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Quality Evaluation of Freshly Prepared Biscuits from Composite Flour of Sprouted Sorghum, Soybean and Finger Millet

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Abstract

This study was aimed at producing quality biscuit using composite flour blends from cheap and underutilized crops like sorghum, soybean and finger millet. Sprouted sorghum flour in the amounts of 80%, 70%, 60%, 50%, 40% with 10%, 20%, 30%, 40%, 50% of soybean flour and 10% constant amount of finger millet flour were added to prepare 100% composite flour. Biscuits prepared from 100% of wheat flour were used as control treatment. Treatments of composite flour vs.: T1 - 100% wheat, T2 - 80% Sprouted Sorghum + 10% Soybean, T3-70% Sprouted Sorghum + 20% Soybean, T4 - 60% Sprouted Sorghum + 30% Soybean +, T5 - 50%. Sprouted Sorghum + 40% Soybean, T6 -40% Sprouted Sorghum + 50% Soybean were subjected to analysis of nutritional, organoleptic, microbial qualities and physical properties. Analyses were carried out for three replicates. Total plate count was done for the fresh and stored samples to find out microbial quality. The nutritional analysis of the biscuits revealed that protein, ash, fiber, fat and total sugar were increased from 10.53-14.35, 1.41-2.16, 1.27-3.93, 17.90-24.77 and 28.56-31.37 respectively while moisture content was decreased from 3.78-3.27 when increasing the soybean flour 10%-50% in the biscuits mixtures. The physical properties of biscuits revealed that there were significant differences between the treatments of biscuits (at 5% level of significance) when the level of soybean increased. According to Turkey`s test, the mean scores for all assessed organoleptic characters varied significantly ($p < 0.05$) in biscuits. No harmful micro-organisms were observed in the biscuits. Based on the nutritional and organoleptic qualities of biscuits, most preferred treatments of nutritionally enriched biscuit samples such as T3-70% Sprouted Sorghum + 20% Soybean + 10% Finger millet, T4 - 60% Sprouted Sorghum + 30% Soybean + 10% Finger millet,T5 - 50% Sprouted Sorghum + 40% Soybean + 10% Finger millet.

Keywords: Composite Flour; Biscuit; Sprouted Sorghum; Soybean; Finger Millet; Organoleptic Characters; Microbial qualities; Physical properties.

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1. Introduction

Most of the people, children in rural areas in Sri Lanka are suffering from Malnutrition due to lack of nutritious specially protein, energy and minerals also many people are unable to properly digest the gluten. It is very low in essential amino acids and also prevents the absorption of minerals into body. Composite flour is a mixture of different flour from cereal, legume or root crops that is created to satisfy specific functional characteristics and nutrient composition. It could be a mixture of cereals with legumes or cereals with tubers. The use of composite flour based on wheat and other cereals including minor millets in bakery products is becoming popular because of the economic and nutritional advantages of composite flour.

The biscuit produced from sprouted Sorghum (sorghum bicolor), Soybean (Glycine max) and Finger millet (Eleusine coracana) is nutritionally, healthy and tasty product. The composite flour, including above three types of flour is fulfilled with protein, fiber and minerals (Calcium and Iron) specially. Therefore, present study was undertaken for the production of nutritionally enriched biscuit by compositing three type of flour from sprouted sorghum, soybean and finger millet and analyzing the nutritional, sensory and physical qualities of the biscuits.

2. Materials and method

This study was undertaken at the Food Science Laboratory in Department of Agricultural Chemistry, Faculty of Agriculture, Eastern University, Sri Lanka for the period of July to October 2017.

2.1. Preparation of Sprouted Sorghum Flour

The cleaned grains were thoroughly washed and steeped in water for 12 hours. The hydrated grains were allowed to germinate for four days. The sprouted grains were ground by a grinder (PRESTIGE PMG 02) and sieved (0.3 mm sieve) into fine flour.

