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Enhancement of Nutritional and Functional Characteristics of Noodles by Fortification with Protein and Fiber: A Review

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Abstract

Instant noodles is one of breakfast and staple food item of East Asian countries, whose consumption is gradually increasing day by day worldwide. Noodles, being a poor source of proteins due to use of refined flour in its production. Therefore, now it is an obligatory to fortify noodles with protein and fiber rich ingredients which will potentially enhance not only nutritional value but also functional characteristics. The present review focuses on fortification of protein and fiber rich ingredients in foods and its effects. The fortification could be optimized with the use of soy and like other protein rich ingredients as a source of protein. To uplift the fiber content, ingredients like Rice bran, Oat, Whole grains are being used. Although, fortification of soy in noodles would add nutraceutical values to noodles by *isoflavones*, *phytosterols* and *oligosaccharides*. Moreover, it balances essential amino acids of foods especially lysine. *Cellulose*, *hemicelluloses*, *pectic substances*, *gums*, *resistant starch*, *inulin* are existing as principle dietary fibers of cereals, legumes, fruits and vegetables. Fortification of foods with rice bran possibly replaces functional characteristics of noodles like water absorption capacity, water holding capacity, texture, gelling, thickening, emulsifying and stabilizing properties of noodles. Beyond the functional characteristics it contributes immense therapeutic benefits like, reduction of cholesterol, coronary heart diseases, diabetes, weight loss etc.

Keywords: Instant noodles, fortification, protein, fiber, nutrition, functional.

Introduction

Noodles are one of the primary foods consumed in many Asian countries. Instant noodles have become internationally recognized food and worldwide consumption is on the upsurge. Many researchers are exploring the potential of noodle fortification as an effective public health intervention and increase its nutritional characteristics. The characteristics like taste, nutrition, convenience, safety, longer shelf life, and reasonable price have made the noodles popular. Quality factors obligatory for instant noodles are color, flavor, and texture, cooking quality, rehydration rates throughout final preparation, and the presence or absence of rancid taste after prolonged storage (Gulia *et al.*, 2014) [26]. According to Lee *et al.*, (2008) [38] noodles belongs to China as early as 5000 BC, and then spread to other Asian countries such as Japan, Thailand, Korea and Malaysia, and now days it has become one of the fastest budding sectors in the world with the compound annual growth rate (CAGR) reaching 4%. Worldwide, China ranks first in the consumption of noodles followed by Indonesia, Japan, and Vietnam (Anonymous b, 2016) [6]. Noodles are one of the favorite food products that are well loved by many people of all ages (Afalla A., 2010) [1]. As per the Guoquan Hou (1998) [27] the amount of flour used for noodle making in Asia accounts for about 40% of the total flour consumed. Wheat flour noodles are an important part in the diet of many Asians.

Now day's consumers all around the world are more at the risk of many diseases such as diabetes due to obesity, high cholesterol, cardiovascular diseases, high blood pressure and irregular blood sugar levels. These risk factors are because of the unfit diet which is low in essential nutrients like dietary fiber, phytochemicals and antioxidants. Functional foods provide health benefits and help in the avoidance of diseases by incorporating nutraceutical ingredients and other essential nutrients (Suman and Rajinder, 2015) [60].

The market of instant noodles gaining popularity in the world. Usually, wheat flour is preferred to prepare instant noodles with low protein and dietary fiber content. Wheat flour noodles can be supplemented with a range of materials that can boost fiber, protein etc. Protein in human diets is obtained from several sources that include cereals, vegetables, root crops, legumes, meat, egg, milk and fish. However, the cost of animal protein is increasing every day; sources from animals are regarded as the best because of its amino acid content thus making it unavailable for most people in developing countries. This unavailability has resulted

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into looking for other alternatives protein sources (Akinoso *et al.*, 2010) [3]. Recently, food manufacturers have responded to consumer demands for foods with higher fiber content by developing products in which high-fiber ingredients are used dietary fiber can also impart some functional properties to foods, e.g., increase water holding capacity, oil holding capacity, emulsification and/or gel formation. Traditionally, consumers have chosen foods such as whole grains, fruits and vegetables as sources of dietary fiber (Nelson, 2001) [44].

The need hour enforced us to find out the potential sources of protein and fiber, and its utilization in various foods to upgrade the same content in developed product. So, the sincere efforts were made to review the suitable articles and come towards an appropriate conclusion.

