Original Research Article

Effect of Partial Replacement of Whole Wheat Flour with Sago and Sweet Potato Flour on Organoleptic Attributes of Noodles

ABSTRACT

The present study was conducted to prepare nutritionally enriched noodles that have high dietary fiber and essential mineral content that provide various health benefits. The study aims to evaluate the sensory profile of the noodles, prepared by using fortifying flour i.e., sweet potato flour (SPF) in different concentrations of (10% and 15%) with the addition of wheat flour (90%, 85%, 80%, and 75%) and sago flour (5% and 10%) to formulate 7 samples i.e., C, S1, S2, S3, S4, S5 and S6. Among the different samples, 15% SPF along with 75% wheat flour and 10% sago flour recorded the highest score in terms of organoleptic properties like colour, taste, flavor, texture, appearance, and overall acceptability when compared with control and other samples of the product. It was concluded that the addition of sweet potato flour and sago flour to the noodle flour (wheat flour) resulted in a good quality noodle with an improved softer texture, better visual appearance, appealing taste and flavor and higher acceptance of noodles in terms of overall acceptability. That was also verified by t-test at a significance level of $p<0.05$.

Keywords: Sago flour; sweet-potato flour; nutritionally-enriched noodles; health benefits; fortifying flour;sensory

1. INTRODUCTION

Noodles are gaining popularity worldwide including in India as it is convenient, take less time to cook and also have appealing flavor. Approximately, 40% of the total flour consumed in Asia is used for noodle production [1]. Wheat flour noodles play a significant role in the Asian diet, being a staple for many individuals in the region [2]. Noodles can also be made from alternative flours like rice, buckwheat, and starches from sources such as potatoes, sweet potatoes, and pulses. Traditional noodles lack essential nutrients like dietary fiber, vitamins, and minerals, which are lost during the refinement of wheat flour. Therefore, incorporating sources of fiber and essential nutrients can enhance the health benefits of noodle products, which is also a significant use of wheat [3].

The primary ingredient used to make noodles is hard wheat flour *(Triticum aestivum L.)* [4]. Wheat comes from a type of grass called (*Triticum*) and is very essential cereal because the seed can be ground into semolina, flour, etc., which create the basic ingredients of bread, pasta and noodles as well as other bakery products and consequently, the main source of nutrients presents to most of the world population. In its raw or natural state, wheat is a good source of B2 (riboflavin), vitamin B1 (thiamin), B6 (pyridoxine), niacin, E (Tocopherol), and Zinc and Iron [5].

Metroxylon sagu is one of the oldest tropical palmsfrom which ‘sago’ is extracted. Sago is a type of starch, naturally gluten-free and is a good substitute for wheat-based flour used in cooking and baking highly beneficial for those on restricted diets.It has a low protein value

(0.27%) and a high carbohydrate value (83.35%) [6].It also contains a small amount of fat and fiber and lacks many minerals and vitamins.The usage of sago starch can improve the quality of the noodle as it has some functions as a binding material in making noodles. It also contains 77% amylopectin and 23% amylose [7].

Sweet potato (*Ipomoea batatas*) is an underground root tuber, which belongs to the family of convolulaceaewhich is a dicotyledonous plant. Sweet Potato Flour is flourished with carbohydrates than wheat flour and it has a high anthocyanin content- 519 mg/100g on a wet basis [8]. Anthocyanin contains high levels of antioxidant properties and has the potential to capture free radicals [9]. Sweet potato flour based food items can boostthe health and nutritional status of the consumers [10,11].It also gives a flavour and good taste well-received by consumers in recent studies [12].

The present study was performed to formulate noodles and to analyze sensory properties with having a high nutritional profile by incorporating sweet potato flour and sago flour into the noodle flour i.e., whole wheat flour without considerably affecting the sensory attributes of the product.

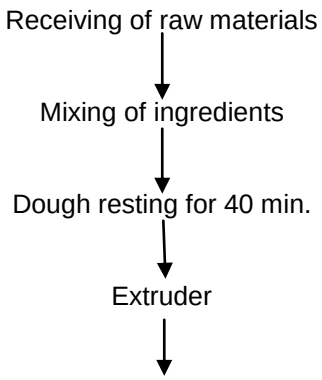
2. MATERIALS AND METHODS

2.1 Raw Materials

Wheat flour and sago flour were purchased from the local market in Prayagraj. Sweet Potatoes also purchased from the local market were subjected to processing to produce sweet potato flour. Sweet potatoes were washed to remove dirt from the skin, peeling off the outer skin, trimming, slicing into pieces and then blanching for about 5 minutes in boiling water. Then, dried in a cabinet dryer for about 8-10 hours at 60-65^0 C temperature and then, finally ground to make sweet potato flour, sealed in poly bags for further use.

