Preparation of Wheat-Malted Flour Blend Biscuit and Evaluation of its Quality Characteristics

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Abstract: The study was carried out to find out the feasibility of partially replacing the wheat flour by malted flour blends of finger millet and mungbean in biscuit product. The malted seeds of local varieties of finger millet and mungbean were milled in to fine flour and blended at a ratio of 4:1. Then, biscuits were prepared by substituting wheat flour with different levels of malted flour blends (10, 20, 30, 40 and 50 %). The sensory attributes including appearance, flavor, texture, taste and overall acceptability of biscuits were evaluated by a five point hedonic scale test. The formulation of 30% malted flour blend (6% malted finger millet flour, 24% malted mungbean flour) incorporated biscuit had the highest median value for flavor and taste and no significant difference with wheat biscuits in all other sensory characteristics. Physical properties of biscuits like bulk density and spread factor decreased with substituting malted flour blends. The nutritional value of sensorially accepted composite biscuit was higher in total protein, crude fibre, ash, K, Na, free amino acid and reducing sugar content than wheat flour biscuit. The bacterial count of 30% malted flour blend incorporated biscuit was $3.6 \times 10^2$ CFU/g after two months of storage and this was well below the safe level of $1 \times 10^4$ CFU/g. There was no yeast and mold growth observed during two months of storage. Therefore, nutritionally superior malted flour blend incorporated biscuit can be prepared from the locally available finger millet and mungbean and it can be used as a substitution for wheat flour biscuit in children diet.

Key words: Biscuit • Finger millet • malting, mungbean

INTRODUCTION

Biscuits have become a traditional and significant food in many countries. They are staple foods, snacks, dietary products, infant foods and with additions of chocolate and cream. Since the major ingredients of all biscuits are flour, sugar and fat, they are a major source of energy [1]. Generally soft wheats with weak gluten and low protein content are preferred for biscuit making [2].

Wheat flour is the principal component of nearly all biscuits [1]. This holds a unique position due to its ability to form dough [3]. Wheat flour is deficient in certain essential amino acids, specially, lysine. Legumes are higher in proteins (18–24%) than cereal grains and could be used to support certain amino acids such as lysine, tryptophan and methionine [4].

Gluten protein is well known in terms of the importance for producing high-quality bakery products and some other grain foods that require elastic and extensible dough. However, since millet grains are gluten-free, they are unsuitable to convert into pure-millet bakery products. The use of millet grains as replacement in wheat composite flours, complementary food and food blends seems the best method that can be used for the preparation of nutritional, healthy and safe, high-quality and shelf-stable food products at household and commercial scales to promote utilization of millet grains [5].

The simple traditional household technologies have been used to process in order to improve nutritional quality as germination, fermentation, roasting and cooking, as far it is concerned germination when grains are hydrated in ambient conditions endogenous enzyme.
start to modify the grain constituents in particular changes to soluble sugars, protein and activities in enzyme [3].

Malting is a simple bio-technological technique to bring about sufficient increase in enzyme activities and causes predigestion of carbohydrate and protein [6]. Malting of grains produces malt with improved nutritional quality that can be used in various traditional recipes. This process reduces the activity of antinutritional factors [5]. Malted seeds of finger millet and mungbean after 24 hours of germination have significantly higher level of free amino acid and reducing sugar content when compared to raw seeds [7]. Germination also improves the GABA content in all the millets and legumes. These germinated food grains could be useful for the development of functional foods especially health foods for children and geriatric population [8].

Hence, the study was undertaken to formulate nutritionally superior biscuit using different levels of wheat-malted flour blends and evaluates its physical, sensorial, nutritional and microbial quality characteristics.

**MATERIALS AND METHODS**

Raw materials of finger millet (*Eleusine coracana* L. Jaffna local variety) and mungbean (*Vigna radiata* L. Jaffna local variety) were procured from the Department of Agricultural extension office, Jaffna, Sri Lanka. The study was carried out in the Laboratory of Agricultural Chemistry, Department of Agricultural Chemistry, Faculty of Agriculture, University of Jaffna, Sri Lanka in 2013.

