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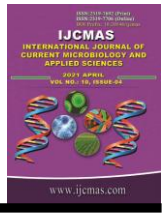

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Role of Food Additives on Functional and Nutritional Properties of Noodles: A Review

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A B S T R A C T

Noodles are considered as a staple food and are consumed all over the world. Noodles become popular due to the ease of availability, easy to cook and less time consuming. People of all ages like to eat noodle and become one of their favorite food. This review paper focuses on the effects of various food additives on the nutritional and functional properties of noodles Use of different types of additives like protein based additives, carbohydrate based additives, enzymes, organic acids and phytochemicals in noodles gain much more attention as these additives improved overall quality of noodles like texture, sensory attributes, enhances shelf life and provides nutrition as well.

Introduction

Food additives has been defined by the Food and Drug administration of the United States (FDA) as "any substance the intended use of which results or may reasonably be expected to result directly or indirectly in its becoming a component or otherwise affecting the characteristics of any food". Food Protection Committee of the Food and Nutrition Board also define food additives as "substance or mixture of substances other than a basic foodstuff, which is present in a food as a result of any aspect of production, processing, storage or packaging. The term does not include chance contaminants". Codex Alimentarius also defines food additives as "any substance not normally consumed as a food itself and not normally used as a typical ingredient of the food, whether or not it has nutritive value".

Noodles originated in China and these are widely used all over the world (Adejunwon *et al.,* 2019). However noodles are among the staple foods and are consumed in many parts of Asia from the times and are gaining popularity widely (Ahmed *et al.,* 2016). Noodles are convenient, takes less cooking time, having convenient shelf stability and

desirable taste. While as noodles can be classified into white salted noodles and yellow alkaline noodles. White salted noodles contain flour, water and sodium chloride. A yellow alkaline noodle besides these components contains potassium and sodium carbonate (Gatade & Sahoo 2013). Noodle products are generally made from common wheat flour by the process of sheeting and cutting. Wheat flour noodles is fortified with various ingredients as sweet potato flour, rye flour, soy flour buckwheat flour, barley flour, coconut flour etc, have been applied to various noodle quality studies (Aydin & Cocmen 2011). Although researchers are investigating the role of noodle fortification with protein and fiber rich ingredients as one of the effective public health intervention and enhance the nutritional attributes, Now a day's consumers all around the world face many health problems for example cardiovascular diseases, obesity, high blood pressure and cholesterol. All these diseases are related to the unfit diet that does not contain antioxidants, phytochemicals and dietary fiber (Pakhare *et al.,* 2018). Noodles lack essential components like proteins, vitamins and dietary fiber during processing (Kong *et al.,* 2012). Noodles are consumed globally at second after bread. For the production of instant noodles having low dietary fiber and protein, wheat flour is generally used. However instant noodle market is gaining popularity in western market of Asian countries. (Chandrajith *et al.,* 2014). Brown rice flour was used in instant fried noodles as a functional ingredient and the quality characteristics were analyzed. Results showed that with the increase in content of brown rice flour there is increase in tough tendency, peak and final viscosities (Kim *et al.,* 2015). Salt that is usually added up to 1 to 3% tightens and strengthens dough gluten and has inhibitory effect on the proteolytic enzymes. However salt enhance flavor and texture as well. The use of antioxidants inhibits oxidation thus avoids rancidity in noodles. Improvers like phosphates and hydrocolloids improve quality of noodles, increases water absorption ability of noodles, modifies dough and also prevents off color formation in noodles (Ahmed *et al.,* 2016). Hydrocolloids resulted in increased dough consistency, produce fresh noodles with larger diameter, firmness, hardness and reduce cooking loss (Gasparre & Rosell 2019). While as enzymes like galactose oxidase, glucose oxidase, peroxidases and lipoxygenase improve quality of noodles, soybean lipoxygenase was found to inhibit the discoloration of white salted noodles. Microbial transglutaminase MTGase increases strength of wheat dough, improves texture in low protein instant noodles (Li *et al.,* 2014). Also hydrocolloids like locust bean gum, carboxymethyl, alginates and guar gum are used in instant noodle processing widely. These hydrocolloids improve texture, increases water absorption in noodles. Starch and gums increased mechanical bonding in the dough. Noodles with alginate showed increased cooking weight, cutting, tensile forces and yellowness and decrease in redness, lightness and cooking loss. Flavoniods and caroteniods are pigments of alkali and wheat reagents that contribute color to noodles (Gulia., 2013). This review focuses on the role of food additives which includes protein based, carbohydrate based, phytochemicals, enzymes and organic acid based additives on nutritional and functional properties of noodles.

