J. Appl. Res Plant Sci. Vol. 4(1), 370-377, 2023, https://doi.org/10.38211/joarps.2023.04.01.45

Research Article

OPEN ACCESS

Available on https://www.joarps.org
Journal of Applied Research in Plant Sciences
(JOARPS)
ISSN: 2708-3004 (Online), 2708-2997 (Print)

Product Preparation of Instant Noodles from Wheat Flour Supplementing with Sweet Potato Flour

Sana Nawaz[1], Shahzor Gul Khaskheli[1*], Aijaz Hussain Soomro[1], Aasia Akbar Panhwar[1], Ashfaque Ahmed Khaskheli[2], Dileep Kumara Lohano[1] and Shaista Soomro[1]

[1]Institute of Food Sciences and Technology, Faculty of Crop Production, Sindh Agriculture University, Tandojam, Sindh, Pakistan-70060

[2]Department of Food Science and Technology, Faculty of Engineering Science and Technology, Hamdard University Karachi

***Corresponding Author: -mail:** sgkhaskhali@sau.edu.pk*

Article Received 05-10-2022, Article Revised 27-10-2022, Article Accepted 29-11-2022

Abstract

Sweet potato (Ipomoea batatas) available throughout the country and is very important. Sweet potato flour is good source of carbohydrates less expensive and highly beneficial. The current study was carried out to evaluate the noodles prepared from the supplemented flour of sweet-potato flour with various proportions. Four different treatments were used for this study including T1 100 % wheat flour, T2 90 % wheat flour and 10 % sweet potato flour, T3 80% wheat flour and 20 % sweet potato flour, and T4 70 % wheat flour and 30 % sweet potato flour. The noodles prepared with T1 = (WF 100 % Control) showed 8.42% moisture, 2.36 ash, 11.11% protein, 6.72% fat content, 59.53% starch, 67.41% carbohydrate, 0.68% crude fiber, 0.11% acidity of water, as compared to noodles prepared with (T3 = WF 80+ SPF 20%) results showed that 8.23% moisture, 5.80% ash, 11.99% protein, 7.23% fat content, 61.50% starch, 68.50% carbohydrate and 0.88% crude fiber, It was concluded that noodles prepared with T1 WF 90% + 10% showed better results in physico-chemical properties of instant noodles. Overall acceptability was given in terms of sensorial parameters due to the good flavor of instant noodles. It was concluded from the study that addition of sweet potato flour improved the visual appearance of noodles from white to creamy, and the texture was found to be softer, as indicated by sensory analysis of the resulting noodle.

Keywords: Self-rising flour, sweet potato, noodles, nutritional quality.

