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Research Article

Studies On The Physico-Chemical And Nutritional Aspects Of Sweet Potato Flour, Sago Starch- Wheat Flour Blend Noodles

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ABSTRACT

The studies on the physico-chemical and nutritional properties of the noodles prepared from blends of wheat flour, sago flour, and sweet potato flour were carried out. The substitution of the noodle flour to enhance product acceptance is one of the strategies, along with the increasing of nutrition content. Sago and sweet potato flour were used to replace the wheat flour at different proportions of which seven treatments were prepared i.e., T0, T1, T2, T3, T4, T5, T6; where T0 is the control sample made with 100% wheat flour. Proximate, mineral analysis and β-carotene were evaluated during the study. It was found that moisture content ranging from 9.44% to 9.79%, protein from 8.43% to 13%, fat from 1.97% to 2.5%, ash from 1.25% to 1.62%, crude fiber from 7.14% to 11%, carbohydrate from 62.44% to 71.39%, magnesium from 86.30 to 136 mg/100g, calcium from 32.90 to 38 mg/100g, iron from 2.92 to 3.86 mg/100g, potassium from 309.45 to 394 mg/100g and β-carotene from 5 to 96.39 µg/100g during estimation. It was concluded that sago, sweet potato flour blend wheat flour noodles should be encouraged as a good source of nutrients and essential minerals that are beneficial for human health.

Keywords: *Noodles, Sweet Potato, Physico-chemical, Minerals, β-carotene*

INTRODUCTION

Noodles are staple foods or widely used traditional foods in Asia because of their variety, convenience, palatability, less cooking time, nutrition, versatility, and flavor (Aydin and Gocmen *et al.,* 2011). After bread, noodles are being consumed second globally. For noodle preparation, the main ingredients required are salt, water and wheat flour, etc., and in dough quality, it plays an important role as well as helps in enhancing the textural properties viz., gumminess, cohesiveness, chewiness, and springiness (Kaur *et al.,* 2005; Zawawi *et al.,* 2014). Commercial noodles lack essential nutrients, such as vitamins, proteins, and dietary fiber. These days' consumer demands food products that have added vitamins, and minerals, and are free from synthetic additives. Therefore, in today's world, one of the greatest challenges is to develop food products that are inexpensive and nutritionally superior, highly acceptable so that they fulfill the needs of the consumers. Due to their high popularity, these could also be used as a way to boost the nutritive value of regular diets (Kumar *et al.,* 2019).

In the world, the most widely cultivated cereal crop is wheat (*Triticum aestivum*). Wheat is a staple food globally, including in India. Aside from being a staple, wheat is used in the preparation of various types of processed food products. The wheat grain consists of approximately 2-3% germ, 13-17% bran, and 80-85% mealy endosperm, with these constituents converted to dry matter basis (Belderok *et al.,* 2000).

The tropical palms like *Metroxylon sagu,* is one of the oldest plam, extract the 'sago' which is a type of starch utilized by man (Mathur *et al.,* 1998). Sago contains resistant starch and antioxidants that have been linked to multiple health benefits, including enhancing exercise performance and improving risk factors for heart disease. Although, sago starch does not contain protein, the heat treatment can be done through a steaming or boiling process which starch gelatinization and eventually undergoes retrogradation forming starch noodles (Engelen *et. al.,* 2015).

The sweet potato also called *Ipomoea batatas* is grown for its underground tuberous roots. It is rich in antioxidants known as beta carotene, which is very effective at raising blood levels of vitamin A, particularly in children (Paul J. *et al.,* 2005). Sweet potato flour plays an important role in the preparation of various food items that can boost the health and nutritional status of consumers (Ndayishimiye *et al.,* 2016; Ngoma *et al.,* 2019).

The product development using composite flour is not yet properly commercialized in developing countries like India, even though it provides multiple health benefits. Thus, the study aims is to develop nutritionally enriched noodles by blending wheat flour, sago flour, and sweet potato flour with different proportions and identifying the proximate content and mineral composition.

MATERIALS AND METHODS

The study was conducted in the Department of Warner College of Dairy Technology, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj, Uttar Pradesh (India).

Raw Materials

Wheat flour, sago flour and sweet potato were purchased from the local market in Prayagraj. Sweet Potatoes were collected from the local market were washed thoroughly, peeled the outer skin, trimmed, sliced into pieces and blanched for about 5 minutes in boiling water. Then, subjected to dry in a cabinet dryer at 60-65^{o} C for 8-10 hours approximately and then, finally ground to produce sweet potato flour. All flours were sieved using 100 µm IS sieve. The sieved flour samples were packed separately and sealed in poly bags, stored at ambient room temperature for further use.

Basic Formulation for Noodle Preparation

The basic formulation of noodle preparation from composite flour is represented in the Table 1 in the form of T0, T1, T2, T3, T4, T5 and T6. In the formulated treatments sweet potato flour variations occurred at 10% and 15%.

Table 1. Basic Formulation of Noodle Preparation from Composite Flour

Treatments	Ingredients		
	Wheat Flour (%)	Sago Flour (%)	Sweet Potato Flour (%)
To	100	-	-
T1	70	30	10
T2	70	30	15
T3	80	20	10
T4	80	20	15
T5	90	10	10
T6	90	10	15

where, T0= Control treatment with 100% wheat flour only; T1= noodles with 70% wheat flour, 30% sago flour and 10% sweet potato flour; T2= noodles with 70% wheat flour, 30% sago flour and 15% sweet potato flour; T3= noodles with 80% wheat flour, 20% sago flour and 10% sweet potato flour; T4= noodles with 80% wheat flour, 20% sago flour and 15% sweet potato flour, T5= noodles with 90% wheat flour, 10% sago flour and 10% sweet potato flour; and T6= noodles with 90% wheat flour, 10% sago flour and 15% sweet potato flour.