Classification of food additives used in noodles

Protein based food additives

Noodles are not rich source of proteins as refined flour is used in the production of noodles. Thus it becomes necessary to add protein that enhances not only functional characteristics but also the nutritional value as

well (Pakhare *et al.*, 2018). By the addition of soy milk the properties like sensory and texture of frozen cooked noodles were improved, continuous protein network was observed in frozen cooked noodles with smaller ice crystals (He *et al.,* 2018). However it had been observed that nutritional composition of maize noodles having 10% soya protein had raised protein content of noodles by 12.7%. Also soluble and insoluble fiber by 3.18 and 21.67 than control having 0.15 and 9.3g only (Shobha *et al.,* 2015). The presence of high content of protein and fat showed lowest swelling power in soy flour. Highest solubility of soy flour is related to the higher protein and water absorption. Increase in antioxidant profile of multigrain noodles was observed and this could be related to the soy flour and sorghum flour (Rani *et al.,* 2019). Gluten-free noodles incorporated with 15% soy flour in wet noodles was accepted and it was seen that with the increase in soy flour content, the carbohydrate content decreases and the protein content increases (Violalita *et al.,* 2020). Whereas microwave dried instant noodles incorporated with egg yolk, chicken meat, and seaweed improved the protein content and decreased the cooking loss (Pongpichaiudom and Songsermpong 2017). Some of the examples of protein based food additives in noodles are listed below:

Carbohydrate based food additives

Wheat flour incorporated with root tuber flour at 10%, 20% and 30% was assessed for nutritional and sensory quality of noodles. However it was found that 10% incorporation of root tuber flour had great effect on the protein, moisture, carbohydrate, fat, gluten and crude fiber. While with the increasing root tuber flour levels in wheat flour, carbohydrate increased while fat and protein levels decreased in noodles (p ‹0.05) (Dankwa *et al.,* 2017). The supplementation of wheat flour with watermelon rind powder at 0, 100, and 150 g/kg was assessed and it was found that 50 to100g/kg had great role on the physicochemical and sensory characteristics of the wet yellow noodles and increased carbohydrate, crude fiber, fat and ash levels were observed on increasing levels of watermelon rind powder (Ho & Dahri 2016). Segoami noodles a newly variety developed with the fortification of amylase contents and dietary fiber which aims to reduce GI. However the 1.5% level of Arabic gum proves to be most effective in improving cooking properties, rheological properties and re-ducing in vitro starch digestibility of Segoami noodles (Bae *et al.,* 2019). However the quality such as as cooking properties, texture characteristics, sensory properties and quality of noodles is affected by the different kinds of physically, chemically, and enzymatically modified starches. Whereas nature of modified starch, the quantity used, presence and absence of gluten and hydrocolloids plays an important role in enhancing the quality of noodles. Now a day's application of modified starches in manufacturing noodles has been increased (Obadi & Xu 2020). Sweet potato flour fortified with 15 & 20% nutriose and sweet potato starch with 10% nutriose which is a resistant starch reduces starch retention in noodles. Also Guar gum at 0.5% in sweet potato starch noodles and 1.0% in sweet potato flour noodles enhances the effect of nutriose in reducing glycemic index of noodles (Menon *et al.,* 2015).

Hydrocolloids perform number of functions in noodles as it increases rehydration, improves food texture, used as gluten substitute, retard the starch retro gradation and extends the overall quality of product (Wang *et al.,* 2018). While the effect of hydrocolloids on the characteristics of noodles both cooked and fresh ones depends on the hydration level during the `production of noodles. Hydrocolloids' resulted in increased dough consistency thus gives fresh noodles having

higher diameter, firmness after cooking, hardness and also reduction in cooking loss was seen. Also 0.5% xanthan gum and alginate out of k-carrageenan, xanthan gum, alginate etc with adjustable water amount reduces cooking loss and provides firmness thus are preferred (Gasparre & Rosell 2019). The hydrocolloids are widely used in instant noodle processing. (0.1–0.5%) gums improves water absorption characteristics of noodles at the time of cooking, enhances the texture and ‘‘mouthfeel” of finished product and reduces the fat absorption at the time of frying of instant noodles as they are having great affinity with water thus having high water binding capacity. Gum and starch are having role in improving bond and mechanical network in the dough (Gulia *et al.,* 2013). However hydrocolloids are used in the noodle production in order to improve water absorption, provide palatable mouth feel and improve texture at the time of cooking. Aliginate increased yellowness, cooking weight, tensile forces and cutting and decreased cooking loss. Gums and starch improved interaction in inter network of dough (Adejunwon *et al.,* 2019). Hydrocolloid like sodium alginate at 0.2g/100g flour proved more efficient along with citric acid 0.6g/100g and 800w microwave for 50s lowers darkening index in green tea fresh noodles (Zhu *et al.,* 2014). Hydrocolloids like xanthan gum, carboxymethyl cellulose and guar gum had great effect on physical properties, digestibility of starch and microstructure of fermented dried natural (Srikaeo *et al.*,(2017). Modified wheat bran dietary fiber (DF) improves the nutritional value of noodles and affects the quality of noodles as well. Microwave treated DF and ultrasonic treated DF were added at 0.5, 1, 1.5 and 2% in wheat flour and it was found that 1.0% microwave treated dietary fiber was preferred in terms of high quality of Chinese noodles. Also results indicated that the color of dough sheets turn darker and the texture of noodles became firmer with the addition of DF. In general the cooking losses and water absorption of noodles increased as compared to the non supplemented samples. The increased tensile distance and breaking strength of the noodles resulted in quality improvement of the noodles (Wang *et al.,* 2017). The Chinese raw noodles incorporated with apple pomace at 5, 10, 15 and 20% (wb) experienced low cooking loss, showed high water absorption due to high dietary fiber content of apple pomace also retains more water than starch. Although 5% to 10% apple pomace levels in refined Chinese raw noodles appeared to be most viable. (Xu *et al.,* 2020).