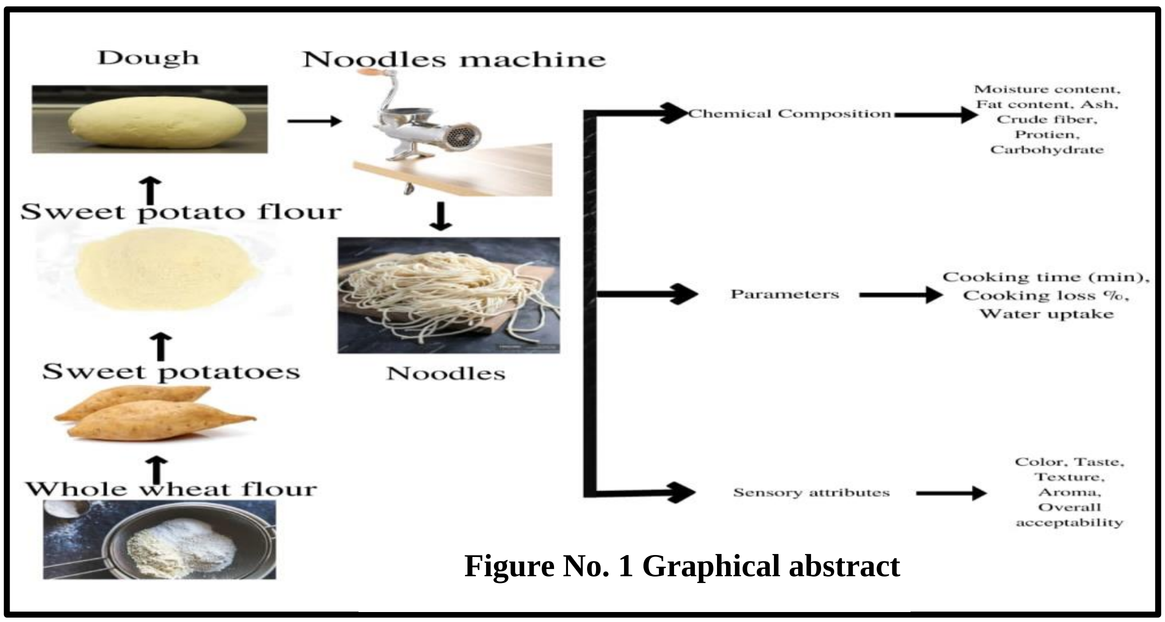

Figure No. 1 Graphical abstract

Introduction

In Asian countries noodles are widely consumed at an average of 20–50% of the total consumption of wheat flour and were developed in China around 5000 BC and dispersed to more Asian countries (Fu. B *et al.*, 2008). Demand for instant noodles is increasing rapidly because of urbanization and modernization, not only in cities but also in rural areas. Noodles are generally produced from wheat flour, water and salt by mixing, sheeting and cutting of dough (Mastromatteo *et al*.,2011; Huang *et al*., 2010). Noodles are available in a variety of styles and sizes, but "instant" noodles have become extremely popular around the world (Akanbi *et al*.,2011). As the noodles play important part in human health by providing high nutritional value and consumers are extremely demanding the product. Sweet potato (Ipomoea batatas) available throughout the country and is important starch-rich tuber crop. The flour of sweet potato is a less expensive, beneficial, and commonly good source of carbohydrates. The sweet potato is the fifth most valuable food next to rice, potato, wheat and maize (FAOSTAT, 2016). It also contain the protein, minerals and many other beneficial nutrients (Woolfe, J.A., 1992), the protein of sweet potato contains essential amino acid composition that is greater to those of cereal proteins. Sweet potato flour can be used in place of brown flour, which has been shown to benefit celiac disease patients. In today's global world, sweet potato flour has developed the ultimate key for creating innovative products. It has been reported that it has high energy content, low protein content, and a high biological value (Hal, *et al.*,2000). Different flours are used such as colocasia, water chestnut and sweet potato and tuber to add the functionality to the noodle products with different substitution (Yadav et al., 2014). The acceptance of noodles is improving, especially in Asian countries, due to the formulation, desired sensory attributes and long shelf life of the product as well as their nutritional value. Flours from different sources such as sweet potato, colocasia, water chestnut, moringa leaf powder for enriching noodles products (Yadav, *et al*.,2014; Mais, *et al*., 2008). Hence, there is a need to supplement wheat flour with other ingredients for developing noodles with good nutritional value (Aemiro *et al*., 2021). Flour can be kept for as long period of time and used to make a variety of products such as pastries, spices, biscuits and baked goods, bread, breakfast cereals, noodles, pasta, sauces, and other beer products are all produced by the food industry (Perez *et al*., 2017). Noodles can be supplemented with a to Wheat flour with arange of materials that can boost fiber, protein etc Ross AS (2013). In recent years food manufacturers have responded to customer demands for foods with higher fiber content by emerging 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. Value added products preparation such as noodles can rise income and boosts the livelihoods for sweet potato farmers in Pakistan adoption due to socio-economic and cultural constraints and in addition enhance the diet of the population and promote the healthy. Such noodles are produced in large quantities in Pakistan and consumed as a regular food director by millions of people. Supplement products/materials can be combined with wheat flour to increase the fiber and protein content of product. Durum 'wheat flour', which is generally used for producing noodles, is running low in fiber, protein, amino acids, and lysine (Yoenyong and Noomhorm 2002). Traditional wheat noodles are low in nutrients because essential nutrients for example the dietary fiber, vitamins, and minerals disappear in the refining process. Due to lack of frost facilities and insufficient post-harvest processing a significant amount of potatoes spoil, wasted, and directly reflects the country's massive economic loss. To reduce the post-harvest losses and it is very important to use of proper technology to convert the sweet potato and useful products in the country to achieve the food security and provides multi benefit like resolving malnutrition and food insecurity in the developing country like Pakistan. Thus, the research was aimed at developing noodles from wheat flour supplemented with sweet-potato flour in order to satisfy consumer's demands with various quantities and characterizing the physico-chemical, cooking, and sensory qualities of noodles.

