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Study on Nutritional Losses in Composite Cookies Made With Wheat and Sweet Potato Flour with Valid Storage Period

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Abstract

A cookie is a baked or cooked food that is small, flat and sweet, which has an endless combination of ingredients that can be used to give the desired finished product. A study was conducted to evaluate the nutritional variations of cookies from the flour of wheat (Triticumaestivum L.) and sweet potato (Ipomoea batatas L.) during validity storage period of 12 weeks. The mature sweet potatoes (cv. Wariapola Red) were procured from the commercial growers. Tubers were washed, peeled, cut into thin slices of 1 mm thickness and dried in the sun until the pieces were quite brittle. The dried chips were milled, passed through a 250µm sieve and packed in air tight containers. Different composite blends of wheat flour and sweet potato flour were mixed in the ratios of 100:00, 80:20, 60:40, 40:60, 20:80 and 00:100. The cookies supplemented with 40% sweet potato flour were well acceptable in the organoleptic point of view and nutritional combination compared to other treatments. The nutrients such moisture, ash, fiber, fat, protein and soluble carbohydrate content were analyzed. Moisture content of cookie increased with storage period while other nutrients were undergoing to slight reduction. 40% sweet potato flour incorporated cookie packed in aluminum laminating foil pouches, can be consumed with nutrition losses ($p<0.05$) in the period of 12 weeks of storage period with universally accepted standards. The outcome of this research can be used as valuable information for the development of high fiber low gluten sweet cookies.

Keywords: Composite flour; cookies; nutrients loss; storage period; sweet potato flour; wheat flour

1. Introduction

Sweet potato (Ipomoea Batatas Lam) is one of the most important and leading vegetable crop in the world mainly in tropical and subtropical regions. A sweet potato is generally stated to a sustenance, food security or scarcity release crop. Its uses have expanded extensively in the developing countries. Sri Lanka has an extended history of sweet potato cultivation. Sri Lankan Sweet potato has a firm white flesh inside, which has a subtle nutty flavor.

A sweet potato is one of the oldest vegetable known to mankind. Options for sweet potato products are numerous and based on recent diagnostic assessments carried out in developing countries; dried chips, starch, and flour were identified as among the most promising (Collins, 1989 and Okorie et al., 2012). Sweet potato, either fresh, grated, cooked and mashed, or made into flour, could with high potential for success, replace the expensive wheat flour in making cookies, buns,

chapattis (flat unleavened bread) and doughnuts. Starch manufacture is the main industrial utilization of sweet potatoes, which has been used in the preparation of noodles, bakery foods, snack foods, confectionery products and for alcohol production and in brewing industries. The functional properties of the flour are provided not only by the starch, but also by other flour components. The flour is used as a dough conditioner for bread, cookies and cakes, and adds natural sweetness, color and flavor to processed food products (Giami et al., 2004). Excellent roasted, boiled, baked or made into sweet potato chips for a healthy treat.

Sweet potato is now being recognized as a healthy food due to several of its nutritional components because it is large, starchy tuberous root vegetable. They are an excellent source of vitamins and minerals; vitamin A (in the form of β-carotene) and a good source of carbohydrate, dietary fiber, natural sugars, protein, niacin, vitamin B5, vitamin B6, vitamin E, potassium, biotin, iron, calcium, and copper. The use of sweet potato flour for supplementing with wheat flour on the baking could substantially reduce need for wheat, reduction in the usage of sugar on the products, and increase the value of sweet potato. Our approach in the present study was to evaluate the nutritional losses of composite cookies (gluten free sweet cookies) during the storage validity period.

2. Materials and methods

2.1. Procurement of materials

Sweet potatoes (cv. Wariapola Red) without any bruises were acquired locally from the field of commercial grower after harvesting. Roots were washed, sheared and cured to make them free from soil and other foreign materials, rotting, insect damage. Trimming was carried out manually and curing was done at 35 °C for 2-3 days, stored at 12-15 °C at 80% relative humidity till further use. Other major ingredients that are wheat flour, sugar, baking powder, salt and margarine were purchased from the super market. Preparation of sweet potato flour and development of cookies are illustrated in Figures 1 and 2 respectively.