Enzymes

Polyphenol oxidase (PPO) in raw Asian noodles is responsible for undesirable darkening and requires much more attention. The elimination of PPO activity alone will not reduce darkening as non enzymatic darkening is also there (Furest *et al.,* 2010).Enzymes like galacto oxidase, glucose oxidase, peroxidases and lipoxygenase are used widely for enhancing the quality of noodles as they are generally regarded as safe (GRAS). These replace the chemical oxidants in noodles. According to the study soybean lipoxygenase retards the discoloration of noodles which contain salt. Xylanases enhance firmness and decreases oil uptake in instant noodles (Li *et al.,* 2014). Enzymes like lipase, peroxidase, in buck wheat flour had role in lipid oxidation and quality deterioration. Also generates flavor in boiled buck wheat noodles while as rutin prevents degradation in buck wheat flour. Lipoxygenase does not have any role in lipid oxidation. Mechanism of lipid degradation varies between rice soy bean with buck wheat. In rice and soybean lipoxygenase is important while in buck wheat lipase is given preference. For reduction in deterioration and better flavor rutin concentration and lipase activity proves

effective (Suzuki *et al.,* 2012). The stability and development time of the whole wheat dough was improved with the use of transglutaminase due to the more binding capacity in the gluten network (Niu *et al.,* 2017). However enzymatic discoloration due to the oxidation of phenolic compounds by PPO is responsible for the formation of melanin pigments in whole and straight grade flours as PPO and its phenolic substrates are located in the bran. Although majority of the enzyme is removed during flour milling. Even small amounts of PPO leads discoloration in refined flour products with moisture content such as white salted noodles and yellow alkaline noodles. (Hystad *et al.,* 2016). Whereas noodles made from the high-protein flour and high levels of polyphenol oxidase activity results in darker noodles (Martin *et al.,* 2010). Also largest changes were observed in discoloration within no time after mixing of dough and the gray color of noodles resulted from tyrosine oxidation and formation of melanin. Yellow color resulted from flavones. However brightness of noodles is inversely proportional to the protein content and color of flour. Increasing protein quality results in increasing eating quality as the noodles become more attractive but the color becomes more objectionable. Lower extraction (30 to 75%) results in lower yellowness and brighter color (Baik *et al.,*1995). With the use of soy lecithin and sodium stearoyl lactate (SSL) the properties like textural, micro structural and sensory of the whole wheat noodle were enhanced. Trans glutaminase (TG) increased the hardness and elasticity of cooked whole wheat noodles. TG and SSL influence sensory properties like mouthfeel, bite, springiness and are effective in enhancing gluten strength of whole wheat noodles (Niu *et al.,* 2017). White and bright colored noodles can be prepared by treating with ozone gas as Ozone is having property of reducing PPO activity and also bleach the yellow pigments in the wheat flour (Li *et al.,* 2014).Addition of MTGase to the dough formulation of noodle/pasta can provides a high-quality product with improved sensory and color characteristics. MTGase) extends shelf life with minimum quality losses. MTGase supplemented products showed lower digestion rates and improved cooking properties without color instability when compared to control samples. (Gharibzahedi *et al.,* 2017). Moreover noodle products made from yellow pea flour with the use of TG enzyme resulted in different cooking quality noodle products. The optimum concentration of TG enzyme was found to be 140 mg/ kg in the yellow pea noodle system. Improved sensory properties, high water uptake and low cooking loss were also noticed (Takacs *et al.,* 2006).

Organic acids

Fresh noodles with high moisture content does not remain for longer periods as microbial growth is largely seen in fresh noodles thus shortens shelf life in them. In order to increase shelf life of fresh noodles, natural and chemical preservatives come in use. Which includes organic acids like lactic acid, citric acid and glycine and among inorganic acids like sorbic acid, benzoic acid and propionate were used to prolong the shelf life in fresh noodles (Wang *et al.,* 2018).The combination of lactic acid and citric acid proved more effective in microbial inhibition ranging from 9.5 to 21.0 mm. The antimicrobial activity of lactic acid and citric acid was found to be slightly lower in Bacills cereus than in Staphylococcus aureus and Escherichia coli. When greater than 0.5% solutions of acidulants were applied, the growth of these microorganisms was significantly inhibited (Lin *et al.,* 2016). Noodles that are prepared from rice grains fermented at 40°C showed higher tensile strength, hardness, chewiness and springiness.In the whole process Lactic acid bacteria found to be the dominant bacteria (Yi *et al.,* 2016). Ethanol extracts of

aromatic leaf Murraya koenigii L., improved shelf life in yellow alkaline noodles (Lucera *et al.,* 2012).