Materials and Methods

Material: Wheat flour, sweet potato, edible oil, salt, onion powder and garlic powder were procured from a local market of Hyderabad City, Pakistan and then transferred to the food process and product development laboratory of Institute of Food Sciences and Technology, Sindh Agricultural University Tandojam, Sindh, Pakistan during the year 2021. All other chemicals and reagents were of the highest grade commercially available.

Flour preparation method: Sweet Potatoes were washed, peeled, trimmed, sliced and blanched for 5 minutes in boiling water. Cabinet dryer was used for the drying the sliced potatoes at 60-65^{0}C for 8-10 hrs and finally ground to produce sweet potato flour. Flour was kept in a plastic bag and kept at the refrigerator till used.

Formulation and Preparation of noodles: The formulation used for producing instant noodles from composite flour and all the required ingredients are shown in the table No 1. The noodles were prepared according to the method of (Aemiro Tadesse *et al*., 2021) using a small-scale laboratory use extruder with slight modification.

Table No 1. Basic formulation of composite flour instant noodles

S. No.	food ingredients	T_1	T_2	T_3	T_4
1.	Flour of wheat (g)	100%	90%	80%	70%
2.	Flour of sweet potato (g)	0%	10%	20%	30%
3.	Powder Onion (g)	0.5%	0.5%	0.5%	0.5%
4.	Salt (g)	1%	1%	1%	1%
5.	Oil (ml)	5%	5%	5%	5%
6.	Powder Garlic (g)	0.1%	0.1%	0.1%	0.1%

Determination of Chemical analysis: The moisture content, fat content, fiber and protein value were determined using the method of the official Association for Analytical Chemistry (AOAC 2000). The ash content was analyzed according to the method described in (Shogren *et al.,* 2006) using crucible and muffle furnace.

Cooking quality of noodles: Cooking weight and loss was analyzed according to the method by (AOAC 2000). The water uptake difference in weight between cooked and dried noodles was used to compute the water intake. Whereas (AOAC 2000) methods used for calculating the swelling index of cooked noodles. The percent increase in the volume of cooked noodles was determined by the following formula.

$$\% \text{ increase in volume} = \frac{\text{Vol.of cooked noodles (ml)} - \text{Vol.of raw noodles (ml)}}{\text{Vol.of raw noodles}} \times 100$$

Evaluation of cooking quality of noodles: The cooking quality of dry noodles was evaluated using cooking loss, and water absorption.

Determination of cooking weight and cooking loss: Methods modified from (AOAC 2000) were used to determine cooking weight and loss. Each sample was performed three times. Instant noodles (10g) were cooked to precision in 300 mL of distilled water in a beaker, then washed, exhausted, and permitted to chill for 5 minutes. The cooked noodles were re-evaluated after cooling, and the result was noted as a % increase in cooking time. The remaining water was eliminated by drying in a 100°C oven, then cooling and weighing. The results are expressed as a % of weight lost while cooking.

Cooking weight and cooking loss was calculated by given formula.

$$CW = \frac{W_C - W_D}{W_D} \times 100$$

Where:

CW = Cooking weight (%)

WC = Weight of cooked instant noodles, g

WD = Weight of dried instant noodles, g

Water uptake: The variation in weight between steamed and dried noodles was used to compute the water intake. To mark the excess adherent water, the cooked noodles were set on filter paper for 5 minutes before weighing.