Production of Noodles

The noodles were prepared in a noodle extruder machine. Wheat flour, sago flour and sweet potato flour were first mixed for about 5 minutes. In the extruder, the particles of premixed raw materials along with the salt and water were fused due to compaction and kneading it resulted in the formation of homogenous noodle strands. The noodles were then steamed for about 2-3 minutes and dried at 60^{o}C in a hot air oven for about 5 hours and packed in High Density Polyethylene (HDPE) packets and stored at room temperature.

Proximate Analysis

Moisture, fat, protein, ash, crude fiber and carbohydrate were assessed using AOAC, (2000) methods. Moisture was determined by hot air oven method (AOAC, 2000), fat content in the sample was estimated by Soxhlet extraction method (AOAC, 2000), protein content of the sample was determined by Kjeldahl procedure (AOAC, 2000), ash determination was followed by the charring method (AOAC, 2000), crude fiber in noodle sample was determined by (AOAC, 2000) method and carbohydrate was estimated by difference method. All analysis was performed with up to three replicates and results were calculated from 100g of each sample.

Mineral Analysis

Magnesium, calcium, iron and potassium were analyzed using the ICP-MS test method in the noodle sample. β-carotene was determined by using PC-based UV Vis double beam Spectrophotometer Systronic , 2202. All results were mentioned in mg/100g of each sample.

Statistical Analysis

Obtained data were subjected to statistical analysis. Means, Analysis of variance (ANOVA) were determined using one-way ANOVA with the help of Microsoft Excel Software and the differences between the mean values were evaluated using a 5 % level of significance at $p<0.05$.

RESULTS AND DISCUSSIONS

The result of the proximate analysis of the wheat flour blend noodles of which raw materials used were wheat flour, sago flour, and sweet potato flour was represented in Table 2. The results showed that composite flour noodles have higher moisture content (9.47% - 9.79%) and carbohydrate content (66.34% - 71.39%) but slightly lower fat (1.97% - 2.44%), protein (8.43% - 10.98%), ash (1.25% - 1.49%) and crude fiber content (7.14% - 9.29%) as compared to control sample (T0). The level of carbohydrates in the noodles increased due to an increase in the proportions of sago and sweet potato starch in the blend as observed by Mustafa *et al.,* 2019**;** and Woofle, 1992, respectively.

Table 2. Mean Average Proximate Composition of Wheat Flour Blend Noodles

Treatments	Moisture%	Fat%	Protein%	Ash%	Crude Fiber%	Carbohydrate%
T0	9.44±0.24	2.5±0.11	13±0.71	1.62±0.07	11±0.55	62.44±0.22
T1	9.79±0.07	1.97±0.10	8.65±0.36	1.25±0.15	7.33±0.28	71±0.29
T2	9.74±0.23	2.04±0.04	8.43±0.13	1.26±0.14	7.14±0.10	71.39±0.22
T3	9.65±0.15	2.18±0.06	9.82±0.14	1.37±0.05	8.31±0.21	68.67±0.11
T4	9.61±0.07	2.24±0.09	9.54±0.08	1.38±0.14	8.08±0.07	69.15±0.19
T5	9.51±0.21	2.39±0.14	10.98±0.07	1.49±0.12	9.29±0.15	66.34±0.15
T6	9.47±0.12	2.44±0.10	10.66±0.29	1.49±0.10	9.02±0.31	66.92±0.13

Values are the mean of up to three replicates ± SD (Standard Deviation)

Mineral Analysis

Table 3 shows the essential mineral content of the wheat flour blend noodles. The result showed that the noodles made from composite flour have a higher amount of β-carotene content i.e., 96.39 µg/100g in T6 sample as compared to control sample having 5 µg/100g as the concentration of sweet potato flour increased, as reported by FAO, 2001. While slightly lower levels of magnesium, calcium, iron and potassium were found as compared to the control sample.

Table 3. Mean Average Essential Mineral Content of Wheat Flour Blend Noodles

Treatments	Magnesium (mg)	Calcium (mg)	Iron (mg)	Potassium (mg)	β-carotene (µg)
T0	136±3.79	38±1.64	3.86±0.02	394±0.96	5±0.03
T1	89.09±0.82	32.90±0.02	3±0.03	309.45±0.77	67.63±0.04
T2	86.30±0.47	33.04±0.03	2.92±0.04	328.76±0.83	95.52±0.05
T3	101.04±0.03	34.54±0.02	3.20±0.06	349.86±0.82	68.09±0.04
T4	98.04±0.84	34.60±0.02	3.12±0.03	359.86±0.83	95.95±0.05
T5	113.64±0.17	36.18±0.02	3.41±0.02	375.81±0.83	68.54±0.04
T6	109.78±0.06	36.17±0.02	3.32±0.04	391.6±0.73	96.39±0.04

Values are the mean of up to three replicates ± SD (Standard Deviation)

CONCLUSION

It was concluded that developed noodle incorporated with sago flour and sweet potato flour was nutritionally rich in protein, carbohydrate, crude fiber, minerals and β-carotene. Treatment T6 having ratio 90:10:15 suited best for producing nutritionally enriched noodles and having desirable quality noodle products. The developed products may have more market demand due to its nutritional value as compared to available market noodles targeting health-conscious consumers.

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