Utilization of Sweet Potato (*Ipomoea batatas*) Flour as an Alternative for Wheat Flour in Bun Preparation

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Abstract
Sweet potato is one of the important and under exploited food crops grown in many countries of the world including Sri Lanka. Although there is a high production, methods of utilization and industrial application of sweet potato are limited. In order to increase its utilization, drying can be regarded as a cost effective processing method. Current study was conducted to find out the possibility of using sweet potato flour as an alternative for wheat flour in bakery industry. Solar dried sweet potato flour was mixed with wheat flour and rice flour in different ratios; 75% Wheat flour and 25% Rice flour (T1: control), 10% Sweet potato flour, 65% Wheat flour and 25% Rice flour (T2), and 15% Sweet potato flour, 60% Wheat flour and 25% Rice flour (T3). According to the consumer preference, best performing treatment was selected. Microbial and physico-chemical (moisture content, crude fiber, fat content, total ash, and pH) characters of the selected combination were determined in triplicates. The storage quality of the selected bun (10% sweet potato flour) packed in LDPE (250 gauge) with or without preservative (calcium propionate-CP) such as T1; control (no added preservatives) T2; 0.3% CP, and T3; 0.15% CP was examined for two weeks period by detecting the moisture (%), colour and microbial quality. Incorporation of sweet potato flour at 10% was successful for preparation of bun with excellent physicochemical and sensory qualities, and it can be stored for 14 days without significant quality deterioration by incorporating of CP (0.3%) as a preservative.

Keywords: Bun, Solar drying, Storage, Sweet potato flour
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Introduction

Sweet potato is native to Central America and is one of the oldest vegetable known to man. It is a seasonal crop grown in tropical and subtropical regions, used mainly for human food. In Sri Lanka, sweet potato is grown in the wet and intermediate zones and nearly about 50,000 tones are produced annually (FAO, 2009). Sweet potato is a good source of vitamins C and E, as well as dietary fiber, potassium, and iron. Also it is low in fat and cholesterol. It serves as an important protein source, and an important source of starch and other carbohydrates the human body needs (Benjamin, 2007). Fresh sweet potato roots are bulky and highly perishable. Therefore production of sweet potato flour is an added advantage to improve its keeping quality and production of value added bakery products. Use of wheat flour in bakery industry is questioned due to various health issues such as poor availability of natural vitamins and minerals in refined white flour. The aim of this study was find out the possibility of using sweet potato flour as substitute for wheat flour in bakery industry.

Materials and Methods

The experiment was conducted at the Food Processing Laboratory, Research and Development Center of the Institute of Postharvest Technology, Anuradhapura.

Sample Collection

Fresh sweet potatoes were purchased from the local market. Diseased and damaged sweet potatoes were discarded to minimize biological variability.

Sweet potato flour preparation

Sweet potato tubers were sorted washed and slices. In order to avoid discoloration, sliced sweet potatoes were subjected to pretreatments by dipping in 1.5 g/L SMS solution for 15 minutes followed by water blanching for 3 minutes at 60°C. Sweet potato then, they was dried in a solar dryer for 48 hrs until reach a final moisture content of (8%). The dried slices were powdered using a grinder and sifted to get fine particles 150μm.

Physicochemical analysis of the sweet potato flour

Moisture, total ash, crude protein, crude fiber, and crude fat contents of the dehydrated sweet potato flour were determined in triplicates according to the standard methods of AOAC (1990).

Product preparation and quality evaluation

Three different recipes were tested ; 75% Wheat flour and 25% Rice flour (T1: control), 10% Sweet potato flour, 65% Wheat flour and 25% Rice flour (T2), and 15% Sweet potato flour, 60% Wheat flour and 25% Rice flour (T3). All three treatments were analyzed for pH (9157 BN, Witchford, England), fat content, crude fiber, total ash, moisture (AOAC, 1990), volume/ Mass Ratio, colour and microbial quality. Colour of prepared buns were observed with suing a colour difference meter (Konica Minolta TR 400) by an increase in the a/b ratio with increase in yellowness (b) and decrease in greenness (a). All three treatments were subjected to consumer acceptability evaluation using 5 point hedonic scale, and the most acceptable product was subjected to phisico-chemical analysis (Moisture content, crude fiber%, Crude fat %, total ash content and volume to mass ratio) to evaluate the product quality. The storage ability of the best treatment (T2) was examined under ambient condition (27±3^{0}C and 70±3%RH) for 14 days in LDPE (250 gauge). With or without addition of preservative (Calcium propionate) (P1; control (no added preservatives) P2 (0.3% preservative) and P3 (0.15% preservative)