Swelling index (%): Cleary and Brennan's procedure for calculating the swelling index of cooked noodles was used (AOAC 2000).

Swelling index was calculated by given formula.

$$\frac{W_C - W_D}{W_D}$$

Swelling Index (%) =

Where;

WC = Weight of cooked noodles, g

WD = Weight of noodles after drying, g

Percent increase in volume: The percent increase in the volume of cooked noodles was determined by the following formula.

$$\% \text{ increase in volume} = \frac{\text{Vol .of cooked noodles (ml)} - \text{Vol .of raw noodles (ml)}}{\text{Vol .of raw noodles}} \times 100$$

Where;
V_1 = Vol. of raw noodles
V_2 = Vol. of cooked noodles

Sensory evaluation: The sensory evaluation was conducted by the faculty members of the IFST, Sindh Agriculture University, Tandojam by using nine-point hedonic scale according to the method of (Shogren *et al.,* 2006). The current panel of judges, as well as all three treatments (T1 to T4), were used to evaluate sensory characteristics such as; Color, Taste, Texture, Aroma and Overall acceptability.

Statistical analysis: The calculated results are presented as the mean value with the standard deviation (mean ± SD). Significant differences were found using analysis of variance (ANOVA) using the software package SPSS (IBM Statistics version 20).

Result and discussion

Proximate composition: The results regarding the Proximate composition of instant noodles supplemented with sweet potato flour at various levels are presented in (Table. 2). The moisture content of the noodles prepared with T4 was significantly higher (8.55%), while the moisture content of the noodles prepared with T_2 and T_3 was significantly lower, 8.27 % and 8.23 %, respectively as compared to 100% wheat-based noodles. T_1 noodles made with WF, on the other hand, have the lowest moisture content 8.42%. Our results are in agreement with the findings of (Kumar, and Prabhasankar, 2013; Quaderi, J. A 2012). Who reported similar findings for the humidity level of rice-based noodles, finding that the moisture content of noodles was 5.00-8.20 %. According to the current study, the moisture content of noodles increases as the WF level increases. The study showed that moisture content of noodles was increased inT_4 = WF 70+ SPF 30 % concentration is increased.

The results showed that the ash content ranged between 4.72 and 5.80 %, with T_3 (5.80%) being significantly higher. T_4 noodles, on the other hand, have the lowest ash content (4.72 %). This demonstrates that 10% sweet potato flour (SPF) is the best option for this parameter. Our findings contradict with the findings of Kang, *et al.,* (2017) they concluded that the value of rice noodles, ranged from 0.24 to 1.51%. As a result, it demonstrates that the current findings are reasonable. The ash content of noodles produced from a mixture of wheat and sweet potato flour decreases as the WF concentration decreases. Further results regarding the protein content of noodles showed highest in T_4 12.53%, while T_2 and T_3 noodles have the lowest protein content, 11.35 % and 11.99 %, respectively. Different researcher (Taneya, *et al* 2014) have been reported same results of sweet potato-wheat instant noodles. The fat content of noodles varied from 7.9 % to 7.23 %, the study showed that noodles produced with T_4, showed fat content (7.9%) as compared to T_1. Our findings are in the agreement with the finding of (Eke-Ejiofor, *et al*., 2015).

