0.10
Energy (Kcal/100g)	379.5±0.05	384.4±0.05

Colour indices of newly established pasta has been summarized in Table 4. The results indicate that the addition of soy flour affects positively on the color of pasta. The increase in soy flour in pasta reduces the lightness value (L*), and increases the redness (a*) values and yellowness (b*) values of the pasta samples. The results of current studies show quite good congruence with the finding reported earlier (Petitot, Boyer *et al.* 2010). Replacement of wheat flour with soy flour may be the reason of the results appear for the color indices, as off white color of soy flour has contributed to the yellowness of pasta.

Table 4: Colour Indices of Newly Developed Pasta

Colour Measurement	Control	Fresh Pasta
Lightness (L*)	48.0 ± 0.9	43.6 ± 0.7
Redness (a*)	- 1.5 ± 0.7	0.8 ± 0.2
Yellowness (b*)	7.8 ± 0.5	20.3 ± 0.9

Cooking qualities have been illustrated in figure-3. Less cooking time and less cooking losses can improve the overall acceptability of pasta. More the cooking time more the energy requirement and high cooking losses results in poor quality pasta. Replacement of wheat flour with soy flour reduces the cooking time to 15.42 min and a very little increase in cooking loss 7.4% has been observed as compared to cooking time (15.59 min) and cooking loss (7.30%) of the control pasta. A study carried out earlier shows decrease in cooking time and higher cooking losses for the pasta produced by the replacement of wheat flour with legume flours (split pea and faba bean) (Bhattacharya, Zee *et al.* 1999). The results are found to be higher than the results reported earlier for the pasta produced by replacing rice flour with maize and fruit peel. The differences in the cooking time could be due to differences in the composition of the composite flour used for the pasta preparation (Rodríguez-Sandoval, Fernández-Quintero *et al.* 2008).

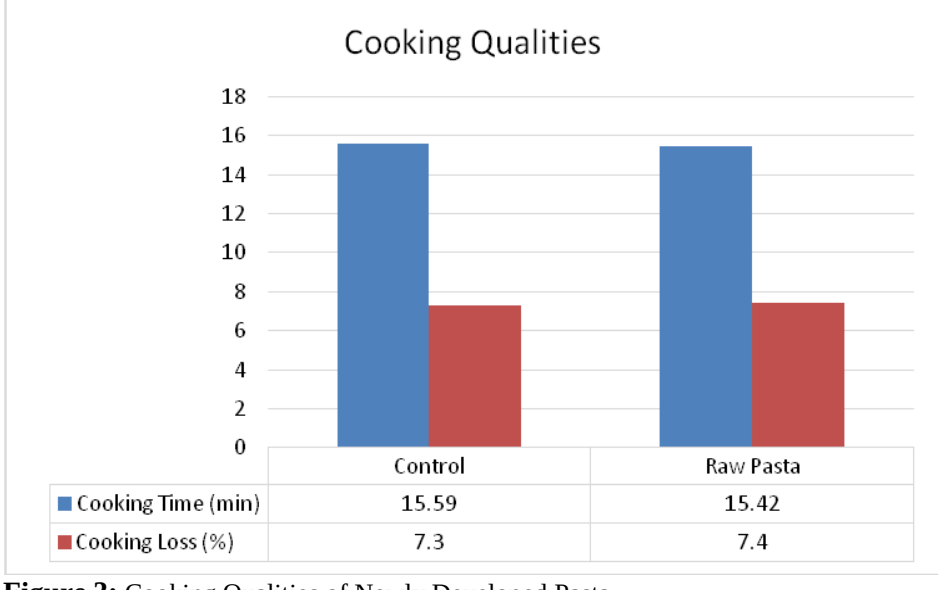

Figure 3: Cooking Qualities of Newly Developed Pasta

Water absorption index (WAI) and water solubility index are reported in Table-5. It is observed that increasing in soy flour with wheat the values of WAI and WSI are increased.

Table 5: Cooking Qualities of Newly Developed Pasta

Cooking Qualities	Control	Fresh Pasta
Cooking Time (min)	15.59 ± 0.5	15.42 ± 0.4
Cooking Loss (%)	7.3 ± 0.2	7.4± 0.2
Water Absorption Index (%)	219±4.9	240±5.3
Water Solubility Index (%)	8± 0.3	10± 0.3

Conclusion

Current study was aimed to develop a gluten free nutritive pasta by replacing wheat flour with soy flour. Standard methods were applied for sensory analysis and physicochemical (proximate) analysis. Among the various combinations, the newly developed pasta sample containing soy flour in a ratio of 65% was found to be better for its nutritional quality and sensory evaluation. Both of the products, control and newly established pasta have been found highly acceptable according to sensory evaluation. Pasta produced in this study can be a nutraceutical food for the celiac disease as well as an alternative to the wheat pasta.