**Preparation of Malted Finger Millet and Mungbean Flour:** Fingermillet and mungbean seeds were cleaned from extraneous matter and washed thoroughly in water. Finger millet (500g) and mungbean seeds (500g) were steeped separately in 1000 ml of boiled cool water (w/v=1:2) for 6 hours. Then, the water was drained and the seeds were allowed to germinate for 24 hours under moistened condition. The germination was arrested at the end of germination time by sun drying. The matled finger millet and mungbean seeds were milled using an electric grinder and passed through 0.5mm sieve to obtain fine malted flour. This malted finger millet and mungbean flour were stored in airtight plastic containers for further use.

**Preparation of Biscuit:** Hydrogenated fat (margarine-50g)and powdered sugar (50g) were creamed together using an electric beater. Then, wheat flour (100g) and baking powder (0.5g) were mixed together and sieved twice. The refined flour with baking powder was added to the creamed paste and dough was prepared from this mixture. The dough was rolled out to 0.6mm thickness in a baking tray and cut into round shape having 4.5cm diameter using a biscuit cutter. The biscuits were placed in a tray containing greased paper and baked in a pre-heated oven at 150°C for 10 min. Then, biscuits were cooled to room temperature (30°C) and packed in low density polyethylene bags for further use of physical, nutritional, sensorial and microbial analysis.

**Formulation of Biscuits:** Biscuits were prepared by substituting wheat flour with blended finger millet and mungbean malt flour as follow:

- T1 - 100% Wheat flour
- T2 - 90% Wheat flour, 2% malted finger millet flour, 8% malted mungbean flour
- T3 - 80% Wheat flour, 4% malted finger millet flour, 16% malted mungbean flour
- T4 - 70% Wheat flour, 6% malted finger millet flour, 24% malted mungbean flour
- T5 - 60% Wheat flour, 8% malted finger millet flour, 32% malted mungbean flour
- T6 - 50% Wheat flour, 10% malted finger millet flour, 40% malted mungbean flour

**Evaluation of Physical Properties of Biscuits:** Physical properties of biscuits including diameter, thickness and spread ratio were measured using the method of AACC [9]. Six biscuits were placed edge to edge in a row and the diameter was measured using venire caliper in millimeters. Six biscuits were stacked on top of each other and thickness was measured using venire caliper in millimeters. The spread factor was calculated as dividing diameter by thickness. Bulk density was determined using the method described by Srivastava *et al.*[10] in g/cm³.

**Evaluation of Sensory Attributes of Biscuits:** The malted flour blend incorporated biscuits were evaluated for sensory attributes of appearance, flavor, texture, taste and overall acceptability by trained fifteen panel members using 5- point hedonic scale. The sensory score pattern was given as follow: 1-Dislike very much, 2-Dislike, 3-Like or dislike, 4-Dislike, 5-Dislike very much.

**Analysis of Nutritional Value of Biscuits:** Biscuits of sensorially accepted formula and the wheat flour biscuit were analysed for nutritional value and compared each other. Nutritional contents like moisture, total fat and ash
content were determined using the method AOAC [11]. Total protein content was determined by Kjeldhal method [12]. Reducing sugar as glucose [13] and free amino acid content [14] were estimated. Total sugar content was determined using acid hydrolysis [12] and following the method of Miller [13]. Minerals like K and Na were determined using flame photometer. Phosphorus content was measured spectrometrically. Total carbohydrate content was calculated by subtracting % moisture, % crude protein, % crude fat and % ash from 100 [15]. Food energy value was calculated by multiplying the values of crude protein, fat and carbohydrate by factors of 4, 9 and 4, respectively [16].

