The Pharma Innovation

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Noodles processing, quality and nutritional aspects: A review-based study

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Abstract

Snacks are one of the most popular products not only in India but also all over the world because of convenience, variety, quality and because easy to carry from one place to another. Noodles are mainly cereal based, that lack some essential amino acids example tryptophan, threonine and lysine. Quality parameters that are important for noodles are color, flavor, texture, cooking quality, rehydration rates during final preparation and the presence or absence of rancid taste after extending the storage period. The wheat flour used to make noodles is substituted with potato flour, soy flour, see weed flour, apple pomace, carrot puree, pearl millet flour, mushroom powder. Gums/Hydrocolloids are widely used in starch-based noodles because it has ability to improve stability, to modify texture and facilitating processing the noodles. Xanthan gum, Guar Gum and Arabic gum which are heteropolysaccharides that are water soluble with high molecular weights, are often used together with starches to provide the desired texture, control moisture, water mobility and overall quality of the product. Wheat flour fortification is a practice that is done to reduce the risk of anemia that is caused by deficiencies of the nutrition and the neural tube defects that is caused by insufficient folic acid. The effects of polyphenols that are health promoting as catechins exert positive impact on plasma antioxidant biomarkers and quercetin that influence the carcinogenesis markers were widely studied. Noodles in particular are important basic food, which is widely consumed not only in India but also across the world and is among one of the food to be authorized by food and drug administration as a good vehicle for incorporation of bioactive compounds in the product.

Keywords: Noodles, PPO (Polyphenol oxidase), fortification, defatted rice bran flour, plantain starch

Introduction

Snacks are one of the most popular products not only in India but also all over the world because of convenience, variety, quality and because easy to carry from one place to another. It is one of the most liked food of choice for children, women and mobilized population. The consumption of snack foods is increasing day by day because of rapid urbanization and sociological changes. The modern technology is based on extrusion technology for production of snacks. The various types of extended snacks are like pretzels, cookies, noodles, sticks, biscuits etc. Noodles can be defined as a type of dough that is extruded into various shapes for cooking (Johri & Chauhan., 2014). Noodles are mainly cereal based, that lack some essential amino acids example tryptophan, threonine and lysine (Gaikwad *et al.* 2021) [29]. The absence of lysine makes the body difficult to produce protein, hormones, enzymes and antibodies which are generally needed for body growth and other functions (Johri & Chauhan., 2014).

Amid the covid 19 crisis, the global market of the noodles is estimated to be US$24.2 Billion in the year financial year 2022, is projected to reach US$27.8 Billion by 2026, growth CAGR of 4% over the period of the analysis (Global Industry Analysts., Inc). Noodles are present in various formulations and content. The consumption rate of noodles is one of the fastest growing sector in Asian countries, because of its ease of cooking and long shelf life. Consumption of noodles is increased in world because of its convenience, palatability, shelf stability and affordability (Chepkosgei & Orina *et al.*, 2021) [2].

The most used alkaline salts are sodium and potassium carbonates. After mixing, the dry crumbly relatively, dough is compressed by passing it through steel rollers for making a crude sheet. Dough sheets are then gradually reduced to its desired thickness by rolling it further, before being cut into strips (Shere *et al.*, 2018) [1]. The most popular types of the noodles are wet or boiled noodles ("Hokkien style"), fresh noodles ("Cantonese" style), dried noodles, raw noodles that contain egg (wonton or wantan) and instant noodles (Chin *et al.*, 2012) [34].

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Quality factors that are important for noodles are color, flavor, texture, cooking quality, rehydration rates during final preparation and the presence or absence of rancid taste after extended storage (Pakhare *et al*., 2016) [3]. The quality of the noodles is usually defined by the visual attributes of uncooked and cooked noodles. The noodles remain firm, non-sticky after cooking are noodles of good quality. Excellent starch noodles have transparent threads that has high tensile strength and less cooking loss even with prolonged cooking (Shere *et al*., 2018) [1].