Phytochemicals

The production of phenolic antioxidant from the peel waste of sweet potato tuber and incorporation into sweet potato starch for the production of functional noodles proved effective. Noodles fortified with 1% extract of the polyphenol extract of Ipomoea peel improved the antioxidant properties of fortified noodles significantly. Thus the sweet potato peel proved useful in the improvement of the nutraceutical and functional properties of noodles (Kadri *et al.,* 2019). Addition of beetroot pulp to wheat flour significantly influenced the color, cooking phytochemical, functional, nutritional and sensory attributes of formulated noodles. Addition of beetroot Pulp resulted in the improvement of the color intensity, nutritional value, and bioactive compounds. It was also found that increased levels of beet root incorporation (0 to 40%) increases antioxidant activity as well. Noodles incorporated with 30% beetroot pulp showed best result by improving phytochemical, nutritional, cooking and sensory characteristics (Chhikara *et al.,*). Garlic pepper powder in a suitable amount that was found to be 2% provided the properties those are preferred in flavored rice noodles. Now a day's herbs and spices have been incorporated into ready-to-eat food and processed food in order to convey aroma and flavor thus improving the visual appearance of food. Various researches showed herbs and spices can improve the sensory, physical, chemical, and texture of snack, pasta and noodle products. However the lemon extract was able to inhibit some bacterial growth without having significant influence on the sensory qualities of the products. Fungal activity was also seen to be prohibited in fresh noodles. The extracts of Chinese herbs such as Allium sativum and Piper nigrum extend the shelf life of fresh noodles (Umang *et al.,* 2020). Fortification of noodles by black carrot powder significantly increased the antioxidant activity, the anthocyanin and the total flavoniod content as well. However water absorption and cooking time was positively affected while as sensory properties were negatively affected by incorporation of black carrot powder. Fortification of noodles by 10% black carrot powder provides acceptable values for cooking, sensory, physical and functional properties (Singh *et al.,* 2018). Chitosan by inhibiting the polyphenol oxidase activity can reduce loss of flavonoids, anthocyanins and total phenolic compounds. Higher antioxidant activities of purple highland barley noodles resulted from chitosan reaction with free radicals by intermolecular hydrogen bonding. Chitosan added at 2% was found to be the most efficient in inhibiting the moulds growth. For the improvement of shelf life of noodles during storage, the combined effect between chitosan and other preservation methods, such as bio-preservation, sterilization and microwave proved significant (Zhang *et al.,* 2020). Sorghum noodles indicated an improved nutritional profile as compared to wheat and non-gluten products without sorghum. Although sorghum tannins tends to decrease the digestibility of proteins (commonly around 10–25%), also decrease the digestibility of starch and can generate low glycemic index (GI). Thus gluten-free sorghum pasta and noodles are the great alternative for people suffering celiac disease. Currently gluten free products available in the market are nutritionally inadequate the reason is due to an unbalanced content of protein, carbohydrates, and limited essential nutrients. Thus in order to improve nutritional profile of plant based foods sorghum flour could become a best alternative (Palavecino *et al.,* 2020).

Table.1

Protein based food additive.	Concentrations used.	Optimum concentration found.	Role on noodles.	Reference.
Micro algae (Spirulina platensis)	0%,7%,9%,11% in paste form (Spirulina platensis powder and basil extract in 1:3 ratio)	9%	Increases nutritional value of dried noodles especially protein by 4 times as that of control (8.88 to 38.6%).	(Agustini et al., 2017)
Wheat and malted ragi flour.	90:10, 80:20, 70:30, 60:40, 50:50.	70:30	Provides highest value of protein (9.93% to 15.66%) and fiber (0.3 to 1.35%).	(S et al., 2012)
Multigrain flour (sorghum, soy) and gluten.	Sorghum flour (10- 50%), soy flour (10- 20%) and gluten (2-4%).	Sorghum (24.61%), soy (13.23%) and gluten (2.95%).	Gives high protein (16.63%) than control (13.13%) and fiber (4.78%) than control (0.00%) in noodles.	(Rani et al., 2018)
Garden cress Lepidium sativum) seeds to semolina flour.	5%, 10% and 15% (w/w).	15%	Raised the protein by 13.06% and fiber by 76.80%	(Hanan et al., 2019)
Chickpea or lupine protein concentrates to wheat flour.	5%, 10%, 15%, 20% and 25% replacement concentration in wheat flour	10.74% chickpea, 5.07% lupine protein concentrate.	Improves nutritional quality and protein content were chickpea 58.63% and lupine 57.68% protein concentrate than control 11.24%.	(Kishk & M et al., 2013)
Texturized defatted meal of sunflower, soybean, flaxseed	10%, 20%, 30% and 40% replaced wheat flour formulation.	10% sunflower, 10% flaxseed and 20% soybean.	Increased protein 13.75% for sunflower, 17.64% for soybean and 13.12% for flaxseed as compared to control 9.29%.Fiber by 14.84,14.18 and 9.58% than control 1.57%.	(Bhise et al., 2014)
Fresh egg white in oat noodles	0.0% to 30% in 70% oat noodles. 0% and 25% in 100 % oat noodles	25% in 100% oat noodles	Induced protein aggregation in 100% oat noodles during cooking. In 70% oat noodles SDSEP decreased by 29% and in 100% oat noodles SDSEP decreased by 23% than in 100% wheat noodles decreased by 59%.	(Guo et al., 2020)
Milk and milk born active peptide (casein).	Milk used in 0, 4, 8, 12, 16 and 20% (w/w), active peptide in 0, 5.44, 6.80, 8.16, 9.52 and 10.92 mg/100g	Milk 12% (w/w) and active peptide 6.80 mg/100g	Enhances nutrition value, sensory quality of cooked noodles by improving texture, stickiness, toughness and palatability.	(Li et al., 2016)

Aloe Vera a natural antioxidant improves water hydration properties in the noodles and was seen that it's having better nutritive value, and was most acceptable when used up-to 0.3% in powder form in the formulation of chicken noodles and it also does not affect the sensory qualities as well. But at and above 0.6% in chicken noodles gives bitter taste (Pavan *et al.*, 2019). The TBHQ has a major part in reduction of oxidation thus resulted in increased shelf life in deep fried and steamed instant noodles having fat percentage greater than 15% (Ahmad *et al.*, 2016)

Phytochemicals, pytocides, allicin, diallyl disulfide from garlic, greenery alcohol from oak and terpenes from pine plays a great role in the food industry. Extracts of cloves, green tea, coriander, hops, sage and rosemary prove effective against pathogens related to food (Li *et al.*, 2014).