2.2. Preparation of Soybean Flour

Soybeans were washed and dried in sun. The soybeans were roasted and ground into fine flour using a grinder (PRESTIGE PMG 02) and sieved through a sieve (0.3 mm).

2.3. Preparation of Finger Millet Flour

Finger millets were washed thoroughly and dried in sun. Dried grains were ground by a grinder (PRESTIGE PMG 02) and sieved to get fine flour by a sieve (0.3mm).

2.4. Development of Biscuit

Biscuits were prepared by using the creaming method.

Table 1: Ingredients for the Formulation of Biscuits

Ingredients	Amount
Flour	300 g
Sugar	100 g
Margarine	60 g
Milk powder	20 g
Baking powder	3 g
Water	150 ml

The sugar and margarine were initially creamed by a beater to produce a creamy mixture. The composite flour and baking powder were sieved together for three times. Then flour was added gradually to the creamy mixture and thoroughly mixed to form hard consistent dough. Milk was added to form dough. Then the dough was spread through a wooden tray and round shapes were cut by using a shape cutter. Those were placed in a non-stick pan and put in the oven of 180^0C for 25 minutes.
After the preparation of biscuits, those were packed separately in laminated aluminium foil according to the treatments and labeled individually. Different combinations of biscuits were assessed for organoleptic, physical and nutrition qualities.

2.5. Nutritional Analysis of Biscuit

Biscuits were analyzed for nutritional qualities such as moisture, ash, protein, fat and fiber by proximate analysis according to AOAC (2002) methods and total sugar was determined by the Lane and Eynon method. The parameters were analyzed initially after formulation and during storage period. Analyses were carried out for three replicates per each treatment.

2.6. Physical Properties Analysis of Biscuit

Physical parameters such as diameter, thickness, volume, density and spread ratio of biscuits prepared from sprouted Sorghum, Soybean and Finger millet composite flour were measured.

2.7. Organoleptic Analysis

Thirty trained panel of judges carried out organoleptic evaluation of above six different biscuit samples. The quality factors such as color, taste, texture, flavor and overall acceptability were measured by seven-point hedonic structure scale.

2.8. Microbiological Analysis

Total plate count was done for the biscuit samples. The media was poured into Petri dishes and they were kept in lamina flow until solidify. Each treatment samples were placed in agar plate. Petri dishes were covered and labeled. The plates were observed after four days for plate count.

2.9. Statistical Analysis

Data of the chemical analysis and storage study were analyzed by Analysis of Variance (ANOVA) ($\alpha = 0.05$) and mean separation was done with Duncan's Multiple Range Test (DMRT). Data related to sensory evaluation were analyzed using the Turkey's test.

3. Results and Discussion

Nutritional analysis was performed initially for Wheat flour, Sprouted Sorghum flour, Soybean flour and Finger millet flour.

Table: 2. Nutritional Characteristics of Wheat Flour, Sprouted Sorghum Flour, Soybean Flour and Finger Millet Flour

Composition	Wheat Flour	Sprouted Sorghum Flour	Soybean Flour	Finger Millet Flour
Moisture %	2.78±0.03	1.51±0.05	1.87±0.04	1.08±0.01
Ash %	1.78±0.04	4.00±0.02	4.91±0.02	4.68±0.09
Protein %	7.88±0.12	9.46±0.07	36.45±0.06	7.66±0.16
Fat %	1.94±0.06	3.49±0.02	15.18±0.03	1.31±0.03
Fibre %	1.37±0.03	1.37±0.03	9.62 ± 0.17	3.46±0.14

The protein content was higher in soybean and sprouted sorghum flour. Fiber content was higher in soybean and finger millet flour. Higher fat content was observed in soybean flour than others. Ash content was lower in wheat than other three type of flour. Higher mineral content was observed in above flour than wheat flour. Finger millet contains high levels of calcium, iron and manganese. Its crude fiber and mineral content is markedly higher than wheat 1.2% fiber and 1.5% minerals. (Singh, 2014)