Wheat as Basic Ingredient for Noodles

Flour of hard wheat (*Triticum aestivum* L.) is the main ingredient which is usually used to make instant noodles is low in fiber and protein contents but also poor in essential amino acid, lysine. Noodles also can be made from other flours like rice, buckwheat, and starches derived from potato, sweet potato, and pulses. Most of the essential nutrients are lack in traditional noodles such as dietary fiber, vitamins and minerals, which are lost during wheat flour refinement. Thus, noodle products which represent a major end-use of wheat, are suitable for enhancing health after incorporating sources of fiber and essential nutrients (Tan *et al.*, 2009) [61].

Composition of Wheat grains

Wheat is a staple food of India and world also, besides the staple food it is used in preparation of various processed food products. The wheat grain contains 2-3% germ, 13-17% bran and 80-85% mealy endosperm (all constituents converted to a dry matter basis) (Belderok *et al.*, 2000) [10].

Table 1: Composition of wheat grain (Morrison W. R. 1978; Rennan *et al.* 2008)

Sr. no.	Components (on dry basis)	Values
1	Protein	10-18 g/100g
	Albumin	25% of Total Protein
	Globulin	
	Gliadins	75% of Total Protein
	Glutenins	
2	Starch (Carbohydrate)	60-75 g/100g
	Amylose	20-30% of Starch
	Amylopectin	70-80% of Starch
3	Total lipid	4.77 g/100g
	16:0	17-24%
	18:0	1-2%
	18:1	8-21%
	18:2	55-60%
	18:3	3-5%
4	Minerals	
	Calcium	0.27 mg g ⁻¹
	Magnesium	0.35 mg g ⁻¹
	Potassium	1.71 mg g ⁻¹
	Phosphorus	1.92 mg g ⁻¹
	Copper	1.84 µg g ⁻¹
	Iron	37.8 µg g ⁻¹
	Manganese	8.2 µg g ⁻¹
Zinc	9.4 µg g ⁻¹	

Protein fortification

The all essential amino acids are not present in Instant noodles mainly consist of wheat flour whose protein quality is not sufficient. Noodles and other pasta types are rich in carbohydrate but they are deficient in terms of protein quantity and amino acid balance (Ebru and Mehmet, 2009) [17]. The consumption of foods enriched with proteins from plant sources has been increasing among vegetarian and health conscious people (Wu *et al.*, 1998) [68].

According to Shao *et al.*, (2009) the protein can be fortified in rice noodle and nutritional value by adding a high quality protein source from soybeans. However, the product must retain satisfactory physical properties (such as pasta appearance, uniformity and color), cooking qualities and sensory acceptability when compared to commercial products derived from durum semolina.

Soy as Source of Protein

Soybeans contain a high content of various important nutrients including protein, oil, and several bioactive compounds such as isoflavones, phytosterols and oligosaccharides. Although isoflavones have a weak estrogenic property they show beneficial effects on human health such as reducing the risk of cardiovascular, hemolytic and carcinogenic diseases (Klein *et al.*, 1995; Lee *et al.*, 2008) [36, 38].

Although isoflavones have a weak estrogenic property they show beneficial effects on human health such as reducing the risk of cardiovascular, hemolytic and carcinogenic diseases (Klein *et al.*, 1995; Lee *et al.*, 2008) [36, 38]. Soybean is an excellent source of dietary protein providing complete human requirement of almost all the amino acid. It is also an excellent source of minerals and vitamins.

Table 2: Basic nutrients in soybean seeds (Van *et al.*, 2004)

Nutrient	Soybean seeds% of DM
Crude protein	37.08
Crude ash	4.86
Crude fat	18.38
NDF	5.12
ADF	12.98
Crude fiber	7.22
N-free-extractive	24.00
Starch	4.66

Soybean contains an isoflavones which have biochemical activity, including estrogenic, anti-estrogenic and hypocholesterolemic effects. The total isoflavones content in soy ranged from 160.8 to 284.2 mg/100g (Hoeck *et al.*, 2000) [29]. The isoflavones in soybean and soy products have three types: *daidzein*, *genistein* and *glycitein*. Totally, there are 12 isomers of isoflavones in soybean. The concentrations of total *daidzein*, *genistein* and *glycitein* carried out of 20.2-206 mg, 31.5-268 mg and 10.9-107 mg per 100g of raw seed respectively (Douglas, 1996; Wang and Murphy, 1994) [14, 66]. The proteins of soybean products characterized much quantity of lysine, tryptophane, isoleucine, valine and threonine however sulphuric amino acids are less than in protein of rape products (Ensminger *et al.*, 1990) [19].