Others

Color

The red dragon fruit peel extract was used as a colorant in dried noodles. This extract also improves nutritional value of the product. By the use of 30ml red dragon fruit peel extract, best quality of dried noodle was obtained (Silaturahmi *et al.*, 2020).

The study by Herawati and others showed the effect of turmeric on arenga arrow starch noodle that is an alternative carbohydrate and is bright brown to opaque in color and therefore needs color improvement and this change in color was observed with the increase in turmeric extract. Result found was decrease in brightness of noodle color, elongation, tensile strength and compression test of arenga arrow starch noodle. Turmeric extract in small concentration like 3%, 6% does not have much more influence when compared with the control (Herawati *et al.*, 2020).

Salt

Noodles without salt were dipped in solution containing resistant starch like fruit coating. The solution contains salt sodium chloride in the range of 10 to 30% with the aim to evaluate the effect of salt coatings on the cooking, textural, sensory and handling properties. The result was found that salt in the coatings reduces cooking loss, cooking time and increases cooking yield. Overall acceptability like sensory hardness, textural and mechanical parameters were influenced with negative impact by increasing salt content. Thus the salt content rather than type plays a major role in determining the noodle quality (Yeoh *et al.*, 2012). Salt besides providing salty taste salt also masks off taste, provides better mouth feel, reduces cooking time provides soft and elastic texture also having role in inhibiting the growth of microbes and inhibit enzyme activity, oxidation reactions and spoilage (Ahmed *et al.*,2016) Besides wheat flour and water, salt plays an important role in noodles. Sodium chloride addition up to 2 to 3% in noodles strengthening gluten network thus enhance texture of noodles (Wang *et al.*, 2018).

The effect of additives on the functional and nutritional properties was studied. The additives are having an important role in improving the overall quality attributes in noodles. Although noodles are gaining popularity widely but adding additives in noodles for quality improvement gains much more attention thus are preferred by all people. From the study it was found that protein based additives such as soy milk, soy flour, egg yolk, chicken meat and sea weed improves nutritional quality and protein content. However hydrocolloids like xanthan gum, carboxymethyl cellulose, guar gum and alginate at 0.1 to 0.5% improves water absorption, texture and provides pliable mouthfeel. Also gums improved cooking properties, rheological properties and reduces glycemic index. Moreover an enzyme like galacto oxidase, glucose oxidase, peroxidases and lipoxygenase also organic acids like lactic acid, citric acid and glycine and among inorganic acids like sorbic acid, benzoic acid and propionate increased shelf life, prevents browning. Phytochemicals inhibit the growth of microbes thus enhances shelf life. Antimicrobials derived from plants like essential oils of clove, cinnamon, rosemary are more effective without having side effects on human body. However chitosan is also used as an antimicrobial as it is non toxic and is biodegradable in nature. Salt at 2 to 3% helps in strengthening gluten network in dough.

While as red dragon fruit peel extract and turmeric extract besides color provides nutrition as well.

References

Adejunwon, O, H., Jideani, A, I, O., & Falade, K, O. (2019). Quality and Public Health Concerns of Instant Noodles as Influenced by Raw Materials and Processing Technology. https://doi.org/10.1080/87559129.2019.1642348

Agustini, T, W., Ma'ruf, W, F., Widayat., Wibowo, B, A., & Hadiyanto. (2017).Study on the effect of different concentration of Spirulina platensis paste added into dried noodle to its quality characteristics. IOP Conf. Series: Earth and Environmental Science55(2017) 01206,doi:10.1088/1755-1315/55/1/012068.

Ahmed, I., Qazi, I, M., Li, Z., & Ullah, J. (2016). Rice Noodles Materials, Processing and Quality Evaluation. Proceedings of the Pakistan Academy of Sciences. Life and Environmental Sciences 53 (3): 215-238 (2016).

Aydin, E., & Gocmen, D. (2011).Cooking Quality and Sensorial Properties of Noodle Supplemented with Oat Flour, Food Sci. Biotechnol. 20(2): 507-511 (2011) DOI 10.1007/s10068-011-0070-1.

Bae, I, Y., Oh, I, K., Jung, D, S., & Lee, H, G. (2019). Influence of arabic gum on in vitro starch digestibility and noodle-making quality of Segoami. International Journal of Biological Macromolecules 125 (2019) 668–673. https://doi.org/10.1016/j.ijbiomac.2018.12.027 http://www.elsevier.com/locate/ijbiomac.

BAIK, B, K., CZUCHAJOWSKA Z., & POMERANZ, Y. (1995). Discoloration of Dough for Oriental Noodles, American Association of Cereal Chemists, Inc..

Bhise, S., A. Kaur, A., & Aggarwal, P. (2014). Development of protein enriched noodles using texturized defatted meal from sunflower, flaxseed and soybean J Food Sci Technol DOI 10.1007/s13197-014-1630-1.