Wheat flour noodles are an important element within the diet of many Asians and it is globally demanded because of its particular viscoelasticity and low gluten in addition to an wide range of vitamins example B1, B2, B3, B5 and B9, which helps in facilitation of the production and consumption of processed foods whose intake is growing because of the global industrialized westernization technique. The wheat flour shows progressed water absorption, tenderizing effect and resiliency (Sinthiya *et al*., 2019) [5].

Guar gum is commonly used as stabilizer for preparing the noodle, to provide the intended viscosity, to improve the firmness and mouth feel in final prepared noodles. Because of the ability of the food gum to bind water, food gums generally reduce the oil absorption of fried noodles and this increases the rehydration rate of the noodles on cooking. (Akajaku *et al*., 2017)

Wheat flour fortification is a practice that is done to reduce the risk of anemia that is caused by deficiencies of the nutrition and the neural tube defects that is caused by insufficient folic acid (Kayla *et al*., 2017) [4].

Consumer are very demanding in terms of quality requirements and do not easily accept the product in its variability, thereby it is important to address the compositional and functional traits of raw materials (Tyl *et al*., 2020) [22]. Recently, food manufacturers have responded to consumer demands for higher fiber content foods by developing products in which ingredients that are high in fiber are used, dietary fiber also have the potential to impart some functional properties to foods (enhancement in water holding capacity, oil holding capacity, gel formation capacity) (Pakhare *et al*., 2016) [3].

History of noodles
There have been many claims about origin of the noodles that is generally considered to be German, Chinese, Arabian, Italian and Mediterranean origins. However investigation evidences showed that noodles originated from china (Karim *et al*., 2015) [24]. It was also reported that the production art of noodles's had spread from china when Asian traveled to Korea, Thailand and Malaysia including Indonesia, Singapore and Vietnam through traders and migrants of china (Ololade *et al*., 2019) [6].

For classification of the noodles, many terms are used, since ancient times, many different types can be found in markets of different regions, with differences on the basis of nomenclature, which may be divided into European or Asian types or it can be further subdivided into Chinese, Japanese, german or Italian noodles with each country have their own specific method of production (Ololade *et al*., 2019) [6].
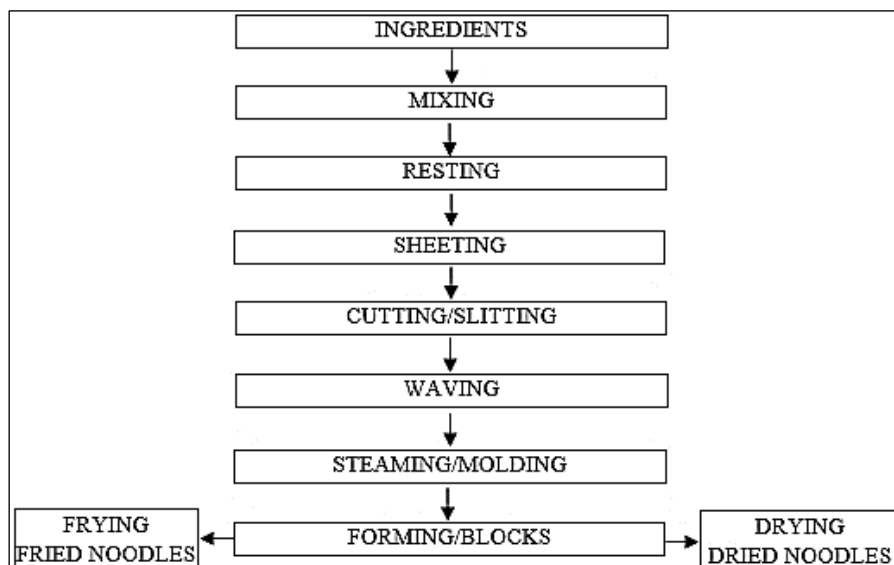
Fig 1: Process of Preparation of Noodles Preparation of Noodles

1. Ingredients mixing/dough making
The combination of different types of flour with water in which other ingredients example alkaline salt have been dissolved. Depending on the type of mixer, mixing time is usually 15-25 minutes. In industries, mixing is generally done for 15-25 minutes, that usually depends on the type of mixture, either it is horizontal or vertical mixer (Gulia *et al*., 2014) [23].

