Phytochemical Content and Microbial Quality of Instant Noodles Made from Substituting Wheat with Levels of Local Rice and Soybean Flours

Ogbonnaya, M., and Onumadu, K. S.
Department of Food Technology, Abia State Polytechnic, Aba.
DOI: 10.56201/rjfsqc.v10.no6.2024.pg73.80

Abstract

This study was carried out to determine the phytochemical content and microbial quality of noodles produced by substituting wheat (Triticum aestivum) partially with local rice (Oryza sativa L.) flour and soybean (glycine max) flours. Simplex lattice design was to generate the design which the total number of experiments N were 10. The minimum and maximum values for component proportions for flour blends were given by: 50<= X_1 (wheat flour) <=100, 0<=X_2 (rice flour) <=50, 0<=X_3 (soy flour) <=50. The saponin, tannins, flavonoid, phenol values ranged from 0.00 - 17.50 mg/100g, 0.50 - 3.25 mg/100g, 2.15 - 9.8mg/100g, and 0.00 - 4.95 mg/100g, respectively. The saponin, tannin, flavonoid and phenol content increased as the component of soybean increased. The pH values of the noodle samples ranged from 6.15 to 6.80 but not significantly (p>0.05) different. The mean bacterial load of the noodle samples ranged from 1.8 to 2.8 x 10^4 CFU/g. While the fungal values range from 3.5 x 10^1 to 2.5 x 10^2CFU/g. However, these values fell within the maximum standard acceptable for dried foods.

Keywords: *Simplex lattice design, Faro 44, Soybeans, pH, bacterial count, fungal population*

INTRODUCTION

The instant noodle market is growing fast in Asian countries and has gained popularity in the western market. Based on the flour used, Asian style noodles can be broadly grouped into two types - those made from wheat flour and those made from non-wheat flour (Collado and Corke, 2004). Among the noodles made from non-wheat flour, rice flour is one of the most used and it can be used to make vermicelli, as well as sheets and flat noodles (Widjaya, 2010).

Rice flour is commonly used in gluten-free formulations because of its bland taste, high digestibility and hypoallergenic properties (Padalino *et al*., 2016), and is being employed in recent years in functional food, extruded products, coating agent, processing aid, emulsifiers, water binders, flavour carriers and fat replacer (Ahmed *et al*., 2016). Rice noodles, a popular and traditional food in China, are made from rice using the following procedure: soaking, grinding, heating (steaming or boiling), molding (extruding or cutting), cooling, and drying (Li *et al*., 2015)

Soybeans contains numerous bioactive phytochemicals such as saponins, phenols, flavonoids/isoflavones, and tannins which possess excellent immune-active effects in the human body. Soya saponins and soya sapogenols are known to be anticancer, anti-virus, hepatoprotective, protect against cardiovascular diseases, and have antioxidant properties (Wu, and Kang, 2011). The saponins from different sources are known to reduce blood cholesterol levels in human subjects, and in variety of animals. When foods rich in saponins such as soyabean, chickpea, and lucerne are consumed, there form large mixed micelles by the interaction of saponins with bile acids, which account for their increased excretion. This increased metabolism of cholesterol in the liver causes reduction of serum cholesterol (Desai *et al*., 2009). Due to this increasing evidence of saponins health benefits such as cholesterol lowering and anticancer properties, there has been in recent years renewed concentration on food and non-food sources of saponins (Guclu-Ustundag and Mazza, 2007).

There are numerous sources of microbial contamination of food (Alghamdi *et al*., 2018). Residue build up in processing, plants, and equipment constitute some of the significant sources of contamination. Other sources can also be a reflection of the storage conditions, permeability of the materials used to package the samples, contamination from the seals of packets or from handlers before the analysis. Spore forming species may even reside in equipment and adversely affect the microbial quality of end product (Akhigbemidu *et al*., 2015).

The objectives of this study are to determine phytochemical contents and microbial quality of instant noodles produced by partially replacing wheat flour with rice and soybean flours.

MATERIALS AND METHODS

Polished rice of FARO 44 variety used for this study was obtained from Abakaliki rice mill in Ebonyi State, Nigeria. The hard white wheat flour used for the production of instant noodles samples was obtained from the Noodles manufacturing industry located in Uturu, Abia State, Nigeria. The soy beans were purchased in New Market in Aba, Abia State.

Raw Sample Preparation

Preparation of rice flour used for noodles production

Rice grains were cleaned, sorted and washed. They were then steeped in water for 12 h, drained and dried at 60^0C in a hot air oven for 10 h. Milling of the dried rice grains was done using attrition mill make and the milled grains sieved using a 300-µm mesh size sieve to obtain fine flour.