Carocho, M., Barreiro, M, F., Morales, P., & Ferreira, I, C,F,R. (2014). Adding Molecules to Food, Pros and Cons: Review on Synthetic and Natural Food Additives, doi:10.1111/1541-4337.12065.

Chandrajith, U, G., Bandara, DMSP, Jayathunge, KGLR., & Thilakaratne, BMKS. (2014). Development and quality evaluation of instant rice noodles (cup noodles) International Research Symposium on Postharvest Technology 2014.

Chhikara, N., Kushwaha, K., Jaglan, S., Sharma, P., & Panghal, A. Nutritional, Physicochemical and Functional Quality of Beetroot (Beta vulgaris L.) Incorporated Asian Noodles. doi: 10.1002/cche.10126.

Dankwa, K, O., Liu, Y, J., & Pu, Z, E. (2017). Evaluating the nutritional and sensory quality of bread, cookies and noodles made from wheat supplemented with root tuber flour. British Food Journal, Vol. 119 Issue: 4,pp. 895-908, doi: 10.1108/BFJ-09-2016-0414, http://dx.doi.org/10.1108/BFJ-09-2016-0414.

FUERST, E, P., ANDERSON, J, V., & MORRIS, C, F. (2010). Effects of Polyphenol Oxidase on Noodle Color: Mechanisms, Measurement, and Improvement. Asian Noodles: Science, Technology, and Processing,

Gasparre, N., & Rosell, C, M. (2019).Role of hydrocolloids in gluten free noodles made with tiger nut flour as non-conventional powder, Food Hydrocolloids 97 (2019) 105194

Gatade, A, A., & Sahoo, A, K. (2013). Effect of additives and steaming on quality of air dried noodles. Food Sci Technol, DOI 10.1007/s13197-015-2013-y.

Gharibzahedi, S, M, T., Yousefi, S., & Ioannis S. Chronakis, T, S.(2017). Microbial Transglutaminase in Noodle and Pasta Processing, Critical Reviews in Food Science and Nutrition, DOI: 10.1080/10408398.2017.1367643.

Gulia, N., Dhaka, V., & Khatkar, B, S. (2013). Instant Noodles: Processing, Quality and Nutritional Aspects DOI:10.1080/10408398.2011.638227 http://www.tandfonline.com/loi/bfsn20.

Guo, X, N., Gao, F., & Zhu, K, X. (2020). Effect of fresh egg white addition on the quality characteristics and protein aggregation of oat noodles. Food Chemistry 330 18) (2020) 127319. https://doi.org/10.1016/j.

Hanan, AL-Sayed, M, A., Zidan, N, S., & Abdelaleem, M, A. (2019).Utilization of Garden Cress Seeds (Lepidium sativum L.) as Natural Source of Protein and Dietary Fiber in Noodles. International Journal of

Pharmaceutical Research &Allied Sciences, 2019, 8(3):17-28

He, L, D., Guo, X, N., & Zhu, K, X. (2018). Effect of soybean milk addition on the quality of frozen-cooked noodles, Food Hydrocolloids (2018), doi: 10.1016/j.foodhyd.2018.07.048.

Herawati, E., Araini, D., Miftakhossolikhah, M., Ningrum, V, A., & Pranoto, Y. (2020). The effects of turmeric extract addition on physical and sensory characteristic of arenga-arrowroot starch noodle IOP Conf. Series: Earth and Environmental Science 462 (2020) 012023, doi:10.1088/1755 1315/462/1/012023.

Ho, L, H., & Dahri, N, C. (2016). Effect of watermelon rind powder on physicochemical, textural, and sensory properties of wet yellow noodles, CyTA - Journal of Food, 14:3, 465-472, DOI: 10.1080/19476337.2015.1134672,https://doi.org/10.1080/19476337.2015.1134672.

Hystad S, M., Giroux, M, J., & Martin, J, M. (2016). Impact of Null Polyphenol Oxidase Alleles on White Salted Noodles. Cereal Chem. 93(3):255–262,.http://dx.doi.org/10.1094/CCHEM-05-15-0105-R.

Kadiri, O., Gbadamosi, O., & Akan,, T. (2019). Extraction kinetics, modelling and optimization of phenolic antioxidants from sweet potato peel vis-a-vis RSM, ANN-GA and application in functional noodles. Journal of Food Measurement and Characterization https://doi.org/10.1007/s11694-019-00249-7.

Kim, H, J., Baek, J, J., Min, B, J., Kim, J,H., Yoo, S, H., & Lee, S. (2015).Utilization of brown rice flour as a functional ingredient in instant fried noodles, J Korean Soc Appl Biol Chem (2015) 58(5):637–642 DOI 10.1007/s13765-015-0086-y.

Kishk., & M, Y, F. (2013). QUALITY CHARACTERISTICS OF NOODLE FORTIFIED BY CHICKPEA OR LUPINE PROTEIN CONCENTRATES. Food and Dairy Sci., Mansoura Univ., Vol. 4(10): 519 - 538, 2013.

Kong, M., Chen, X, G., Xing, K., & Park, H, J.(2010). Antimicrobial properties of chitosan and mode of action, International Journal of Food Microbiology 144 (2010) 51–63.