Vertical mixers: Most a mixing blade is present in vertical mixers that have a large surface area. These have limited capacity to mix as much dough in comparison to other mixers.

These mixers generally operate at moderate speed (90-100 rpm) for about 10-20 minutes. (Liu *et al*., 2019) [28].

Horizontal mixers: The mixing effect of these mixers is better in comparison to vertical mixers (Obadi *et al*., 2022). The horizontal mixers are further categorized into Pin-shaped mixing blade and blade shaped mixing blade. Fresh noodles made with a pin shaped blade mixer at speed of about 8 rpm/min showed poor tensile properties and the low hardness and chewiness were observed in cooked noodles that indicated that the incomplete formation of gluten structure and the strength of the gluten was insufficient (Liu *et al*.,

2013).

The studies done by Li *et al*., showed that the mixing process in noodle making process is very useful for enhancing the number of disulphide groups, amount of amide I band and proportion of beta sheets which further improves the gluten protein's combination and formation of network structure (Li *et al*., 2017) [25].

Liu *et al*., studied and explained that by mixing the sheeted dough for about 8 minutes, led to even more robust microstructure and better textural properties. Excessive mixing was found detrimental to the developed network of dough, that further resulted in decrease in spatial distribution and uniformity in the components of the dough (Liu *et al*., 2015) [27].

2. Dough resting
Resting of dough permits the relaxation of the structure of gluten and this further causes the hydration or absorption of water by particles of the flour, redistribution of the water and uniform moisture's penetration into dough particles, which further lead to improvement in processing and hence this lead to improvement in the product quality as this further facilitates the formation of gluten during sheeting process (Ololade *et al*., 2019) [6].

3. Sheeting of dough
This step involves the folding, compounding and compression of the dough over a series of smooth sheeting rolls that are generally arranged in decreasing order of their diameter. To avoid the dough's surface injury and disruption of gluten's structure. The problem can be solved by reducing the thickness of the dough gradually until smooth dough sheet that have continuous and uniform network of the gluten with the desired thickness is achieved (Karim *et al*., 2015) [24].

4. Slitting and waving of dough
This is a process that is of size reduction, which used to determine the thickness, length and shape of the prepared noodles. Cutting and waving are the steps that enhances the packaging and it further contributes to the aesthetics where different shapes are used to bring wide variety to the meal that usually contain the same ingredients (Karim *et al*., 2015) [24].

5. Steaming of noodle strands
Steaming of noodle strands is one of the important step in processing of the noodle, particularly instant noodles, as this process involves the cooking the noodle strand to bring the gelatinization of the starch (Ololade *et al*., 2019) [6].

The extent to which starch is gelatinized during the process caused the rehydration rate, firmness and viscoelasticity of the cooked noodles. Hot air-dried noodles was usually steamed longer as compared to dried fried noodles for achieving the higher degree of gelatinization of starch (Gulia *et al*., 2014) [23].

6. Frying/drying of noodles
The removal of moisture from steamed noodles is important for the purpose of preservation. This could be achieved either by deep frying or by hot air drying for the production of either noodles or instant dehydrated noodles (Ololade *et al*., 2014).

The frying process further gelatinized the starch, which causes the reduction in the cooking time during rehydration and it also impart some pleasant shortening taste, mouth feel and flavor in the final product (Ololade *et al*. 2014).

During frying, further gelatinization of the starch occurs, the temperature of frying oil causes the evaporation of free water from the noodle 's surface and subsequently water migrates from the interior to the exterior of noodles and ultimately to atmosphere (Ololade *et al*., 2014).

7. Cooling and Packaging
The rationales for food packaging as processing aid, protection in storage, distribution, material handling tool, convenience tool have well documented in literature (Mahajan *et al*., 2015) [17].

Cooling of hot foods prior to packaging helps in prevention of undesirable condensation of moisture and further associated increase in water activity, which increases the growth of microbes and this further triggered the hydrolytic rancidity inside the product's package. Instant ramen that is generally found in chinese and Japanese supermarkets are usually packaged in cellophane along with packets of seasoning (Ololade *et al*., 2019) [6].