The result regarding the starch content showed that noodles prepared with T4 had the highest starch content (62.21%), while the lowest starch content (60.31 % and 60.50%, respectively was recorded in T_2 and T_3. The noodles prepared with T_1, showed lowest starch content (59.53 %) similar finding also were observed by (Pakhare *et al.,* 2016). According to the findings of this study, the starch content of noodles increased with increase of composite flour. This variation could be attributed to a different wheat-to-sweet potato ratio during the noodle-making process. The results regarding the carbohydrate content showed increase as the sweet potato flour (SPF) in wheat flour (WF) increased. Noodles prepared with T4 had the highest carbohydrate content (69.96 %), while T2 and T3 had the lowest carbohydrate content (68.35 % and 68.50 %, respectively). Noodles prepared with T1 have the lowest carbohydrate content (67.41 %). All noodle samples had significantly different carbohydrate contents ($p < 0.05$), and all instant noodle samples had high calorie values. Musa spp-wheat instant noodles have a carbohydrate content of 64.6 – 79.1 %; cassava instant noodles have a carbohydrate content of 70.39-73.80 %; and corn-Tapioca-wheat instant noodles have a carbohydrate content of 68.30% as reported by (Naeshi *et al.*,2011; Omeire, *et al.*,2015). According to the findings of this study, the carbohydrate content of noodles increased as WF levels increased. This variation could be attributed to a different wheat-to-sweet potato ratio during the noodle-making process. Crude fiber of noodles prepared with T_4 had a significant increase in fiber content (0.91 %), while T_2 and T_3 had the lowest fiber content (0.78 % and 0.88 %), respectively. The noodles prepared with T_1 had the lowest fiber (0.68 %). The results for the crude fiber content of WF and SPF-based noodles, crude fiber content of noodles was 0.58-0.54% reported by (Pakhare *et al.,* 2016). The results regarding the acidity of cooking water showed ranged between 0.102 % and 0.09 %, with T_3 (0.102 %) being significantly higher.

The noodles prepared with T_4 noodles, showed lowest acidity of cooking water (0.09 %). The similar results found when using soy flour pasta. According to the current study, acidity of the cooking water of noodles.

Table No 2 proximate composition of instant noodles supplemented with sweet potato flour

Treatments	Moisture %	Ash content	Protein %	Fat content	Starch %	Total carbohydrate	Crude fiber
T_1 = WF 100 % Control	8.42a	2.36a	11.11a	6.72a	59.53c	67.41b	0.68a
T_2= WF 90+ SPF 10 %	8.27a	4.65b	11.35a	6.95a	60.31bc	68.35ab	0.78a
T_3 = WF 80+ SPF 20 %	8.23a	5.80b	11.99ab	7.23b	61.50ab	68.50ab	0.88a
T_4 = WF 70+ SPF 30 %	8.55a	4.72a	12.53a	7.90b	62.21a	69.96a	0.91ab

The different letters significantly indicating differences ($p \leq 0.05$).

Physical properties of noodles: The results regarding the physical properties of instant noodles supplemented with sweet potato flour at various levels are presented in (Table. 3). The cooking loss of noodles prepared with T4 were significantly lower (44%), while the cooking weight and cooking loss (g) of noodles prepared with T_1 and T_3 were significantly higher, 49.67 g and 46.33 g, respectively (Table 3). The noodles prepared with T_2 had highest cooking weight and cooking loss (71.67 g). Noodles produced with T_1showed (158.33g), similar to T_2 (157.0g), T_3 (156.66g), and T_4 (155.33g). The high starch and protein content of the noodle samples will be attributed to the highest cooked weight in according to the (Adebowale et al., 2005). As a result, the current findings are justified, because as the concentration of WF in noodles decreases, so will the cooking weight and weight loss. Noodles qualities in this study were evaluated to the optimum time of each individual sample. The volume of cooked noodles prepared with T_4 was significantly reduced (256.67 %), while the volume of cooked noodles prepared with T_2 and T_3 was the smallest, 260.33% and 278 %, respectively. These results fall within the parameters specified in (Fradique, et al., 2010). Furthermore, noodles produced with T_4 resulted in a significant decrease in the swelling index of the noodles (0.93%), while T_1 and T_3 noodles resulted in the smallest swelling indexes, 1.81 % and 1.03%, respectively. Noodles produce with T_1 has the highest swelling index (2.16 %), followed by T_2 (2.14), T_3 (2.13), and T_4 (2.14%) had higher (p < 0:05). As a result, as the concentration of WF in noodles made from a mixture of wheat and sweet potato flour decreases, so does the swelling index, proving the validity of this study.