Table 3: Essential amino acids of soybean seeds (Anonymous a, 2001) [5]

Amino acids	Soybean seeds (% Dry Basis)
Arginine	2.45-3.1
Cystine	0.45-0.67
Histidine	1.0-1.22
Isoleucine	1.76-1.98
Leucine	2.2-4.0
Lysine	2.5-2.66
Methionine	0.5-0.67
Phenylalanine	1.6-2.08
Threonine	1.4-1.89
Tryptophan	0.51-2.44
Valine	1.5-2.44

Plants as source of Proteins

Effects of plant proteins supplementation from mushroom powder, and defatted soy flour, Bengal gram flour at different levels were assessed by Gurpreet Kaur *et al.*, (2013) [28] on the nutritional quality of pasta. A result founds a significant increase in protein and mineral content of pasta. Natural supplement of protein are legume seed in cereals for producing an overall essential amino acid balance (Singh and Singh, 1992) [57]. Young Soo Kim, (1998) prepared wet noodles from wheat flour with 3, 5 and 7% oyster mushroom and oak mushroom with improved protein and fiber contents having better acceptability. Oyster mushroom powder supplement in sweet balls and cookies sweet buns, the substitution contributed to increase amino acid and digestibility coefficient.

Nutrient rich noodles were developed by the addition of optimized proportions of wheat and malted ragi flour with other ingredients. Combinations of wheat and malted ragi flour (90:10, 80:20, 70:30, 60:40 and 50:50) and other ingredients like vegetable oil, corn flour, wheat gluten, GMS and guar gum were optimized by varying proportions to result a better quality noodles. Whereas iodized salt, baking powder and water were kept constant for all formulations. Results revealed that among all the formulations tried, noodle sample prepared from 70:30 flour combination had same sensory score as that of control and higher values of protein, fiber and minerals (i.e. calcium, iron and phosphorous) than the control sample (Kulkarni *et al.*, 2012) [37].

By-products of fruit processing industries as protein source

On incorporation of apple pomace powder into an extruded product (noodles) at three different levels (10, 15 & 20%), the total dietary fiber and protein content of the noodles increased from 6.0 to 13.28% and 10.20 to 11.80%, respectively, as compared to the control wheat based noodles. As an Apple pomace powder is valuable source of antioxidants, the prepared noodles also improved antioxidant activity of the noodles. As well as it is an excellent source of dietary fiber, protein, phenolic acids and flavonoids (Suman and Rajinder, 2015) [60].

Ebru and Mehmet, (2009) [17] utilized apricot kernel, a by-product of apricot processing plants containing wide range of nutrients, in enrichment of noodle. The various physical and chemical parameters of noodles were examined. Apricot kernel flour (AKF) was added to the noodle formulation at the level of 5, 10, 15, 20% flour weight basis. The results of the study indicated that samples of AKF added noodles, for all addition levels, contained more protein, lipid and ash as compared to control sample.

A high-protein pasta was prepared from cream and orange-fleshed sweet potato varieties using additives like whey protein concentrate, defatted soy flour, and fish powder, and its nutritional and digestibility characteristics are increased specially protein content (Jyothi *et al.*, 2012) [34].

Other sources of protein fortification

Omeire *et al.*, (2015) [45] found that 10% cassava flour is used in the production of the protein rich noodles. The 70% of cassava flour had been acceptable. the cooking quality of noodles produced from blends of wheat/cassava/defatted oil seeds and the acceptability of the noodles replacement or substitution of wheat flour with flours from other sources as a possibility to increase the utilization of indigenous crops as well as contributing to lowering the cost of baked products has being on the increase. Addition of cassava flour that has low protein content to wheat flour will reduce the percentage of protein in the composite flour.

Noodles can be prepared by using defatted wheat germ flour (DWGF) and wheat flour in a suitable ratio with appropriate amounts of additives (Yiqiang *et al.*, 2001) [70]. Noodles that are prepared with sweet potato flour and soy flour can increase the β carotene and protein content as well as increase the cooking loss of noodles (Collins and Pangloli, 1997) [13]. In developing countries lysine fortification of wheat flour has been used toward reducing protein energy malnutrition. Fortifying instant noodles with lysine was evaluated by Polpuech *et al.*, (2011) [49] based on sensory qualities and the residual lysine content. The feasibility of Fifty grams of deep-fried and dried instant noodles was fortified with 0.23 and 0.21 g lysine for final selection.