Ingredients used in noodles
1. Wheat
Traditionally wheat flour is the basic raw material used in production of noodles. The two major types of wheat that are used for production of noodles are, namely wheat (*Triticum aestivum*) and durum wheat (*T. turgidum L. var. durum*) (Ololade *et al*., 2019) [6].

The quality attributes of wheat flour used in making noodles is more closely related to noodles eating quality, Solvent retention capacity and other protein qualities as proportion of polymeric proteins are the some parameters that can be positively correlated with chewiness and gumminess characteristics of noodles and flour protein content generally affect the chewiness of cooked noodles (Li *et al*., 2017) [25].

2. Different ingredients incorporated
Efforts are underway for the improvement in formulation, to extend the shelf life and for the promotion of the fortification of the noodles as an effective public intervention.

- **Pearl millet flour:** For optimization of the noodles, wheat flour is substituted with pearl millet flour and guar gum. A blend of wheat and pearl millet flour (90:10) with guar gum (2%) was extruded. Substitution with pearl millet flour resulted in nutritious noodles because of increase in cooking yield and sensory attributes. The noodles if stored in polyethylene bags by not using any preservative upto 1-2 months (Shere *et al*., 2018) [1].

- **Spinach puree:** The spinach puree can be substituted upto 40 gm/100 gm in wheat flour. This leads to improvement in sensorial qualities with respect to color, flavor and texture. The cooking time decreased with increase in incorporation of spinach puree. The cooking weight and water absorption were increase with increase in incorporation of spinach puree in wheat formulation. The green color of the noodles was slightly reduced during cooking of noodles and there was negligible color loss in cooking water (Shere *et al*., 2018) [1].

- **Soyabean and carrot pomace flour:** Commonly used ingredient wheat flour for making noodles is good in starch but it is poor in protein and fiber. With the increase of the soyabean and carrot pomace flour in wheat flour, the cooking loss and water absorption increases. But there is decrease in brightness with increase in carrot pomace flour. Noodles made from 8% wheat flour, 15%

soyabean flour and 5% carrot pomace flour was most preferred because of its sensory attributes example color, flavor and texture properties (Chepkosgei & Orina et al., 2021) [2].

- **Defatted rice bran and soy flour:** The quantity of DRB and DSF was used at 6% and 10% respectively for incorporation in wheat flour. Noodles made was good source of nutrients because of the amount of nutrients present in noodles example crude protein (14.29%), crude fat (4.98%), crude fiber (4.02%), ash (1.54%) and calcium (498 mg/100g). Microbial study was done for deciding the different packaging material HDPE or LDPE, which is good for packaging of noodles. In HDPE, yeast and mold count was ranged from $0.06*10^2$ to $0.12*10^2$ CFU/g. The yeast and mold count in LDPE packaging is $0.06*10^2$ to $0.26*10^2$ CFU/g. This showed that HDPE packed noodles have better shelf life than LDPE packed noodles because as less microbial growth. (Pakhare et al., 2016) [3].

- **Mocaf flour, rice flour and corn flour:** The noodles were prepared from mocaf flour: rice flour: corn flour (40:30:30) formulation. The moisture, ash, protein content in noodles was 10.9 to 14.18%, 1.23 to 1.39% and 4.09 to 5.5% respectively. The values of cooking time (12-13.8 min), cooking loss (10.6-14.3%) and cooking weight (204-248%) (Afifah & Ratnawati., 2017) [8].

- **Green seaweed:** The formulation to prepare noodles were corn flour (5%), tapioca starch (10%), cooked pangasius and green seaweed (U. reticulata) puree (20%). The crude fibre content was higher (2.62+0.18%). With the substitution of 20% seaweed puree, the water absorption increased, which produces softer and spongier textural noodles. The overall score for the properties example taste and flavor was higher as compared to control. The noodles were good in fibre content (Debbarma et al., 2017) [9].