Results and Discussion

Evaluation of consumer acceptability

When comparing median values (α=0.05) of sensory scores of external appearance, internal appearance, colour, aroma, taste and texture were in acceptable level in T1 (75% wheat flour and 25% rice flour) rather than T2 and T3. External appearance, internal appearance, aroma, taste and texture were found to be the more acceptable in T2 compared to T3. The results of sensory evaluations exhibited the significant differences *($p<0.05$)* among treatments and bun containing 10% sweet potato flour scored highest rating for overall acceptability (Figure 1).

Evaluation of physicochemical properties

The moisture content of 3 different buns prepared by T1, T2 and T3 were 23.77±0.55, 20.04±0.71 and 15.28±0.28, respectively. These results suggest that the moisture content of the prepared buns were slightly decreased with the increase in sweet potato flour. Moreover, the pH of the prepared buns was slightly increased from 5.22 to 5.81 with increasing sweet potato flour. The fat content of 3 different buns T1, T2 and T3 were 2.06±0.03, 1.96±0.02 and 1.91±0.01, respectively, and the fat, crude fiber, and total ash contents were slightly decreased with increase of sweet potato flour. Benjamin (2007) stated that the sweet potatoes are low in fat and cholesterol, and this might be a reason to observe low fat content with the increase of sweet potato flour levels. Volume to Mass ratio of T1, T2 and T3 were 4.01±0.01, 3.51±0.01 and 3.07±0.02, respectively. SLS 141, (1992) indicated that the bun shall be considered as having a good volume if its volume to mass ratio is not less than 2.5 ml/g. All treatments exhibited the volume to mass ratio greater than 2.5 ml/g and therefore all buns recorded acceptable level in its volume.

The colour of a product can be described in three coordinates: L^* (lightness), from 0 (black) to 100 (white); a^*, from -60 (green) to 60 (red);