The difference in percent increase in volume in T_1 (50 %) remains (p < 0:05) higher. Noodles produced with T_4 had the lowest percent increase in volume (30 %) when compared to the control according to the (Prabhasankar, *et al*., 2009). Noodles prepared with T_4 resulted in a significant maximum weight gain (213.66%), whereas T_2 and T_3 resulted in the smallest weight gains, 188.33 % and 174% respectively. The weight gain of T_1 noodles produced with WF, was the least (148.66 %). Pasta weight gain ranges from 112 % to 127 %, respectively. The results showed that when comparing different levels of spirulina to control samples, weight and volume increases were observed these results are in the contract with similar reports (Jane and Chen 1996; Hutkin. 200).

Table. 3 Physical properties of instant noodles supplemented with sweet potato flour.

Treatments	Acidity of Cooking Water	Cooking wright loss (g)	Volume of Cooked noodles	Swelling Index (%)	Percent Increase in Volume	Weight Increase
T_1 = WF 100 % Control	0.11a	49.67ab	317.33a	1.81a	50.12a	148.66b
T_2 = WF 90+ SPF 10 %	0.09a	71.67a	260.33b	1.85a	38 .14b	188.33ab
T_3 = WF 80+ SPF 20 %	0.102a	46.33ab	278.10b	1.03b	36.66b	174.22ab
T_4 = WF 70+ SPF 30 %	0.06b	44.00b	256.67b	0.93b	30.44c	213.66a

The different letters significantly indicating differences ($p \leq 0.05$).

Sensory evaluation of noodles

The results regarding the sensorial analysis mean scores for color, flavor, texture, and overall acceptability of instant noodles supplemented with sweet potato flour at various levels are presented in (Figure-No 2). The result regarding the color score showed that noodles produced range between 6.6 % and 6.3%, and noodle produced with T_2 (6.6%) remaining significantly higher. Whereas the noodles produced with T_4 had the least amount of color (6.3 %). Our findings contradict the findings reported of (Umego E 2012) the noodles prepared with 30% had the highest color score (7.7), while noodles with only wheat flour had the lowest color score (6.9). furthermore, the taste scores of noodles made from sweet potato flour (SPF) and wheat (WF) ranged from 5.7% to 6.6%, with T_2 (6.6%) being significantly higher. Whereas T_3treatment had the lowest taste rating (6.5 %). This indicates that 10% sweet potato flour (SPF) is the best choice for this variable. Our findings contradict those reported by (Umego 2012). The results revealed that the taste ranged between 6.2% and 6.5%, with T_2 (6.5 %) remaining significantly higher. Our findings resist the findings of (Fari *et al.*, 2011). The score of aroma range was found to be between 5.9 % and 6.5 %, with T_2 (6.5 %) remaining significantly higher as compared to the T_3. The results revealed that the overall acceptability ranged from 6.0 % to -6.9 %, with T_2 (6.9 %) remaining significantly higher acceptability. Based on composition and sensory attributes of the processed noodles, it may be concluded that good quality mixed flour instant noodle may be processed incorporating 10% sweet potato flour in the formulation of instant noodles.