- **Dried pumpkin powder:** The dried pumpkin powder substitution can affect the physical chemical and sensory properties of the noodles. With the increase in dried pumpkin powder, the level of ash and mineral content increased. Color of the prepared noodles was yellowish with lower in lightness as compared to control. With addition of dried pumpkin powder the cooking time decreased but the cooking loss and water absorption increases. The prepared noodles had higher hardness and lower elasticity (tensile strength and breaking length). The substitution of wheat flour with 20% dried pumpkin powder produced the noodles with desired characteristics (Aukkanit et al., 2017) [11].

- **Riceberry flour:** The noodles were prepared by 10% RB. With the increase in concentration of RB flour, the stickiness of the noodles decreased and the appearance become darker, water absorption, breaking length, sensory attributes and cooking time decreased, whereas the cooking loss and tensile strength increased significantly (Sirichokworrakit et al., 2015) [12].

- **Soyabean and carrot pomace flour:** The noodles were prepared from 80% wheat flour, 15% soyabean flour and 5% carrot pomace were best noodles prepared in terms of sensory and cooking qualities. With the increase in soyabean and carrot pomace flour, the cooking loss and

water absorption increases, while there was decrease in breaking length of noodles. The brightness of noodles decreased with increase in carrot pomace substitution (Chepkosgei et al., 2021) [2].

- **Chicken meat noodles:** The noodles were prepared by substituting 30% of the minced chicken meat. The level of moisture and fat increased with increase in meat content. The crude fiber content decreases with increase in meat level is due to higher crude fibers in grain flours as compared to food of animal sources. The ph was declined with increase in meat content because of acidic nature of chicken meat (Verma et al., 2014) [7].

3. Water
Water is an indispensable component that is used in dough making. Water is added to flour during mixing process specifically for hydration, which is necessary for development of gluten. Water hydration of the proteins namely gliadin and glutenin is primarily responsible for formation of gluten and subsequently lead to swelling that form fine strands of continous network, which causes the creation of the viscelastic properties and structure that is associated with dough. (Ololade et al., 2019) [6].

4. Sodium chloride and alkaline salts
Normal and alkaline salts are part of the custom ingredients that is commonly used for the preparation of noodles. Salts have the potential to slow down the process of oxidative discoloration and this lead to production of noodles with more elastic and softer texture. The inhibitory effect shown by the salt on proteolytic enzymes may be considered as factor that is mainly responsible for dough tightening (Ololade et al., 2019) [6].
The yellower coloration of noodles treated with alkaline salts is because of its reaction with the flavones that is present in flour and yielded elastic properties but have softer texture because of the influence of properties of gluten proteins (Karim et al., 2015) [24].

5. Frying oil
Vegetable oil is commonly used to fry noodle blocks, after steaming for gelatinizing the starch further and dehydration for final moisture content. Flavor is the quickest sensory perception of quality of oil. Oil quality is one of the key contributing factor to the flavor of instant noodle quality. During frying, when temperature of the oil is greater than water saturation temperature, there is rapid heat and mass movements, hence substantial amount of frying oil migrates inside the food for the replacement of the expelled moisture (Tarmizi et al., 2013).

6. Additives used in noodles
Hydrocolloids, starch, enzymes, polyphosphates, emulsifiers and antioxidants are most commonly used additives used in making of noodle for enhancing the quality of the noodles. Some of the additives used to minimize the oil intake by instant fried noodles are guar gum, carboxymethyl cellulose, acetylated potato starch and transglutaminase (Choy et al., 2012).
Use of guar gum with CMC mixture increased the swelling indices of pearl millet noodles as compared to control sample of the noodles (Hymavathi et al., 2014).