2.2 Production of Noodles

The processing of noodles production is shown in Figure 1. Preparation of all the raw materials required for noodle production is done. All the flours were sieved through a 100 µm mesh sieve. All the sieved flours were then weighed and different formulations were made to prepare composite flour samples named C, S1, S2, S3, S4, S5 and S6. These compositions of the mixed flours were followed by hydrating with water to prepare the dough properly. Then, the formed dough is kept for resting for about 40 minutes. Resting is done to homogenize the spreading of water and gluten formation [13]. After the resting is period over, the dough is fed into the extruder, which results in the homogenous noodle strands formation. These noodle strands were steamed before drying for about 2-3 minutes. Steaming was done to gelatinize starch and to coagulate gluten, which resulted in the formation of chewy noodles [14]. Then, noodles were dried at 60^{0}C-75 ^{o}C in a hot air oven for about 6 hours to reach the moisture content at 8-10% level and packed in High-Density Polyethylene (HDPE) packets and stored at room temperature.



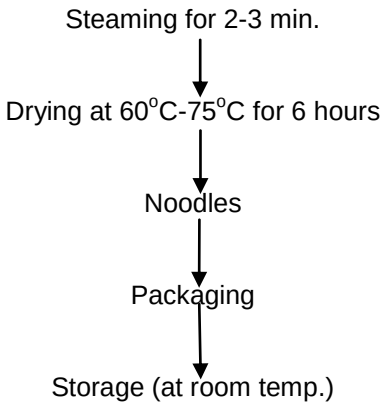


Figure 1. Flow Chart for Noodles Preparation

2.3 Sensory Evaluation

The cooked sweet potato flour, sago starch- wheat flour blend noodles along with the control sample were evaluated for sensory evaluation for their colour, taste, texture, flavor, appearance and overall acceptability by 15 panelists from the department of Warner College of Dairy Technology, SHUATS. Noodles were prepared according to the ideal cooking time-temperature guidelines in boiling water, rinsed and kept in warm conditions until testing. All the samples were appropriately coded before being subjected to sensory evaluation. The "9-point Hedonic scale" was utilized to evaluate the product in which 1= dislike extremely, 2= dislike very much, 3= dislike moderately, 4= dislike slightly, 5= neither like nor dislike, 6= like slightly, 7= like moderately, 8= like very much and 9= like extremely.

2.4 Statistical Analysis

Data obtained were subjected to statistical analysis for up to three replications; reported as means ± standard deviation (SD). Means and Analysis of variance were determined using one-way ANOVA with the help of Microsoft Excel Software and the differences between the mean values were evaluated at $p<0.05$ using a 5 % level of significance.

3. RESULTS AND DISCUSSIONS

3.1 Sensory Evaluation

The sensory evaluation of the wheat flour blend cooked noodles with sweet potato flour and sago starch was carried out based on organoleptic characteristics by comparing each sample. Panelists evaluate a specific food mainly based on its smell, taste, appearance and feel. The mean sensory scores of the noodles prepared by using formulations such as C, S1, S2, S3, S4, S5 and S6 for colour, taste, texture, flavor, appearance and overall acceptability are presented in Table 1 and graphically represented in Figure 2. Analysis of variance was applied for colour, taste, texture, flavor, appearance and overall acceptability of the noodles and the results presented that panelists accepted all the noodles samples with different degrees of acceptability. As the percentage of sweet potato flour increases overall acceptability of the product also increases. Similar results were also reported by Taneya et al., (2014) [15].

Table 1. Mean sensory scores of wheat flour blend noodles with sago and sweet potato flour

Samples	Colour	Taste	Texture	Flavour	Appearance	Overall Acceptability
C	7.92±0.12	8.02±0.09	7.12±0.11	8.22±0.12	8.68±0.07	8.45±0.11
S1	7.20±0.06	6.80±0.35	7.76±0.07	7.44±0.22	6.66±0.29	7.04±0.06
S2	7.24±0.02	6.92±0.08	7.78±0.15	7.64±0.09	7.14±0.04	7.20±0.09
S3	7.84±0.05	7.62±0.22	7.88±0.07	7.88±0.22	7.24±0.04	7.76±0.07
S4	7.46±0.03	7.86±0.07	7.96±0.14	7.98±0.04	7.46±0.22	7.80±0.09
S5	7.50±0.06	8.22±0.09	7.90±0.07	8.10±0.46	8.10±0.09	8.20±0.19
S6	7.64±0.11	8.40±0.18	7.84±0.09	8.68±0.12	8.22±0.12	8.62±0.22

Values are the mean of up to 3 replicates ± standard deviation (SD).

where, C= 100% wheat flour (control), S1= 90% wheat flour, 05% sago flour, 05% sweet potato flour, S2= 85% wheat flour, 05% sago flour, 10% sweet potato flour, S3= 80% wheat flour, 05% sago flour, 15% sweet potato flour, S4= 85% wheat flour, 10% sago flour, 05% sweet potato flour, S5= 80% wheat flour, 10% sago flour and 10% sweet potato flour and S6= 75% wheat flour, 10% sago flour, 15% sweet potato flour.