Preparation of soy bean flour

Soybeans were cleaned and sorted, washed and boiled in water at 100^0C for 30 min. It was dehulled manually, oven dried at 70^0C for 15 h milled in a disc attrition mill to obtain the flour followed by sieving using a muslin cloth. The resultant fine flour was stored in air tight polyethylene bags at room temperature for further use.

Formulation of composite blends

Flour mixture of processed wheat, rice, soy flours were prepared to fit into the experimental design as shown in Table 1. The flours were thoroughly mixed at predetermined ratios using a Kenwood food mixer run at a speed of 100 rpm for 3 min to obtain a homogenous blend.

All ingredients were weighed out in their right proportions. A single stage mixing was used in all cases. The alkali mixture i.e. guargum, iodized salt, sodium phosphate, potassium carbonate and water mixed in a mixer with constant stirring for about 20 min. They were then added one after the other to avoid lumps formation. The flow diagram for the noodles production is shown in Figure 1:

Table 1. Blends of Wheat, Rice, and Soy bean Composite Flours

Run	Wheat flour %	Rice flour %	Soybean flour %
1	100	0	0
2	75	25	0
3	75	0	25
4	50	50	0
5	50	25	25
6	50	0	50
7	83.33	8.33	8.33
8	58.33	33.33	8.33
9	58.33	8.33	33.33
10	66.67	16.67	16.67

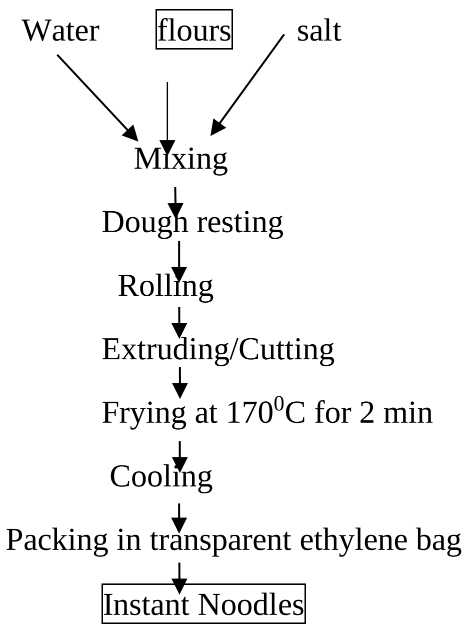

Fig 1: Flow chart for instant noodles production

Determination of Phytochemicals

The saponin, alkaloid, tannin, flavonoids and phenol contents were determined using the method described by Onwuka (2018).

Determination of pH and Microbial Quality

The method employed by Ghaffar *et al*. (2009) was used to determine the pH. Ten gram of samples was homogenized in 90 mL distilled water for 5 minutes at 30^0C and allowed to stand for 1 minute. pH was then measured using an electronic pH meter. Determinations were made in duplicate.

Preparation of culture media

All media for culturing were prepared aseptically according to the manufacturer's instruction and autoclaved at 121 °C for l5 min at 15 lbs/psi (Cheesebrough, 2009).

Nutrient agar medium

A 5.6g of nutrient agar powder was dissolved and homogenized in 200mL of distilled water in two 500 mL conical flasks as instructed by the manufacturer, and sterilized at 121 and 15 lbs/psi pressure in stainless steel autoclave for 15 minutes. The temperature of the molten nutrient agar medium was allowed to drop to 45^0C and 15 mL was dispensed into each sterile glass petri-dishes each and allowed to solidify. The sterile nutrient agar plates were used to determine total heterotrophic organisms in the samples.

RESULTS AND DISCUSSION

Phytochemical content of wheat-rice-soybeans noodles

Table 2 depicts the phytochemical content instant of the noodle samples. There was absent of saponin, tannin, and phenol in samples made from flours with zero % proportion of soy bean flour as shown in samples no 1, 2, and 4. (Table 2).Whereas, the samples no 6 with the highest component proportion of soy bean flour had the highest saponin, tannin, and phenol contents of 17.50, 3.25, and 4.95 mg/100g, respectively. This implies that saponins, tannin, and phenol were not detectable in wheat and rice flour used in this study, but present of in soy beans flour. Flavonoid contents, which ranged from 2.15 to 9.8mg/100g, significantly ($p<0.05$) increased with increase in soy bean component of the flour blends. Similarly to other phytochemicals, the noodle sample produced from 50% wheat and 50% soy bean flour had the highest flavonoid, while the least flavonoid content (2.15 mg/100g) was recorded for the noodle sample produced from flour blends that had zero proportion of the soy bean flour. Generally, phytochemicals are plant-derived chemicals thought to be potentially beneficial to health and can prevent certain degenerative diseases. According to Omeire *et al*. (2014), substituting wheat flour with soybean up to 25% could go a long way to increase noodles variety, make them affordable to many and boost their nutritional content.