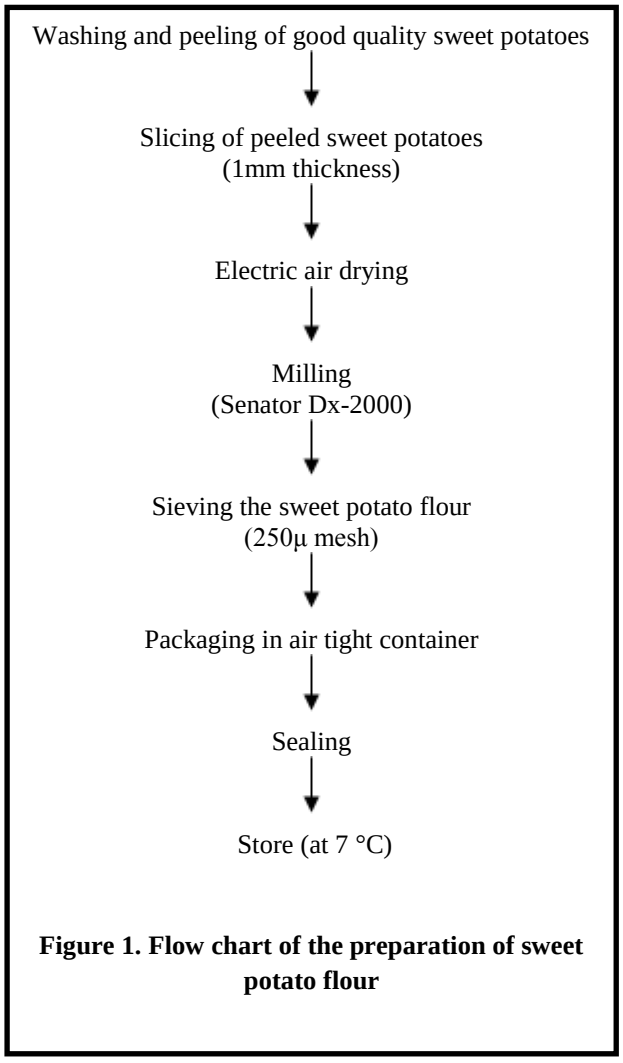

Figure 1. Flow chart of the preparation of sweet potato flour

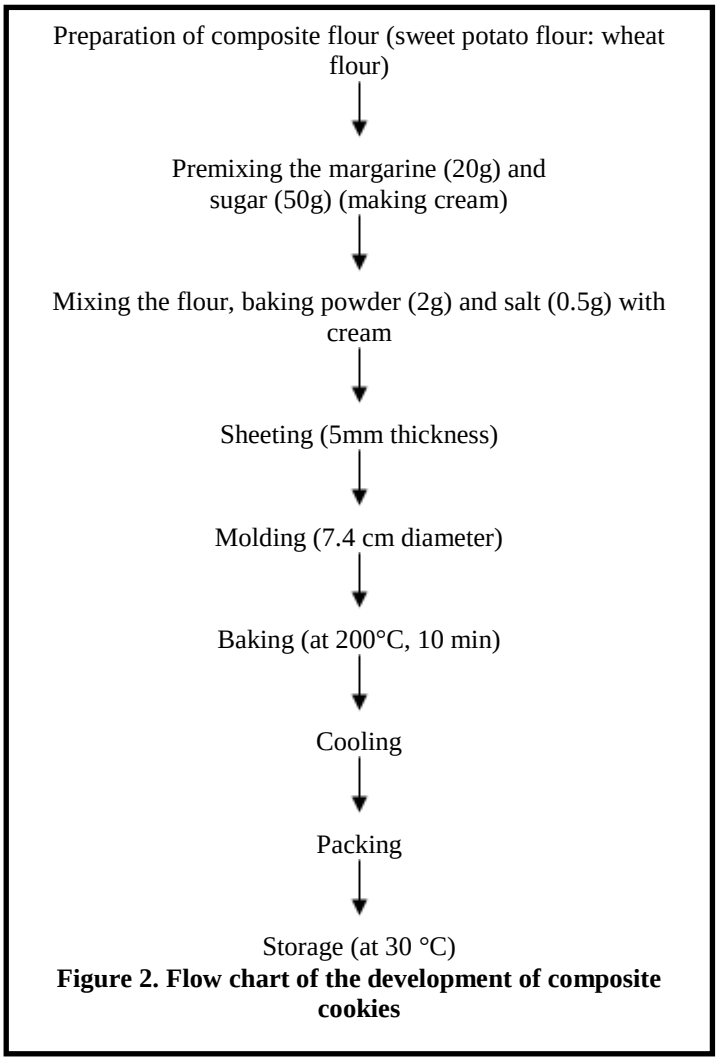

Figure 2. Flow chart of the development of composite cookies

2.2. Experimental combinations of composite cookies

T1: Cookie made by 100% wheat flour
T2: 20 g sweet potato flour + 80 g wheat flour
T3: 40 g sweet potato flour + 60 g wheat flour
T4: 60 g sweet potato flour + 40 g wheat flour
T5: 80 g sweet potato flour + 20 g wheat flour
T6: Cookie made by 100% sweet potato flour

2.3. Nutritional analysis of wheat - sweet potato flour blended cookies

Nutritional qualities such as moisture (oven drying method), carbohydrate (phenol-sulfuric acid method), protein (Kjeldahl Method), fat (AOAC 935.38), ash (AOAC 900.02) and fiber (AOAC 985.29) were analyzed up to the storage validity period. The difference between means was compared using Duncan's multiple range test through Statistical Analysis System (SAS 9.4) software

3. Results and discussion

3.1. Nutritional composition of the sweet potato flour

The nutritional composition of the sweet potato flour used in the study contained 8.1% moisture, 9.4% fiber, 3.6% minerals, 2.3% protein and 11.2% total sugar (Jemziya, and Mahendran, 2015). The nutritional composition of sweet potato flour was closely related to the results obtained by Sukhcharn et al. in 2008. High fiber content increases the utility of sweet potato flour in various food products with health concern. Sweet potato flour also had a lower protein content compared to that the wheat flour (13.7%). Okorie et al. in 2012, reported that most of the non-wheat flours have lower protein but higher carbohydrate content than wheat flour.

3.2. Most accepted level of substitution of sweet potato flour in the blend of cookies