3.1.1 Colour

As represented in Table 1, the score for colour of all the samples was slightly lower than the control sample (7.92). Among all the formulated samples, S3 has the darkest colour (7.84) containing 80% wheat flour, 05% sago flour and 15% sweet potato flour, which may be due to the processing and composition variations. Similar findings were also reported by Nawaz et al., (2023)[16].

3.1.2 Taste

From Table 1 it is clear that a significantly higher score was recorded for taste in Sample S6 (8.40) having 15% sweet potato flour as compared to the control sample (8.02). A sweet taste was experienced by some panelists; which may come from sweet potato. This may be due to the reason that during processing, a chain of starch is broken into simple sugars; similar findings were also reported by Ticoalu et al., (2016)[17].

3.1.3 Texture

Table 1 showed that there was considerable hard texture in all the experimental samples, highest in sample S4 (7.96), which may be due to the level of substitution of non-gluten flourssuch as sago and sweet potato flour with wheat flour as the power of protein binding becomes less. Thefinding in the present study confirms the findings reported by Kang et al., (2017)[18].Similar findings were also reported by Boonpichai and Sirivongpaisal, (2019)[19]. This may be due to the reason that during dough formation, established networks do not form, which leads to the formation of hard noodles and is prone to breakage also suggested by Khoo et al., (2017) [20].

3.1.4 Flavour

A substantial increment in the scores for flavor in the formulated samples was observed in Table 1, which is highest in Sample S6 (8.68), revealing that there were significant

differences among the samples. A sweet, floral and potato odour was observed which may be due to the volatile compounds present in sweet potatoes, it may also increase consumer acceptance; also reported by Wang and Kays(2000) [21]. Also, a bland flavor was experienced by most of the panelists as samples served were without any added seasonings; similar findings were also reported by Astuti et al., (2020) [22].

3.1.5 Appearance

A significant difference was reported for the appearance of all the samples in Table 1 having varied incorporation levels due to high surface roughness and some dark yellow colour of the noodles.The reason for the surface roughness may be due to the presence of high fiber content and inconsistency that occurred during the processing of the noodles.According to the study reported by Yadav et al., (2014) [23], light yellow colour noodles were formed by using refined wheat flour and sweet potato flour blends. The highest score was observed in control sample C (8.68) followed by formulated sample S6 (8.22).

3.1.6 Overall Acceptability

As it is clear from Table 1, the overall acceptability of Sample S6 has the highest score (8.62), revealing a higher acceptance of the noodles than other samples as well as the control sample (8.45).Through the sensory analysis, the overall acceptability of the S6 sample based ontaste, texture, flavor and appearance is very close to the control sample (100% wheat noodles) which will increase the consumer acceptance of the functional noodles.

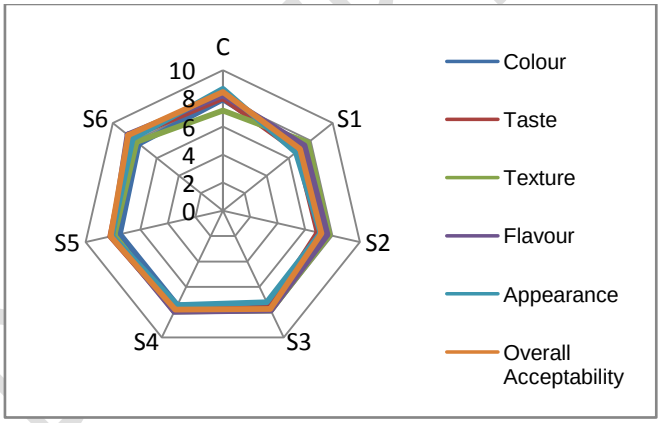


Figure 2. Sensory Analysis of Functional Noodles

4. CONCLUSION

This study reports the effects of the addition of sweet potato flour and sago flour to the noodle flour (wheat flour) on the organoleptic properties of noodles. Noodles made with wheat flour, sago flour and sweet potato flour at a ratio of 75:10:15 resulted in a product having improved nutritional composition and was most acceptable among all the samples based on organoleptic characteristics. These composite flour noodles may gain widespread popularity in society among health-conscious consumers. Consumers demand variety and improved functional and nutritional properties in processed products like noodles.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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