3.1. Nutritional Analysis

3.1.1. Protein Content

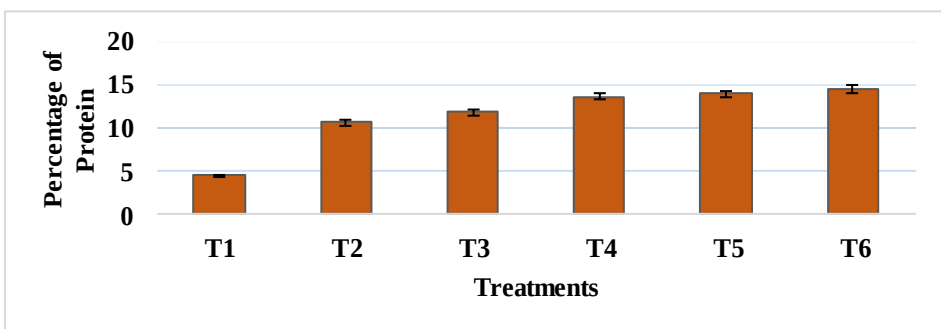

Figure: 1. Protein Content of Biscuits

The protein content of the biscuit was increased with increasing in the percentage substitution of soybean flour in the biscuit dough blends. The increase in the protein content of the biscuit could be due to the significant quantity of protein in soybean seeds. Soybeans have been reported to be a good source of cheap protein (Wardlaw, 2004). The protein content (7.28% to 11.74%) of the malted sorghum-soy biscuits produced in this study was within the range of the protein content (7.06% to 11.84%) of sorghum-wheat composite flour biscuits reported by Adebowale et al., (2012).

3.1.2. Fiber Content

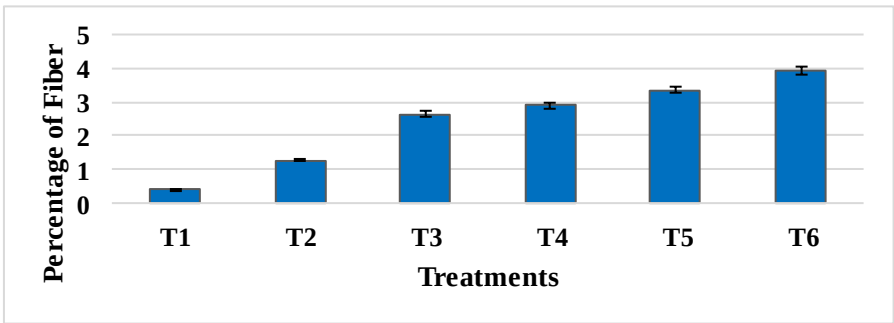

Figure: 2. Fibre Content of Biscuits

The fiber content of the sprouted sorghum-soybean-finger millet biscuit samples was increased from 0.40% to 3.93% when increasing 10% to 50% of soybean flour while 100%of wheat flour had 0.4% of low fiber content. The increment in the fiber content of the biscuits could be due to the hydrolysis of fiber during germinating process. Sprouted sorghum and has been reported to contain low levels of fiber. (Dewar J, 1997). Ayo et al. reported lower fiber content (1.12-1.40%) for malted soybean-acha biscuit.

3.1.3. Fat Content

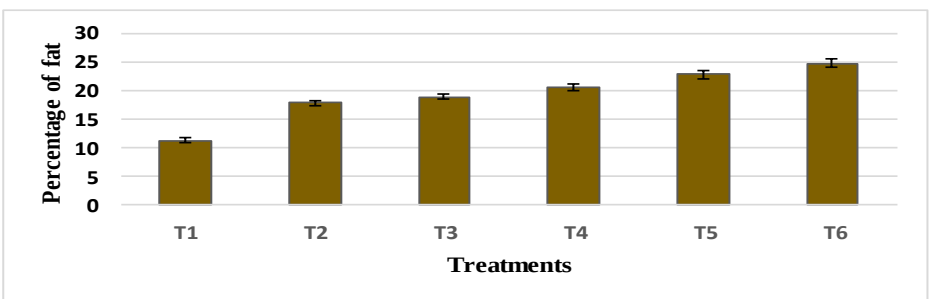

Figure: 3. Fat Content of Biscuits

The fat content of freshly made sprouted sorghum-soybean-finger millet biscuit was increased with the substitution of soybean flour. The fat content of biscuits was increased from 17.90% to 24.77% when increasing the proportion of soybean flour 10% to 50%. The biscuits made from 100% wheat flour had lowest amount (11.37%) of fat content. This can be due to higher fat content of soybean flour than sprouted sorghum flour and lowest fat content of wheat flour.