Table 2.Phytochemical Content of Wheat-Rice-Soybeans Noodles Samples

S/n	Wheat-Rice-Soy proportions	Saponin (mg/100g)	Tannin (mg/100g)	Total Flavonoids (mg/100g)	Phenol (mg/100g)
1	(100: 0: 0)	0.00	0.00	$3.55^{d}\pm0.07$	0.00
2	(75: 25: 0)	0.00	0.00	$2.15^{e}\pm0.04$	0.00
3	(75: 0: 25)	$9.50^{c}\pm0.61$	$0.80^{d}\pm0.15$	$2.95^{de}\pm0.0$	$4.05^{b}\pm0.07$
4	(50: 50: 0)	0.00	0.00	$4.60^{c}\pm0.21$	0.00
5	(50: 25: 25)	$4.30^{e}\pm0.14$	$1.95^{b}\pm0.01$	$6.50^{b}\pm0.11$	$4.00^{b}\pm0.14$
6	(50: 0: 50)	$17.50^{a}\pm0.81$	3.25a±0.07	$9.80^{de}\pm0.14$	$4.95^{a}\pm0.21$
7	(83.33: 8.33: 8.33)	$1.70^{f}\pm0.14$	$1.65^{bc}\pm0.06$	$2.85^{de}\pm0.07$	$1.78^{de}\pm0.04$
8	(58.33: 33.33: 8.33)	$4.65^{e}\pm0.21$	$0.50^{e}\pm0.03$	$3.15^{d}\pm0.14$	$1.50^{e}\pm0.14$
9	(58.33: 8.33: 33.33)	$10.95^{b}\pm0.07$	$1.85^{b}\pm0.07$	$3.10^{d}\pm0.0$	$2.25^{c}\pm0.04$
10	(66.67: 16.67: 16.67)	$7.65^{d}\pm0.21$	$1.00^{d}\pm0.14$	$3.30^{d}\pm0.11$	$1.95^{cd}\pm0.07$

pH of Noodles Samples

Table 3 showed the values of the pH, bacterial and fungal counts of the instant noodle samples made from blends of wheat, rice, and soy beans composite flours. The pH values ranged from 6.15 to 6.80, (near neutral 7.0). There was no significant ($p>0.05$) difference in the pH values. This near neutral range indicates that a wide range of microorganisms can survive and grow in the noodles samples. Thus, noodles should be properly processed and packaged to avoid contamination. The pH of a food is among the important parameters used to restrict microbial growth in food preservation. Foods with pH over 4.5 are often referred to as *low acid* foods, while those with pH of 4.5 and below are referred to as high acid foods.

Bacterial Counts and Fungal Population of Noodles Samples

The mean bacterial of the noodle samples ranged from 1.8 to 2.8×10^4 CFU/g. These values are comparable with the range of bacterial load ($1.7 – 2.7 \times 10^4$ CFU/g) of noodles studied by Akhigbemidu *et al*. (2015). The fungal values range from 3.5×10^1 to 2.5×10^2 CFU/g. However, these values are within the maximum standard acceptable for dried foods. The East African Standard 747 of 2010 states that dried foods are unacceptable if the total number of microbes (per gram) in them for TVC is $>10^4$ and TFC is $>10^3$ (Ahmed *et al*., 2020). In another standard, a lot of food product is considered acceptable for sale and safe for consumption, if not more than two out of five samples should have counts of mesophilic aerobes falling in the range of 10^5-10^6 CFU/g (Sandy *et al*., 2016). The cut-off point between spoiled and unspoiled food can be considered at the level 10^6 CFU/g, known as level of insipient spoilage and often forms the basis for criteria used to assess food quality (Ghaffar *et al*., 2009).