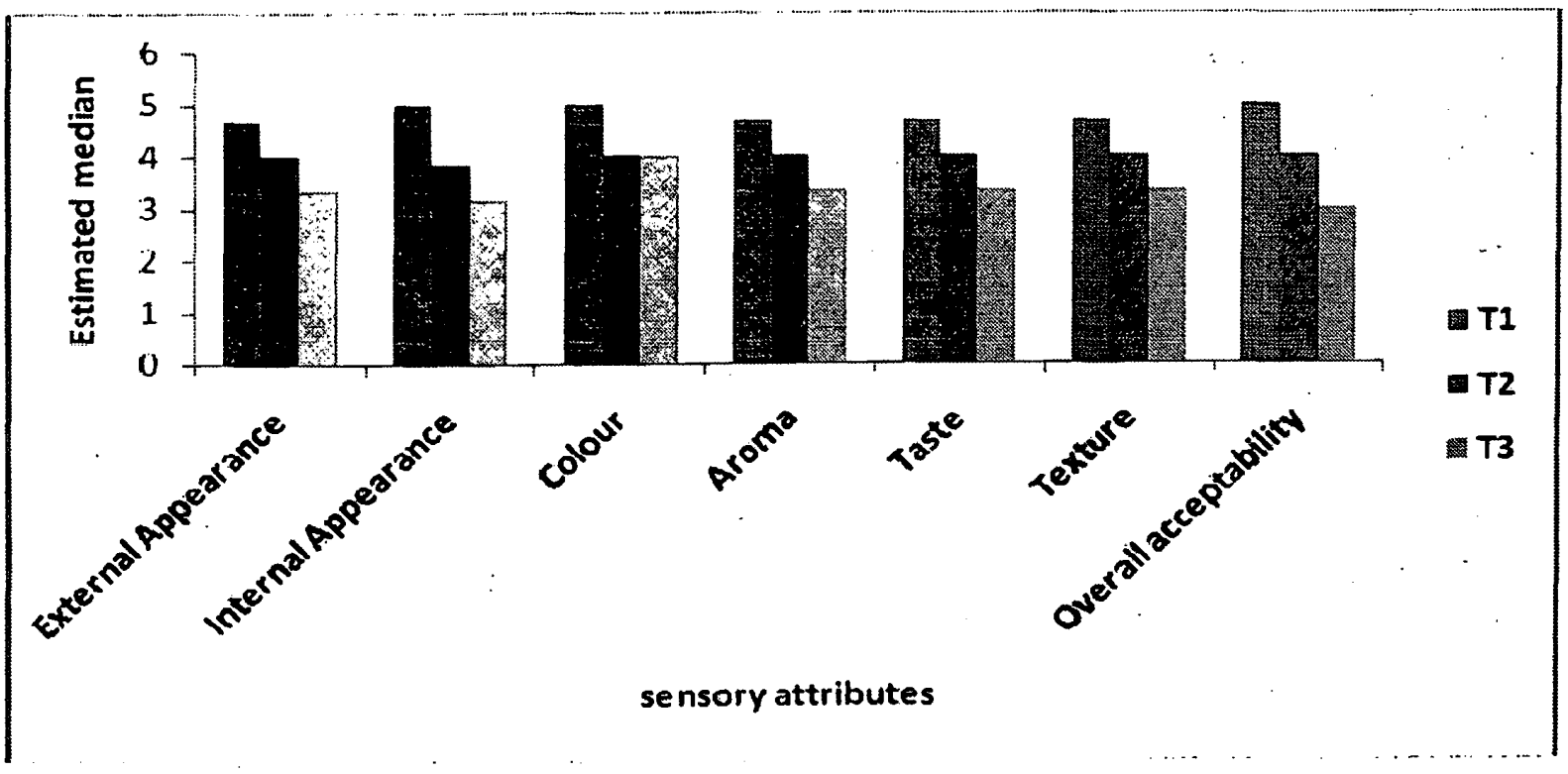

Figure 1: Estimated median for sensory quality attributes of bun
T1-75% Wheat flour and 25% Rice flour; T2- 10% Sweet potato flour, 65% Wheat flour and 25% Rice flour ;T3- 15% Sweet potato flour, 60% Wheat flour and 25% Rice flour

and *b**, from -60 (blue) to 60 (yellow). *L**colour space was changed in different recipes. The colour of T2 was more acceptable than other treatments, and exhibited light yellow colour by appearance. Further in T2, *L**colour space range from 48-49, a*colour space was in the range of 13-14, and *b**colour space was range from 35-36.

Storage quality evaluation

The microbial quality of the prepared buns was tested in 7th day and 14th days of storage. This is a common criterion used to determine the acceptability and shelf life of the developed products. Microbial counts of the developed products mainly depend on handling quality of utensils used during the processing. It was observed that the less number of colonies in all treatments, and the least number of colonies were observed in P2 which used 0.3% calcium propionate as preservative, and the highest number of colonies was observed in buns without adding the preservative. The initial moisture content of P1, P2 and P3 were 19.05±0.19, 17.95±0.19 and 17.48±0.13, respectively. Within two weeks period the moisture contents were decreased in all treatments giving the value 17.87±0.03, 17.61±0.09, and16.69±0.30 in P1, P2 and P3, respectively. *L**colour space of each treatments changed during the storage period. *L**colour space of P1 decreased than other treatments from week1 to week 2. *a* and b** colour space of each treatments changed during the storage. Light yellow colour was observed in all treatments and the intensity of colour is more acceptable in P2 during storage.

Conclusions

Incorporation of sweet potato flour at 10% was successful for the preparation of bun with acceptable physicochemical and sensory qualities. Moreover, the bun treated with calcium propionate up to (3%) as a preservative could be stored for 14 days without significant quality deteriorations.

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