Non-Conventional Sources of Protein

Fish

Fish flour is one of processed fish product, which can be utilized to prepare value added food such as fish stock powder, a type of instant food, different types of extruded food products. This can also be fortified to different foods such as snacks, biscuit, noodles etc. to improve quality characteristics viz. flavour, taste and nutritive value. Fish flour is rich in protein with the benefit of colour, flavour and functional properties make it an ideal raw ingredient for supplementation in texturized protein products like snacks and certain types of specialty foods (Anahle *et al.*, 2017) [4].

Fiber fortification

The well documented thing about dietary fiber is they are involved in the prevention of diseases. Due to this they can enhance the health of consumers. Industry has investigated ways of improving the overall nutritional balance of carbohydrate rich foods recently. They want to focus on increasing their dietary fiber. Physicochemical properties can improve by fiber like viscosity, texture, sensory characteristics and shelf-life of the products. The food industry can take advantage of this (Martina *et al.*, 2013) [39]. Dietary fibers are composed by cellulose, hemicelluloses, pectic substances, gums, resistant starch, inulin, they are the mixture of plant carbohydrate polymers, Both oligosaccharides and polysaccharides, that may be associated with lignin and other non-carbohydrate components (e.g., polyphenols, waxes, saponins, cutin, phytates, resistant protein) algae, cereals, fruits as well as vegetables are sources of abundant dietary fiber (Mohamed *et al.*, 2011) [41].

There are many fiber rich by product they can increase the nutritional value of the products and also they can produce

healthy product low in calories, cholesterol and fat (Mohamed *et al.*, 2011) [41]. The role of dietary fibers in health and nutrition has prompted since the mid-1970s (Azizah and Yu, 2000) [8].

The rapid increase in lifestyle diseases such as diabetes, obesity, cancer and cardiovascular problems coupled with the global awareness on these issues have increased the demand for fiber enriched health foods. Consumption of low glycemic foods rich in fiber has been reported to reduce obesity and its linked problems such as diabetes and heart disease as well as in exerting protective effects against certain types of cancer (Buttriss and Stokes, 2008) [11].

By-products of fruit processing industries as fiber source

Unripe banana flour is used as an ingredient to make dried noodle of high nutritional quality with low carbohydrate digestibility and rich in resistant starch and dietary fiber. They incorporated 30% of unripe banana flour in the noodle, which increased total dietary fiber and resistant starch content of noodles. Unripe banana flour is one of the starchy food and it contain contains an indigestible compound such as resistant starch in high proportion, and non-starch polysaccharides, which are included in the dietary fiber content (Pitiporn *et al.*, 2011) [47].

The main by-product of cider industry is apple pomace which is rich source of carbohydrates and high amount of dietary fiber, small amount of protein, fat and ash (Sudha *et al.*, 2007; Wang and Thomas, 1989) [67]. The apple pomace added into the noodles up to 5% as well as the soy milk residue up to 10%, resulted in improvement of dietary fiber content compared to normal wheat noodles (Hong *et al.*, 1993) [30].

Mango peel is the byproduct of mango processing industries which is rich source of as polyphenols, carotenoids, vitamins, enzymes and dietary fibers, and it was incorporated in macaroni products by Ajilaa *et al.*, (2010) [2] at three different levels (2.5, 5.0, 7.5%) and checked the cooking properties, firmness, nutraceutical and sensory characteristics of macaroni. The product was found increase in the dietary fiber and other nutritional compounds. Apple pomace also can be used as a source of nutraceuticals (Suman and Rajinder, 2015) [60].

Vinod *et al.*, (2015) [64] developed Jackfruit Seed and soy flour blended noodles, different levels of refined wheat flour, jackfruit seed flour and soy flour were added. For all addition levels contained more protein, fat, fiber and ash as compared to control sample.

Cereals and other sources of fibers

There are different dietary fiber sources like wheat bran, resistant starch and locust bean gum (Eveline *et al.*, 2013) [20]. The development of foods with high fiber content should be desirable because fiber intake is commonly lower than recommended. The present study was carried by using the commercial sources of fiber like carob fiber, inulin and pea fiber added in bread. And analyzed the effects of addition of these fibers to wheat flour on the viscoelastic properties of dough and both mixing and proofing behavior is presented. Although decreasing specific loaf volume (very slightly in the case of carob fiber), conferred softness to the bread crumbs. Sensory evaluation showed that consumer panelists judged these fiber enriched breads as acceptable Bread can be enriched with dietary fiber, including wheat bran (Ranhotra *et al.*, 1990) [50].