Table 1: Substitution of Different Ingredients in Wheat for Development of Noodles

S. No.	Ingredients Incorporated in Noodles	Formulation	Properties of Prepared Noodles				References
			Moisture (%)	Protein (%)	Cooking Loss (%)	Cooking Time (Min)	
1.	Dried Pumpkin Powder	WF (80g) DPP (20g)	39.59	7.96	11.73	3.57	Aukkanit *et al.*, 2017 [11]
2.	Spinach Puree	WF (100g) SP (40g)	8.98	13.20	7.40	5.18	Shere *et al.*, 2018 [1]
3.	Chicken Meat	WF (63g) Minced chicken meat (MCM) (27g) Starch Corn (SC) (8g)	9.638+0.111	24.113+0.690	6.516	11.167	Johri & Chauhan., 2014
4.	Green Seaweed (*Ulva reticulata*) and Fish Pangasianodon *hypophthalmus* Mince	WF (62g) Corn flour (CF) (95g) Tapioca starch (TS) (10g) Cooked Pangasius Fish Meat (10g) Green seaweed (10g)	8.37+0.19	5.20+0.08	8.20+0.23	6.80+0.71	Debbarma *et al.*, 2017 [9]
5.	Pearl Millet Flour	WF (90g) PMF (10g)	8.2	10.69	1.39	8.05	Shere *et al.*, 2018 [1]
6.	Mocaf Flour + Rice Flour + Corn Flour	MF (50g), RF (30g), CF (20g)	13.13	5.58	14.28	13.75	Afifah & Ratnawati., 2017 [8]
7.	Brown Rice Flour + Mung Bean Powder	BRF (95g) MBP (5g)	13.2+0.1	8.4+0.2	18.67+4.6	5.61+0.37	Muniandy *et al.*, 2019
8.	Riceberry Flour	WF (90g) RBF (10g)	36.92	8.11	5.09+0.01	4.09+0.01	Sirichokworrakit *et al.*, 2015 [12]
9.	Soyabean + Carrot Pomace Flour	WF (80g) SF (15g) CPF (5g)	4.497+0.401	10.161+1.701	9.353+0.124	13.5	Chepkosgei & Orina *et al.*, 2021 [2]
10.	Defatted Rice Bran + Soy Flour	WF (84g) DRB (6g) DSF (10g)	7.43	14.29	1.19	7.30	Pakhare *et al.*, 2016 [3]

From the Table it is Concluded that the Noodles Made From Defatted Rice Bran and Soy Flour is of Good Quality as Compared to Other Formulations Because it is Having Less Moisture Content, High Protein Content and Less Cooking Loss.

Evaluation of the noodles quality
Consumer preference to be put at first while the selection of the criteria of the noodles quality. The another criteria or the factors are appearance (color, shape and size), texture, flavor, eating quality and cooking quality that are generally dependent on characteristics of the raw material example flour used, formulation of ingredients and processing variables. The factors are explained as:

1. **Color:** It is one of the most important factor because this is the one which is first viewed by the consumer and let the consumer know the apparent properties of the noodles. The expectation from the color of the noodles will be yellow tonality or creamy appearance and bright in appearance (Karim *et al.*, 2015) [24]. The factors that affect the color of the noodles is content of xanthophyllor lutein pigment that is generally present in wheat flour, chromophoric shift that is induced by the alkali of the flavonoids, addition of the food colorant by the producers leads to yellowness of the noodles. The activity of polyphenol oxidase and flour ash content are said to influence the whiteness of the noodles (Ololade *et al*., 2019) [6].

2. **Texture:** Texture is a factor that varies greatly by region because flour quality, choice and level of salt or alkaline mixtures including the processing variables example steaming, sheeting, dehydration techniques vary greatly with region. The flour that is having high content of the protein and dough resistance, lower maltose level produced noodles that had acceptable textural characteristics (Gulia *et al*., 2014) [23].

3. The combination of the mahine testing is more appropriate for assessing the texture of the noodles. Textural profile analysis (TPA) is a method for the evaluation of the texture. TPA analysis involves properties example chewiness, gumminess, firmness and cohesiveness (Gulia *et al*., 2014) [23].

4. **Flavor:** This is one of the factor that is important to consider. Presence of the rancid flavor because of over extended storage period leads to the rejection of product (Chen *et al*., 2013) [13]. Oil quality is the major factor that determines whether the flavor of noodles after a particular storage time would be desirable or not that means good quality oil must be used during ormulation of the noodles to yield good flavor (Ololade *et al*. 2019) [6].