3.1.4. Moisture Content

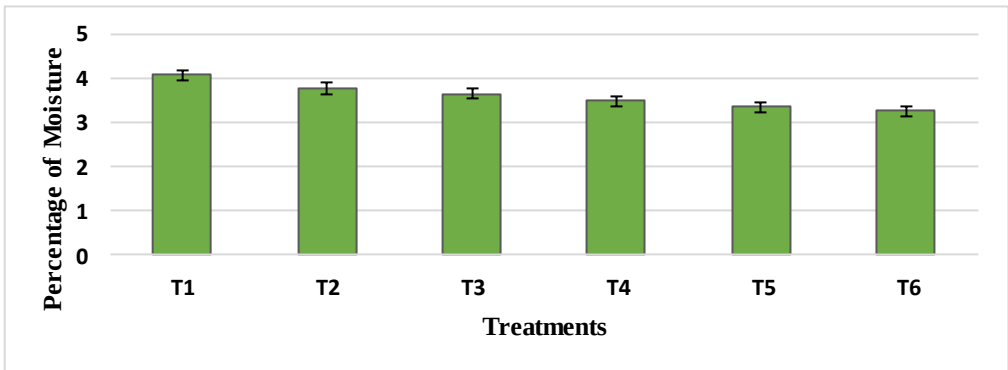

Figure: 4. Moisture Content of Biscuits

The moisture content of sprouted sorghum-soybean-finger millet biscuits was decreased from 3.78% to 3.27% while substitution of soybean flour from 10% to 50%. This can be due to high protein content of soybean flour. Increased protein content, influenced the water holding capacity of biscuits. According to DMRT, there was a significant difference in control treatment and other treatments. 100% of wheat biscuits had highest mean value (4.08 %) of moisture content and the biscuit prepared from 40% sprouted sorghum, 50% soybean and 10% finger millet had the least mean value (3.27 %) of moisture content.

This is due to the fact that soy flour contained greater amount of total dry solid with high emulsifying properties compared to wheat flour. The moisture content of the biscuit decreased with the increasing amount of soy flour in the blend due to low moisture content of the beans.

3.1.5. Ash Content

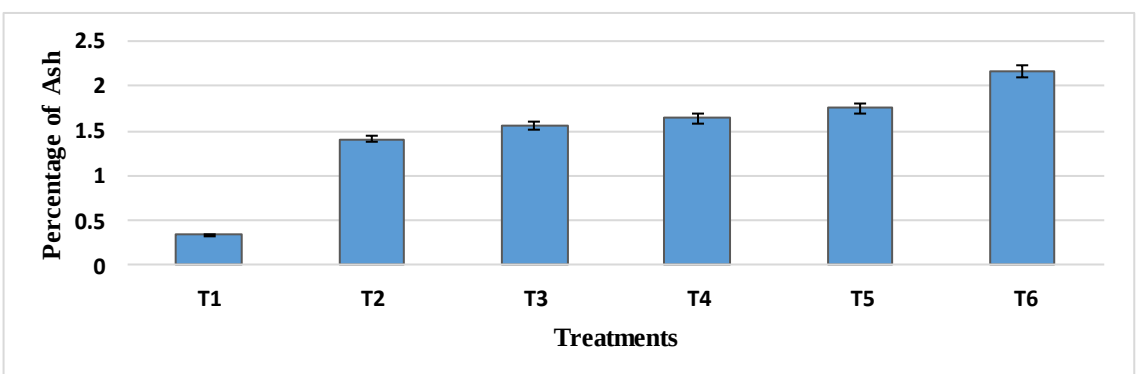

Figure: 5. Ash Content of Biscuits

Ash content is an indication of the mineral content of a food sample. The ash content of the biscuit samples was increased with increasing the soybean flour content in the biscuit. Legumes have been reported to be good sources of ash. (Alabi et al, 2007)