Cookies with various compositions were analyzed regarding nutritional and organoleptic point of view. According to the previous study concluded results of study, 40% sweet potato flour added cookie (T3) has the best quality in nutritional and organoleptic point of view compared to other combinations of wheat and sweet potato flour. From the overall acceptance rating, the 40% sweet potato flour added cookie has the highest mean value and no remarkable changes in organoleptic characters were observed up to three months of storage in ambient condition of average temperature 300C and relative humidity of 75 – 80% (Jemziya, and Mahendran, 2017).

3.3. Nutritional analysis of wheat-sweet potato (40%) composite flour cookies

There was an increase in moisture contents of cookie with storage period. However, a decrease in the protein, crude fiber, ash and fat contents of cookie observed in this study due to the destruction of nutrients and hygroscopic nature. Changes of moisture, ash, fiber, fat and protein content are shown in Figure 3.

3.4. Moisture

According to DMRT, moisture content increased significantly ($p<0.05$) throughout storage period (from 1.352% to 2.013%). There was no significant difference from 4th to 10th weeks of storage period. Cookies are hygroscopic nature. They typically have an equilibrium relative humidity of around 30%. Therefore, in most cases they must be protected from the atmosphere to prevent or at least delay, moisture pick up. Manley in 1986, reported the moisture content in baked goods vary from 4 to 7%. In low and intermediate moisture foods, such as bakery products, the ability of proteins to bind water is critical to the acceptability of these foods (Fennema, 1996).