Reference

Amerine, M, et al. (1965). "Principles of sensory evaluation of food Academic Press." New York/London.

Amin, I and Lee, WY (2005). "Effect of different blanching times on antioxidant properties in selected cruciferous vegetables." Journal of the Science of Food and Agriculture **85**(13): 2314-2320.

Bashir, K, et al. (2012). "Physio-chemical and sensory characteristics of pasta fortified with chickpea flour and defatted soy flour." Journal of Environmental Science, Toxicology and food technology **1**(5): 34-39.

Bhattacharya, M, et al. (1999). "Physicochemical properties related to quality of rice noodles." Cereal chemistry **76**(6): 861-867.

Caperuto, LC, et al. (2001). "Performance of quinoa (Chenopodium quinoa Willd) flour in the manufacture of gluten-free spaghetti." Journal of the Science of Food and Agriculture **81**(1): 95-101.

Chakraborty, M, et al. (2003). "Evaluating quality of yellow alkaline noodles made from mechanically abraded sprouted wheat." Journal of the Science of Food and Agriculture **83**(5): 487-495.

Chemists, AOOA and Horwitz, W (1975). Official methods of analysis, Association of Official Analytical Chemists Washington, DC.

Committee, AaOCCaM (2000). Approved methods of the American association of cereal chemists, Amer Assn of Cereal Chemists.

Dhingra, S and Jood, S (2002). "Organoleptic and nutritional evaluation of wheat breads supplemented with soybean and barley flour." Food chemistry **77**(4): 479-488.

Duranti, M (2006). "Grain legume proteins and nutraceutical properties." Fitoterapia **77**(2): 67-82.

El Wakeel, M (2007). Ultra structure and functional properties of some dry mixes of food, Faculty of Agriculture, Ain Shams University Cairo, Egypt

Feillet, P and Dexter, J (1996). Quality requirements of durum wheat for semolina milling and pasta production, AACC-American Association of Cereal Chemists

Fuad, T and Prabhasankar, P (2010). "Role of ingredients in pasta product quality: A review on recent developments." Critical reviews in food science and nutrition **50**(8): 787-798.

Gomez, KA and Gomez, AA (1984). Statistical procedures for agricultural research, John wiley & sons.

Ikujeunlola, A (2016). "High Nutrient Dense Gluten Free Pasta from Quality Protein Maize, Sorghum and Water Melon Seeds Flour: Chemical Composition, in Vitro Protein Digestibility and Sensor Properties." Ife Journal of Technology **24**(1): 46-51.

Islas-Rubio, AR, et al. (2014). "Effect of semolina replacement with a raw: popped amaranth flour blend on cooking quality and texture of pasta." LWT-Food Science and Technology **57**(1): 217-222.

Mishra, P and Bhatt, D (2017). "Development of quality characteristics of dried pasta enriched with soya protein isolate powder." IOSR J. Environ. Sci. Toxicol. Food Technol.(IOSR-JESTFT) **11**: 1-6.

Mishra, P and Bhatt, DK (2016). "A study on development of fortified pasta with ginger powder." J. Env. Sci. Toxicol. Food Tech **10**(8): 14-18.

Omeire, G, et al. (2014). "Acceptability of noodles produced from blends of wheat, acha and soybean composite flours." Nigerian Food Journal **32**(1): 31-37.

Petitot, M, et al. (2010). "Fortification of pasta with split pea and faba bean flours: Pasta processing and quality evaluation." Food Research International **43**(2): 634-641.

Ribeiro, THS, et al. (2018). "Physicochemical and sensory characterization of gluten-free fresh pasta with addition of passion fruit peel flour." Ciência Rural **48**.

Rodríguez-Sandoval, E, et al. (2008). "Effect of processing conditions on the texture of reconstituted cassava dough." Brazilian Journal of Chemical Engineering **25**(4): 713-722.

Semasaka, C, et al. (2010). "Optimization of extrusion on blend flour composed of corn, millet and soybean." Pakistan Journal of Nutrition **9**(3): 291-297.

Sereewat, P, et al. (2015). "Cooking properties and sensory acceptability of spaghetti made from rice flour and defatted soy flour." LWT-Food Science and Technology **60**(2): 1061-1067.

Singh, S, et al. (2004). "Sweet potato-based pasta product: optimization of ingredient levels using response surface methodology." International journal of food science & technology **39**(2): 191-200.

Sparvoli, F, et al. (2015). Nutritional value. Grain legumes, Springer**:** 291-325.

Tripathi, A and Misra, A (2005). "Soybean-a consummate functional food: A review." Journal of Food Science and Technology-Mysore **42**(2): 111-119.

Wu, AH, et al. (1998). "Soy intake and risk of breast cancer in Asians and Asian Americans." The American journal of clinical nutrition **68**(6): 1437S-1443S.