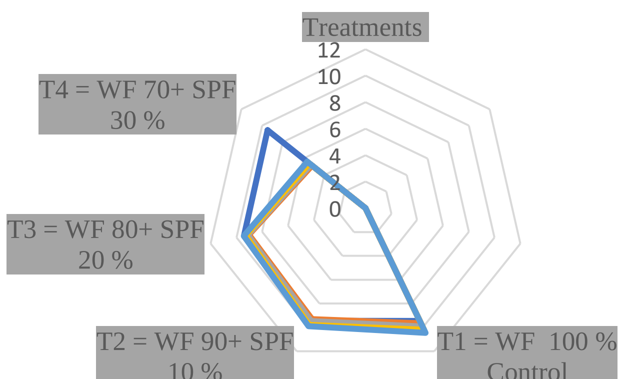

Figure No 2 Sensory evaluation of sweet potato fortified instant noodles

Conclusions

The study concluded that noodles prepared with T_1 WF 90% + 10% showed better results in physico-chemical properties. Significantly moisture (%), ash content, protein (%), fat content, starch (%), carbohydrate total (%), crude fiber (%), water acidity (%), determination of cooking weight and cooking loss, volume of cooked noodles, swelling index, percent increase in volume, weight increase found excellent in the prepared products. Overall acceptability was given in terms of sensorial parameters due to the good flavor of instant noodles. Based on the sensory characteristics of the noodles, it can be concluded that it is possible to produced high quality instant noodles with 10% incorporation of sweet potato flour. It is critical to conduct additional research on the best variety that will produce better results in terms of both sensory and nutritional quality evaluation, which improves general

Acknowledgment

This research paper is part of M.Sc. (Hons.) research and thesis and study was undertaken at Sindh Agriculture University, Tandojam Pakistan.

Conflict T Of Interest:

The authors declare that they have no conflict of interest.

References:

Adebowale AA, Sanni LO, Awonorin SO (2005). Effect of Texture Modifiers on the Physicochemical and Sensory Properties of

Dried Fufu. *Food Science and Technology International*. **11**(5), 373-382.

Akanbi, T. O., Nazamid, S., Adebowale, A. A., Farooq, A., & Olaoye, A. O. (2011). Breadfruit starch-wheat flour noodles: preparation, proximate compositions and culinary properties. International Food Research Journal, **18**(4), 1283.

AOAC (2000) Official Methods of Analysis (2000). 17th Edition, The Association of Official Analytical Chemists, Gaithersburg, MD, USA. Methods **925**(10) 65.17

Eke-Ejiofor, J., Deedam, J. N., & Beleya, E. A. (2015). Effect of addition of three leaf yam flour on dough properties and sensory qualities of bread. Journal of Food Research, **4**(6), 133.

FAOSTAT, (2016). Production quantity [Internet]. Food and Agriculture Organization. Available from: http://www.fao.org/faostat/en.

Fari, M. J. M., Rajapaksa, D., & Ranaweera, K. K. D. S. (2011). Quality characteristics of noodles made from selected varieties of Sri Lankan rice with different physicochemical characteristics. Journal of the National Science Foundation of Sri Lanka, **39**(1).53-60

Fu BX (2008). Asian noodles: History, classification, raw materials, and processing. *Food Research International*. **41**(9), 888-902.

Fradique, M., Batista, A. P., Nunes, M. C., Gouveia, L., Bandarra, N. M., & Raymundo, A. (2010). Incorporation of Chlorella vulgaris and Spirulina maxima biomass in pasta products. Part 1: Preparation and evaluation. Journal of the Science of Food and Agriculture, **90**(10), 1656-1664.

Van Hal, M. (2000). Quality of sweet potato flour during processing and storage. Food Reviews International, **16**(1), 1-37.

Huang, Y. C., & Lai, H. M. (2010). Noodle quality affected by different cereal starches. Journal of Food Engineering, **97**(2), 135-143.

Hutkin, RW, (2006). Microbiology and technology of fermented foods. London; Blackwell Publishing. 12-13 58.

Ghasemzadeh RP, Jaafar, HZ (2011). Effect of CO2 enrichment on synthesis of some primary and secondary metabolites in ginger (Zingiber officinale Roscoe). *International Journal of Molecular Sciences.* **12**(2), 1101-1114.

Jane J, Kasemsuwan T, Chen JF, & Juliano BO, (1996). Phosphorus in rice and other starches. *Cereal Foods World*. **41**(11), 827-832.

Kang, J., Lee, J., Choi, M., Jin, Y., Chang, D., Chang, Y. H., ... & Lee, Y. (2017). Physicochemical and textural properties of noodles prepared from different potato varieties. Preventive nutrition and food science, **22**(3), 246.