Kong, S., Kim, D, J., Oh, S, K., Choi, I, S., Jeong, H, S., & Lee, J. (2012).Black Rice Bran as an Ingredient in Noodles, Journal of Food Science C303 doi: 10.1111/j.1750-3841.2011.02590.x.

Li, M., Zhu, K, X., Guo, X, N., Brijs, K., & Zhou, H, M. (2014). Natural Additives in Wheat-Based Pasta and Noodle Products: Opportunities For Enhanced Nutritional and Functional Properties, doi:10.1111/1541-4337.12066.

LI, Z., LI, W., GAO, P., HU, Y., & ZAN, L. (2016). INFLUENCE OF MILK AND MILK-BORN ACTIVE PEPTIDEADDITION ON TEXTURAL AND SENSORY CHARACTERISTICS OF NOODLE. Journal of Texture Studies ISSN 1745-4603 doi:10.1111/jtxs.12198.

Lin, H, L., Chen, D, S., Tsai, C, H., & Lin, S, J. (2016). Effects of acidification on the extension of shelf life of Japanese wet-type noodles (woo-long noodle). African Journal of Microbiology Research, DOI:10.5897/AJMR2016.8305 http://www.academicjournals.org/AJMR.

Lucera, A., Costa, C., Conte, A., & Nobile, M, A, D. (2012).Food applications of natural antimicrobial compounds, doi:10.3389/fmicb.2012.00287.

Martin, J, M., Berg, J, E., Petrea Hofer, P., Kephart, K, D., Nash, D., & Bruckner, P, L. (2010). Divergent Selection for Polyphenol Oxidase and Grain Protein and Their Impacts on White Salted Noodle, Bread, and Agronomic Traits in Wheat. Crop Sci. 50:1298–1309 (2010).doi: 10.2135/cropsci2009.07.0408.

Menon, R., Padmaja, G., Jyothi, A, N., Asha, V., & Sajeev, M, S. (2016). Gluten-free starch noodles from sweet potato with reduced starch digestibility and enhanced protein content. J Food Sci Technol, DOI 10.1007/s13197-016-2330-9

Menon, R., Padmaja, G., & Sajeev, M, S. (2015). Cooking behavior and starch digestibility of NUTRIOSE ® (resistant starch) enriched noodles from sweet potato flour and starch, Food Chemistry (2015), doi:http://dx.doi.org/10.1016/j.foodchem.2015.02.148.

Niu, M., Hou, G, G., Kindelspire, J., Krishnan, P., & Zhao, S. (2017) : Microstructural, textural, and sensory properties of whole-wheat noodle modified by enzymes and emulsifiers,Food Chemistry 223 (2017) 16–-24 journal homepage: www.elsevier.com/locate/foodchem.

Nwaoha, I, E, M., & Ugwu, C, I. (2018). Production and Evaluation of Pasta (Noodles) from Rice Cowpea and Orange-Fleshed Sweet Potato Flour Blends. Asian Food Science Journal 4(1):1-25, 2018; Article no.AFSJ.43115, DOI:10.9734/AFSJ/2018/43115.

Obadi, M., & Xu, B. (2020). Review on the physicochemical properties, modifications, and applications of starches and its common modified forms used in noodle products Food Hydrocolloids 112 (2021) 106286, https://doi.org/10.1016/j.foodhyd.2020.106286, http://www.elsevier.com/locate/foodhyd.

Pakhare, K, N., Dagadkhair, A, C., & udachan, I, S. (2018). Enhancement of Nutritional and Functional Characteristics of Noodles by Fortification With Protein and Fiber, Journal of Pharmocognosy and Phytochemistry 2018: 7(1): 351-357 Available online at www.phytojournl.com

Palavecino, P, M., Curti, M, I., Bustos, M, C., Penci, M, C., & Ribotta, P, D. (2020). Sorghum Pasta and Noodles: Technological and Nutritional Aspects. Plant Foods for Human Nutrition https://doi.org/10.1007/s11130-020-00829-9

Pavan, M., Sathu, T., Sunil, B., Vasudevan, V, N., Irshad, A., & Sasi, S. (2019). Effect of Different Level of Natural Antioxidant Aloe Vera in Instant Functional Chicken Noodles. *Int.J.Curr.Microbiol.App.Sci* (2019) *8*(10): 1850-1857, https://doi.org/10.20546/ijcmas.2019.810.215.

Pongpichaiudom, A., Songsermpong, S. (2017). Evaluation of microstructure and quality characteristics of microwave-dried instant noodles enriched with chicken meat, egg yolk, and seaweed Food Measure DOI 10.1007/s11694-017-9613-3

Qi, J., Wang, X., Wang, X., Akoh C, C., & Jin, Q.(2019). Effect of Oil Type and Emulsifier on Oil Absorption of Steam-and-fried Instant Noodles, Journal of Oleo Science doi : 10.5650/jos.ess18217 J. Oleo Sci. 68, (6) 559-566 (2019)

Rani, S., Singh, R., Kaur, B, P., Upadhya, A., & Dinkar B. Kamble, D, B. (2018).Optimization and evaluation of multigrain gluten-enriched instant noodles Appl Biol Chem Online ISSN 2468-0842https://doi.org/10.1007/s13765-018-0387-z.

Rani, S., Singh, R.,.Kamble, D, B., Upadhyay, A., & Kaur, B, P. (2019). Structural and quality evaluation of soy enriched functional noodles. Food Bioscience 32 (2019) 100465 https://doi.org/10.1016/j.fbio.2019.100465.