3.5. Minerals

According to DMRT, content of minerals decreased significantly ($p<0.05$) through the storage period. Content of minerals has very little changes (2.17% to 1.68%) throughout the storage duration. Considerable amounts of some soluble minerals are also dissolved in the water. This also leads to mineral loss throughout the storage period due to hygroscopic nature of the product. Likewise packaging can alter the food composition and thus influence mineral bioavailability.

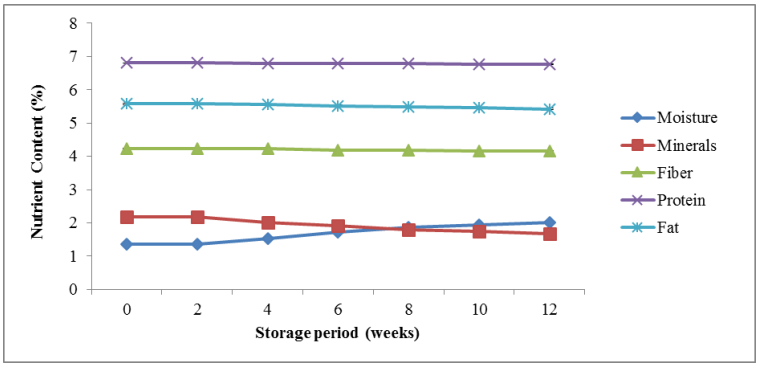

Figure 3. Changes in moisture, minerals, fiber, fat and protein content of 40% sweet potato flour cookies

3.6. Fiber

Reactions during processing that may affect the crude fiber content and its properties are leakage into the processing water, formation of Maillard reaction products thus adding to the lignin content and formation of resistant starch fractions. According to DMRT, fiber content decreased significantly ($p<0.05$) through the storage period. Fiber content has very little changes during the storage period.

3.7. Fat

Fat content is of great economic concern to the food industry, because it leads to development, in edible oil and fat containing foods, of various off flavors and off odors generally called rancid (oxidative rancidity), which render these foods less acceptable. According to DMRT, fat content decreased significantly ($p<0.05$) throughout the storage period (5.57% to 5.42%). There were no significant differences from 4th week until the end of the study period. Reduction may be due to the oxidation of unsaturated fatty acids with the atmospheric oxygen and moisture uptake. Thereby, this will lead to oxidation reaction. In addition, oxidative reactions can reduce the nutritional quality of food (Fennema, 1996).

3.8. Protein

The various flour proteins present in wheat and sweet potato can undergo changes such as protein cross – linking, protein – carbohydrate interactions and protein denaturation during processing and storage of foods, non – enzymatic reaction may cause food deterioration and reduce the shelf life (Singh, 2000). According to DMRT, protein content of cookies decreased significantly ($p<0.05$) throughout the storage period (6.8% to 6.761%). There were no significant differences throughout the study period. This may occur due to interaction between reducing sugars and amino acids (Maillard reaction) and it is a major cause of quality change and degradation of nutritional content in many foods.

3.9. Soluble carbohydrates

Soluble carbohydrate content depends on the combination of other nutrient content such as protein, fat, fiber, ash and moisture. All kind of nutrients except moisture content were decreased throughout the storage period. Therefore, soluble carbohydrate content also shows the decreasing trend from 84.11% to 79.976% (Figure 4).

4. Conclusion

Sweet potatoes are one of the nature's wonderful nutritional and economical resources in the world. Mixture of wheat flour and sweet potato flour could make a protein- fiber enriched baking product with increased economic value. The results of the study revealed that the sweet potato contained a limited amount of protein, although rich in dietary fiber and carbohydrate contents. The results obtained could also be valuable in decision making for industries to take nutritional advantage of sweet potato flour as alternative or supplement to cereal flours. Sweet potato flour could be useful in the manufacture of low gluten sweet cookies.

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