The Glucomannan was added to the noodle dough, comprised of wheat and fermented cassava flours (with ratio of 80:20,

respectively), with varying quantity, from 0.5 to 5.0% w/w. Glucomannan is help to reduce the caloric value of the product and also increase the fiber content. Due to high level of fiber the physical properties of the resultant noodle were affected (Husniati and Fitria, 2013) [31].

The rice noodles were prepared by using Canna starch and its derivatives (retrograded, retrograded de-branched, and cross-linked) for the evaluation of their suitability to be used as prebiotic sources in a rice noodle. The rice flour is replaced up to 20%, the total fiber of control noodle was 3.0% and it get increased to 5.1% and 7.3% when rice flour was replaced with retrograded and retrograded de-branched starches (Yuree *et al.*, 2015) [72].

To use Gracilaria seaweeds is a rich source of vitamins, essential amino acids, indigestible carbohydrates, and dietary fibers and minerals. It was added make the noodles with high nutritional qualities and high fiber content. The noodles containing 3% Gracilaria seaweed were composed of 7.21% protein, 0.5% fat, 1.7% dietary fiber, the incorporation of 3% Gracilaria seaweed in the noodle ingredients significantly increased their total dietary fiber content (Xiren Guli Keyimu, 2013) [69]. The common wheat noodle supplemented with 1% lecithin powder, 20% extruded maize flour, 20% maize flour, 10% defatted soy flour, 20% defatted soy and maize flour blend (1:1), and 7.5% wheat straw results in enriched noodles with dietary fibre and lower glycemic index as well as reduced cholesterol content (Zaneta *et al.*, 2007) [73].

Effects of fortification on noodles

There are many significant changes are appeared in the noodles after fortification by various ingredients. The chemical composition is changed as well as physical properties are also changed.

Effect on Cooking Qualities

Supplementation of wheat semolina with mushroom powder (0–12%), Bengal gram flour (0–20%) and defatted soy flour (0–15%) increases the cooking time of pasta whereas non-significant variation was observed in cooking time of Bengal gram supplemented pasta. Also the correlation was found ($r = 0.97$, $p \leq 0.05$) between water absorption and volume expansion of pasta. Instantization of pasta by steaming improved the cooking quality (Gurpreet *et al.*, 2013) [28]. The locally available composite flours are fortified by partially defatted protein rich flours of wheat-cassava will increase the nutritional value of the products (Omeire *et al.*, 2015) [45].

The noodles fortified by whole lupine meal (WLM) and defatted lupine meal (DLM) results that optimum cooking time significantly decreased with increasing the replacement levels. Calculated protein efficiency ratio, proportion of essential amino acid to the total amino acids, essential amino acid index, biological value, chemical score and limiting amino acid were improved (Eman *et al.*, 2012) [18].

Effect on Rheological Properties

The Water-soluble dietary fibers responsible for increase the viscosity of food in the intestines and thereby slow down glucose and sterol absorption (Kahlon and Chow, 1997; Wood *et al.*, 1994) [35] and the acidification of ramen noodles retarded by the addition of apple pomace (Baek *et al.*, 2001) [9]. Flour protein effects on the firmness of the prepared noodles and it has a positive correlation with cooked noodle firmness and negative correlation with noodle brightness (Wang *et al.*, 2004; Asenstorfer *et al.*, 2010) [65, 7].

The effect of the substitution of purple yam flour on the rheological properties of dough and the quality of salted noodles was studied by Po Hsien *et al.*, (2012) [48]. The quality was compared in appearance, texture and sensory properties. The results indicated that the paste temperature, setback, peak and final viscosity of the pasting properties increased.

High fiber content of legumes provides additional benefits in diet (Mattila *et al.*, 2002) [40]. Addition of dietary fiber in the various products will contribute to increase the functional properties of noodles. It has shown that the fiber components can give texture, gelling, thickening, emulsifying and stabilizing properties to the fortified foods (Dreher, 1987; Sharma, 1981) [15, 56]. The fiber rich noodles are currently in high demand. In the Instant noodles lower fat absorption is carried out and content and higher SDS (Sodium Dodecyl Sulphate)-sedimentation value exhibit to product is due to utilization of high protein flour (Moss *et al.*, 1986; Park and Baik, 2004) [43, 46].