5. **Oil Absorption:** It is one of the important factor that determines the quality of the prepared noodles. During frying of the noodles, the frying temperature causes evaporation of moisture from the noodles and that lead to replacement of evaporated moisture with oil (Kim *et al*., 2013) [31].

6. Gluten quality and content have great role in oil uptake of noodles during frying, the role in the formation of rigid structure network, which leads to the formation of dough more elastic that suggested hat it would be less permeable to the oil absorption (Gulia *et al*., 2014) [23].

7. **Cooking quality:** It is the combination of factors including rehydration rate, cooking loss and cooking time (Purwandari *et al*., 2014) [15].

The cooking qualities is influenced by the flour quality, other ingredients and processing. Proteins are reported to form essential structural elements during cooking of noodles, causing the noodle strands to amalgamate and this leads to

reduction in cooking loss (Ololade *et al.*, 2019) [6].

Starch granules swell and then entrapped in the protein matrix that is coagulated during cooking to form a continous, strengthened network that helps to maintain the integrity in the process (Ololade *et al.*, 2019) [6].

Intervention and public health concerns

The deficiencies of the dietary nutrients results in different forms of the diseases that adversely affect the productivity of the humans and subsequently it negatively affected the economic growth (United States Organization., 2012) [16].

Different fortification programs and nutritional education helps to overcome the macro and micronutrient deficiencies that guide the people to select a balanced diet Consumer attention has recently focused on low calorie food products with focus on eating healthy and increase in content of fiber in a balanced diet. To overcome problem of nutrient deficiencies, staple foods are used to fortified (FAO., 2014)

Wheat is the main ingredient present in preparation of noodles which is usually substituted with other ingredients. Wheat undergoes nutrient losses during milling, therefore fortification is the only solution to overcome the problem that is to reduce the risk of neural tube defects that is caused by insufficient folic acid and nutritional deficiencies caused anemia (Barkley *et al.*, 2015) [19].

Because of the use of various synthetic ingredients as MSG, colors, flavors, humectants, thickeners, acid regulators, antioxidants, flour anticaking agents many of which are sodium based, which is concern for public health (McGuire *et al.*, 2016). Substitution of wheat flour with defatted soy flour and whey protein concentrate reduces the uptake of fats, increase the protein content and enhance the in-vitro protein digestibility (Sudha *et al.*, 2011) [32].

Substitution of wheat flour with 10% preharvest dropped apple powder reduces the oil absorption index by 6.9% with fewer and smaller voids that retained oil on noodles strands (Kim *et al.*, 2013) [31]. A major intervention was the development of instant dried noodles, which involves air drying replacing frying process. This has been attractive alternative for health concern people (Gatade *et al.*, 2015) [21].

Conclusion

Efforts are underway for the improvement in formulation, extend the shelf life and to promote the fortification of the noodles. Noodles are the staple food in Asian countries like China, Japan and Korea, but the consumption of the noodles had spread all over the world. Noodles received the acceptance globally because of convenience, texture, flavor, minimal cooking time and affordable price. The basic unit operation that form the production technology which are mixing, dough resting, sheeting, slitting and waving, steaming, frying/drying, cooling and packing. Furthermore, fortification of the noodles with essential micronutrient-vitamins, minerals and fiber for the enhancement of nutritional attributes that ensure better nutrition to the people. Wheat flour that has the lower ash content, low starch gel strength, lower damaged starch, higher protein content and higher SDS-sedimentation value is considered desirable for the production of noodles. Technologies like confocal laser scanning microscopy and epifluorescence light microscopy can be used to know the microstructure changes in the dough and noodles while NIR spectroscopy is used to analyse the other quality parameters.

The health concerns attributed to fat content in the noodles.

Factors affecting the oil/fat uptake and identification of the strategies to reduce the oil/fat uptake, for the minimization of the associated risks.

In order to ensure healthier human consumption, hurdle technology cannot be over emphasized. Use of antimicrobial agents and antioxidants which are natural should be adopted by the industry for the production of the noodles. Fortification of the seasoning of the noodles with heat labile nutrients would be a option that can be considered because of this fortificants would be protected from heat and moisture to that it get exposed to during noodle processing.

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