S, K, S., D, D, A., C, R, R &. K, S, A. (2012). Development of nutrient rich noodles by supplementation with malted ragi flour International Food Research Journal 19(1): 309-313 (2012).

Shobha, D., Vijayalakshmi, D., Puttaramnaik., Asha, K, J. (2015). Effect of maize based composite flour noodles on functional, sensory, nutritional and storage quality. J Food Sci Technol, DOI 10.1007/s13197-015-1890-4.

Silaturahmi., Zaidiyah., & Rahmiati, T, M. (2020). The Utilization of Red Dragon Fruit Peel Extract (*Hylocereus costaricencis*) As a Natural Colorant of Dried Noodle.*Serambi Journal of Agricultural Technology, Vol 2 No.1Hal 136-140. 2020,*E-ISSN: 2684-9879

Singh, J., Kaur, S., & Rasane, P. (2018). Evaluation of the Nutritional and Quality Characteristics of Black Carrot Fortified Instant Noodles. Current Nutrition & Food Science, 2018, 14, 1-8, DOI: 10.2174/1573401313666170724115548.

Srikaeo, K., Laothongsan, P., Lerdluksamee, C. (2012). Effects of gums on physical properties, microstructure and starch digestibility of dried-natural fermented rice noodles, International journal homepage: www.elsevier.com/locate/foodchem, doi: 10.1111/j.1750- 3841.2011.02590.x.

Suzuki, T., Mukasa, Y., Morishita, T., Woo, S, H., Kim, S, J. Noda, T., Takigawa, S., & Yamauchi, H. (2012). Possible Roles of Lipase, Lipoxygenase Journal of Biological Macromolecules 109 (2018) 517-523 homepage: www.elsevier.com/locate/ijbiomac.

TAKÁCS, K., NÉMEDI, E., D. MÁRTA, D., É. GELENCSÉR, E., & KOVÁCS, E, T. (2007).USE OF THE ENZYME TRANSGLUTAMINASE FOR DEVELOPING GLUTENFREE NOODLE PRODUCTS FROM PEA FLOUR. DOI: 10.1556/AAlim.2007.0008.

Tuersuntuoheti, T., Wang, Z., Zheng, Y., Wang, S., Wang, Z., Wu, Y., Liang, L., Li, X., Zhang, M. (2019). Study on the shelf life and quality characteristics of highland barley fresh noodles as affected by microwave treatment

and food preservatives.DOI: 10.1002/fsn3.1151.

Utama-ang, N., Cheewinworasa, T., Simawonthamgul, N., & Samakradhamrongthai, R, S. (2020). Influence of garlic and pepper powder on physicochemical and sensory qualities of flavored rice noodle. www.nature.com/scientificreports (2020), | https://doi.org/10.1038/s41598-020-65198-4.

Violalita, F., Evawati., Syahrul, S., Yanti, H, F., & Fahmy, K. (2020).Characteristics of Gluten-Free Wet Noodles Substituted with Soy Flour. IOP Conf. Series: Earth and Environmental Science515 (2020) 012047,doi:10.1088/1755-1315/515/1/012047.

Wang, C,C., Ma, S., Li, L., Zheng, X, L., & Wang, X, X. (2018). Effect of modified dietary fibre from wheat bran on the quality of noodle. Quality Assurance and Safety of Crops & Foods, 2018; 10 (1): 61-68,DOI 10.3920/QAS2017.1076.

Wang, X., Ma, Z., Li, X., Liu, L., Yin, X., Zhang, K., Liu, Y., & Hu, X. (2018) :Food additives and technologies used in Chinese traditional staple foods. Chem. Biol. Technol. Agric. (2018) 5:1 https://doi.org/10.1186/s40538-017-0113-9.

Xu, J., Bock, J, E, Stone, D.(2020).Quality and textural analysis of noodles enriched with apple pomace. Food Process Preserv. 2020;00:e14579. DOI: 10.1111/jfpp.14579.

Yeoh, S, Y., Lubowa, M., Tan, T, C., Murad, M., Easa, A, M. (2020).The use of salt-coating to improve textural, mechanical, cooking and sensory and Peroxidase in Buck Wheat Flour and Noodles, The European Journal of Plant Science and Biotehnology.

Yi, C., Yang, Y., Zhou, S., & He, Y. (2016). Role of Lactic Acid Bacteria in the Eating Qualities of Fermented Rice Noodles. http://dx.doi.org/10.1094/CCHEM-07-16-0187-R.

Zhang, Y., Yin, L., Rasheed, H, A., Xia, X., Tekliye, M., Li, Z., Li, J., Dong, M. (2020). Effects of chitosan on the physicochemical properties, in vitro starch digestibility, antimicrobial potentials, and antioxidant activities of purple highland barley noodles. LWT - Food Science and Technology 132 (2020) 109802, https://doi.org/10.1016/j.lwt.2020.109802.

Zhu, K, X., Dai, X., Guo, X., Peng, W., & Zhou, H, M. (2014). Retarding effects of organic acids, hydrocolloids and microwave treatment on the discoloration of green tea fresh noodles LWT - Food Science and Technology 55 (2014) 176e182 journal homepage: www.elsevier.com/locate/lwt.

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