Health benefits of fortification

Dietary fiber is very beneficial to the human body for the health and good body functions (Dreher, 1987) [15]. Dietary fiber is the substance which can reduce the risk of many human disorders. 25-35 grams per day is the ideal amount of daily requirement (Redgwell and Fischer, 2005) [51]. Generally wheat flour is low in fiber and protein contents but also poor in essential amino acid lysine. Lupine is the low cost grain legume becoming popular in various food applications as it is rich in fiber and protein with high lysine content. Also it contains range of phytochemicals with beneficial health effects (Vijay *et al.*, 2008) [63].

According to current recommendations (Food and Nutrition Board, Institute of Medicine, 2001) [22] increased intake of dietary fiber help numerous health benefits like reduced risk of coronary heart disease, diabetes, obesity, and some forms of cancer. Effects of dietary fiber depend on the type of fiber. Like physicochemical effects they even can prevent constipation. Now days the life style is very fast so there is no time to regulate the diet. Much type of diseases can attack on human health. Diseases have led to an increasing awareness among the consumers about the health benefits of dietary fiber (Buttriss and Stokes, 2008) [11].

Cholesterol Reduction and Heart health

The modern trends in the pasta production are the fortification of cereals for potential health benefits. They connected with the reduction of the use of eggs due to the cholesterol control, and with the use of other ingredients (Feillet *et al.*, 1996) [21]. Research shows that 40% risk is lower of heart attack if the consumption of dietary fiber is daily basis (Rimm *et al.*, 1996) [53].

Dietary fiber help evade hydrolysis as well as it help digestion and absorption in the human small intestine, increases the fecal bulk, stimulates colonic fermentation and reduces pre-prandial cholesterol levels (Champ *et al.*, 2003; Fuentes *et al.*, 2010) [12]. A good correlation has become evident between fiber consumption and the reduction of coronary heart related diseases and diabetes incidence (Jinshui *et al.*, 2002) [33]. Low glycemic diets which are rich in dietary fiber have been reported that reduce the insulinemic responses to food and exert hypocholesterolemic action.

Helps in Diabetes and Cancer

Dietary fiber also helps slow your body's breakdown of carbohydrates and the absorption of sugar, helping with blood

sugar control. These all the aspects are important for those people suffering from diabetes (Jenkins *et al.*, 2007) [32]. It also decreases in blood glucose levels, preventing constipation and facilitating good colonic health (Grajek *et al.*, 2005) [25]. In colon cancer prevention dietary fiber can play an important role. Also the risk of gallstones and kidney stones may reduce by the help of high fiber diet because dietary fiber has the ability to regulate blood sugar (Scragg *et al.*, 1984) [54].

Effect on functional properties of foods

Dietary fiber has many physico-chemical functions (such as water binding and alteration of viscosity) physiological attenuations such as cholesterol and fat binding. Dietary fibers promote beneficial physiological effects including laxation, and/or blood cholesterol attenuation, and/or blood glucose attenuation. Serum cholesterol can be reduced by oat bran because it has capacity to bind bile acid (Drizikova *et al.*, 2005) [16]. It also improves constipation management and B₁₂ bioavailability in the elderly with multiple chronic diseases (Sturtzel *et al.*, 2010) [58].

High fiber content of legumes provides additional benefits in diet (Mattila *et al.*, 2002) [40]. Plain semolina pasta has positive health benefits. The pasta with common bean flour shows highest enzymatic hydrolysis rate and spaghetti with a higher level of common bean flour is more slowly than control one (Gallegos *et al.*, 2010) [24]. Addition of partially defatted protein rich flours that are locally available into the composite flours of wheat-cassava will increase the nutritional value of the products (Omeire *et al.*, 2015) [45].

Conclusion

Wheat is well known for its various processed products, but its products are lacks in some essential nutrients viz. Dietary fibers, Proteins and especially amino acid lysine. The Instant noodles made up of only wheat are poor source of above mentioned nutrients, whereas it could be overcome by fortifying the noodles with some protein and fiber rich ingredient. The soy and rice bran founds more suitable for fortification due to it easily availability and cheap cost as they are by product of oil and rice milling industry. The fortified noodles will be the potential source of dietary fiber and proteins, which will be useful in various remedies as it, hold some therapeutic actions. Moreover, fortification will modulate functional characteristics of noodles as it contains fibers and more proteins.

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