Bharath Kumar, S., & Prabhasankar, P. (2015). A study on noodle dough rheology and product quality characteristics of fresh and dried noodles as influenced by low glycemic index ingredient. Journal of food science and technology, **52**(3), 1404-1413.

Mais, A., & Brennan, C. S. (2008). Characterisation of flour, starch and fibre obtained from sweet potato (kumara) tubers, and their utilisation in biscuit production. International journal of food science & technology, **43**(2), 373-379.

Mastromatteo, M., Chillo, S., Iannetti, M., Civica, V., & Del Nobile, M. A. (2011). Formulation optimisation of gluten-free functional spaghetti based on quinoa, maize and soy flours. International journal of food science & technology, **46**(6), 1201-1208.

Nasehi, B., Mortazavi, S. A., Razavi, S. M., Tehrani, M. M., & Karim, R. (2009). Effects of processing variables and full fat soy flour on nutritional and sensory properties of spaghetti using a mixture design approach. International Journal of Food Sciences and Nutrition, **60**(sup1), 112-125.

Ojure MA, Quaderi JA, (2012). Quality evaluation of noodles produced from plantain flou using xanthan gumInternational Journal of Recent Research and Applied Studies, 13; 3–09.

Omeire GC, Nwosu JN, Kabuo NO, Nwosu, MO (2015). Cooking properties and sensory evaluation of enriched cassava or wheat noodles. *International Journal of Innovation*. **3**(2),46-50.

Pakhare, K. N., Dagadkhair, A. C., Udachan, I. S., & Andhale, R. A. (2016). Studies on preparation and quality of nutritious noodles by incorporation of defatted rice bran and soy flour. Journal of Food Processing and Technology, **7**(10): 629.

Pérez, I. C., Mu, T. H., Zhang, M., & Ji, L. L. (2017). Effect of heat treatment to sweet potato flour on dough properties and characteristics of sweet potato-wheat bread. Food Science and Technology International, **23**(8), 708-715.

Prabhasankar, P., Ganesan, P., Bhaskar, N., Hirose, A., Stephen, N., Gowda, L. R., ... & Miyashita, K. J. F. C. (2009). Edible Japanese seaweed, wakame (Undaria pinnatifida) as an ingredient in pasta: Chemical, functional and structural evaluation. Food Chemistry, **115**(2), 501-508.

Ross SA (2013). The arbitrage theory of capital asset pricing. *In Handbook of the fundamentals of financial decision making*: Part I (pp. 11-30).

Shogren, R. L., Hareland, G. A., & Wu, Y. V. (2006). Sensory evaluation and composition of spaghetti fortified with soy flour. Journal of Food Science, **71**(6), S428-S432.

Taneya, M. L. J., Biswas, M. M. H., & Ud-Din, M. S. (2014). The studies on the preparation of instant noodles from wheat flour supplementing with sweet potato flour. Journal of the Bangladesh Agricultural University, **12**(1), 135-142.

Umego E (2012). Chemical composition, physical and sensory properties of fried noodles prepared from wheat, sweet potato and soybean flour blends. A B. Sc. Project, *Department of Food Science and Technology,* University of Nigeria, Nsukka, 5.

Woolfe JA, Sweet potato (1992). An Untapped Food Resource. *Cambridge University Press, Cambridge.*

Yadav, B. S., Yadav, R. B., Kumari, M., & Khatkar, B. S. (2014). Studies on suitability of wheat flour blends with sweet potato, colocasia and water chestnut flours for noodle making. LWT-Food Science and Technology, **57**(1), 352-358.

Yoen yong buddhagal S, Noomhorm A (2002). Effect of raw material preparation on rice vermicelli quality. tarch-Stärke, **54**(11), 534-539.

Zula, A. T., Ayele, D. A., & Egigayhu, W. A. (2021). Proximate composition, antinutritional content, microbial load, and sensory acceptability of noodles formulated from moringa (Moringa oleifera) leaf powder and wheat flour blend. *International Journal of Food Science*. 2021.