Table 3. pH and Microbial Quality of the Noodle Samples

s/no	Rice-wateryam-soybeans proportions	pH	Bacterial population (CFU/g	Fungal population (CFU/g)
F1	(100: 0: 0)	6.55 ± 0.05	2.4×10^4	5.0×10^1
F2	(75: 25: 0)	6.30 ± 0.28	2.5×10^4	3.5×10^1
F3	(75: 0: 25)	6.80 ± 0.17	2.8×10^4	1.8×10^2
F4	(50:5 0: 0)	6.45 ± 0.05	2.3×10^4	1.3×10^2
F5	(50: 25: 25)	6.15 ± 0.04	2.5×10^4	1.5×10^2
F6	(50: 0: 50)	6.25 ± 0.02	1.8×10^4	1.7×10^2
F7	(83.33: 8.33: 8.33)	6.65 ± 0.04	2.8×10^4	1.9×10^2
F8	(58.33: 33.33: 8.33)	6.50 ± 0.14	2.8×10^4	2.1×10^2
F9	(58.33: 8.33: 33.33)	6.75 ± 0.32	2.0×10^4	2.0×10^2
F10	(66.67: 16.67: 16.67)	6.55 ± 0.03	2.7×10^4	2.5×10^2
	LSD	NS		

Values are means of triplicate experiments ± SD

The microbial count observed in this study could have occurred during handling of the samples as the research assistants involved in the process may not have taken necessary precautions and as such microbial contamination is prominent. It may also be a reflection of the storage conditions, permeability of the materials used to package the samples, contamination from the seals of packets or from handlers before the analysis.

CONCLUSION AND RECOMMENDATION

The inclusion of soy flour showed significant increase in the phytochemical contents of instant noodle samples. Substituting wheat with some level of soy flour could improve the nutritional quality of noodles. The mean bacterial and fungal counts of the noodle samples within the maximum standard acceptable for dried foods. In other words, the product samples in this study are considered acceptable for sale and safe for consumption having counts below the range of 10^5 to 10^6 CFU.

REFERENCES

Ahmed, I., Qazi, I. M. and Jamal, S. (2016). Proximate compositions and functional properties of blends of broken rice and wheat flours. Sarhad Journal of Agriculture, 32(3):42-50.

Ahmed, T., Sharmin, A., Paul, A., Dipu, M.R. and Islam, T. (2020). Microbiological quality analysis of different types of popular dried food items. *Food Research*, 4(4): 1297 - 1302.

Akhigbemidu, W., Musa, A. and Kuforiji, O. (2015). Assessment of the microbial qualities of noodles and the accompanying seasonings. *Nigerian Food Journal*, 33: 48–53.

Alghamdi, S. S., Khan, M. A., El-Harty, E. H., Ammar, M. H., Farooq, M. and Migdadi, H. M. (2018).Comparative phytochemical profiling of different soybean (Glycine max (L.) Merr) genotypes using GC-MS. Saudi Journal of Biological Sciences, 25(1).

Cheesebrough, M. (2009). District Laboratory Practice in Tropical Countries (2nd Ed.). Cambridge University press pp. 28-94.

Collado, L. S., and Corke, H. (2004). Encyclopedia of grain science Oxford. *Journal of Cereal Science*, 2: 293-304.

Desai, S. D., Dhruv G. Desaib, D. G. and Kaurc, H. (2009). Saponins and their biologicalactivities. Pharma Times, 41(3):13-16.

Ghaffar, S., Abdulamir A. S., Abu Bakar, F., Karim, R. and Saari, N. (2009). Microbial growth, sensory characteristic and pH as potential spoilage indicators of Chinese yellow wet noodles from commercial processing plants. *American Journal of Applied Sciences*, 6(6):1059-1066.

Guclu-Ustundag, O. and Mazza, G. (2007). Saponins: Properties, Applications and Processing. CriticalReviews in Food Science and Nutrition, 47:231–258.

Li, Y., Chen, J., Liang, J. and Han, B. (2015). Traditional Chinese rice noodles: History, classification, and processingmethods. Cereal Foods World, 60(3):123-127.

Omeire, G. C., Umeji, O. F. and Obasi, N. E. (2014). Acceptability of noodles produced from blends of wheat, Acha and soybean composite flours. *Nigerian Food Journal*, 32(1): 31-37.

Padalino, L., Conte, A. and Del Nobile, M. A. (2016). Overview on the general approaches toimprove gluten-free pasta and bread. Foods, 5(87): 1-18.

Sandy, M., Sik Fon, T., Goburdhun, D. and Neetoo, H. (2016). A study on the microbiological quality of fresh noodles sold in Mauritius. African Journal of Food Science and Technology, 7(6): 125-130.

Widjaya, C. (2010). The Impact of Ingredient Formulation and Processing Parameters on Colour and Texture of Instant Noodles. Portfolio: School of Applied Sciences, Engineering and Technology RMIT University.

Wu, X and Kang, J. (2011). Phytochemicals in soy and their health effects. In PhytochemicalsBioactivities and Impact on Health. Arkansas: https://www.researchgate.net/publication.