The ash content (1.41 – 2.16%) of the biscuit prepared from sprouted sorghum-soybean-finger millet in this study was higher than the ash content (0.64 - 1.17%) of wheat-plantain-soy bread and plain wheat biscuits reported by Olaoye et al, (2006) has reported that finger millet has higher mineral content than wheat. It has the highest calcium content among all cereals (344 mg/100 g).

3.1.6. Total Sugar

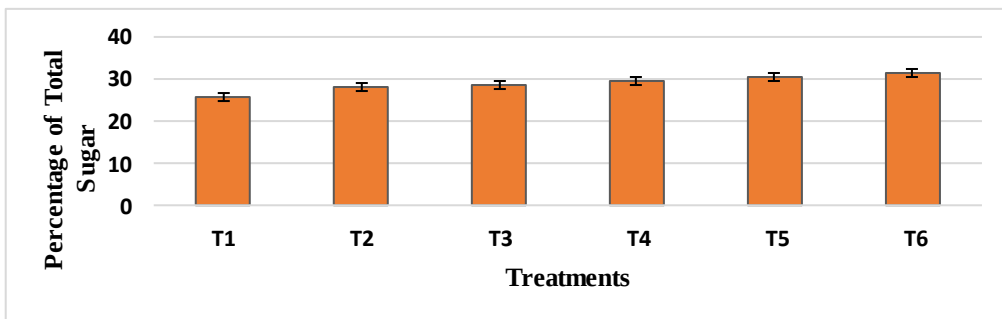

Figure: 6. Total Sugar Content of Biscuits

According to DMRT, there was a significant increase in sugar content by increasing the proportion of soybean flour. 100% wheat biscuit had least mean value (25.84%) of sugar content followed by the biscuit prepared from 40% sprouted sorghum, 50% soybean and 10% finger millet flour had highest mean value of sugar content.

3.2. Organoleptic Qualities Analysis of Biscuits

According to Turkey`s test, there was a no significant difference between control Treatment and other series of 20%-40% soybean flour added biscuits. Control treatment and T4 had highest mean value and T2 had least mean value.

3.3. Microbial Analysis of Biscuits

Microbiological examination for biscuits, in terms of total plate count revealed that there was no evidence for any microbes observed in the biscuit samples. Processes such as roasting and baking at high temperature destroy large number of micro-organisms. Therefore, these biscuits were suitable for consumption. The total plate count of biscuits was determined by using Nutrient Agar containing petri dishes.

4. Conclusion

Biscuits prepared from different treatments of composite flours were subjected to analysis of nutritional, organoleptic, microbial qualities with physical properties to evaluate the suitability of this biscuits for consumption after formulation. Based on the nutritional analysis, there was an increase in protein, fiber, fat and ash content and decrease in moisture content as with the increase of the proportion of soybean flour. The total sugar content was slightly increased.The physical properties of biscuits revealed that there were significant differences between the treatments of biscuits (at 5% level of significance) when the level of soybean increased. According to Turkey`s test, the mean scores for all assessed organoleptic characters varied significantly ($p < 0.05$) in biscuits. No harmful micro-organisms were observed in the biscuits. Based on the nutritional and organoleptic quality characteristics, most preferred treatments of nutritionally enriched biscuit samples such as T3-70% Sprouted Sorghum + 20% Soybean + 10% Finger millet, T4 - 60% Sprouted Sorghum + 30% Soybean + 10% Finger millet,T5 - 50% Sprouted Sorghum + 40% Soybean + 10% Finger millet.

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