**Evaluation of Microbial Quality of Biscuits:** Microbial load for bacteria, yeast and mold count were estimated by plate count method using nutrient agar and potato dextrose agar respectively. Microbial population was estimated in terms of colony forming unit per g (CFU/g) of sample. Microbial counts of biscuits were evaluated for fresh and during storage for two months.

**Statistical Analysis:** The triplicate values of physical properties and nutritional content were statistically analysed by Completely Randomized Design (CRD) using analysis of variance (ANOVA) in SAS statistical software (Version 9.1). Mean separation was performed using Duncan's New Multiple Range Test (DNMRT) and significant differences were compared at p<0.05. Sensorial data were statistically analysed by Friedman test using MINITAB (Version 13.2).

**RESULTS AND DISCUSSION**

**Evaluation of Physical Properties of Biscuits:** The following Figures 1-5 represent the effect of treatments on weight, volume, bulk density, diameter, thickness and spread factor of biscuits.

The weight of biscuits decreased from treatment of T1 to T6. There was an increasing trend found in volume of biscuits. The diameter of biscuits was gradually increased with increasing replacement of wheat flour. This would be due to the spreading ability of fat. There was a gradual increase in thickness was found with increasing level of incorporation of malted flour blends. It would be due to the addition of baking powder which increases the dough thickness during baking. Spread factor of prepared biscuits ranged from 6.07 to 6.83 and a decreasing trend found with increasing level of incorporated malted flour blends may be due to the higher water holding capacity of malted flour compared to wheat flour.
Evaluation of Sensory Attributes of Biscuits: The Figure 6 represents the effect of treatments on sensory attributes like appearance, flavor, texture, taste and overall acceptability of biscuits.

The median value of appearance was higher for treatments T1 and T2 and there was no significant difference (p>0.05) found within T2 and T4. A higher median value was obtained for flavor of T4. There was no significant difference (p>0.05) found in the texture from T1 to T4. The median value of taste was higher for treatment T4. Although the median value of overall acceptability decreased from T1 to T6, there was no significant difference (p>0.05) found within T1 and T4. A significant reduction in all sensory attributes of appearance, flavor, texture, taste and overall acceptability was observed from the treatment T5. Therefore, the treatment T4 was selected as the best treatment. A study from Aziah et al. [14] substitute wheat flour with legume flour of mungbean and chick pea and prepared cookies with sensorialy acceptable quality.

Analysis of Nutritional Value of Biscuits: The proximate composition of sensorially accepted composite biscuit (CB) and wheat flour biscuit (WB) is presented in Table 1. Total protein content of composite biscuit (7.73%) had significantly increased (p<0.05) from wheat flour biscuit (5.75%). This would be due to the addition of malted mungbean flour. There was no significant difference (p>0.05), in moisture, total fat, crude fibre and energy content of composite biscuit and wheat flour biscuit. Crude fibre content of composite biscuit was higher than wheat biscuit due to the addition of malted mungbean flour. Carbohydrate and energy value of CB (65.09%, 462.85 kcal) was lower than WB (67.67%, 469.07 kcal). The ash content increased significantly (p<0.05) in CB (1.58%) when compared to WB (1.10%).

Aziah et al. [17] conducted the study to substitute wheat flour with legume flour of mungbean and chick pea and prepared cookies with increased level of protein, crude fibre and ash content and lower in carbohydrate and energy value compared to wheat flour biscuit. Another study by Pasha et al. [18] also noted that there was significant increase in protein, crude fibre and ash content by supplementation of wheat flour with mungbean flour. There was a significant increase (p<0.05) found in K and Na mineral content. The increase in K content for CB may be due to the addition of malted mungbean flour. Reducing sugar and amino acid content increased significantly (p<0.05) for CB than WB. It would be due to the addition of malted flour blends of finger millet and mungbean that had the increased activity of enzymes like amylase and protease.

Evaluation of Microbial Quality of Biscuits: There was no bacterial and fungal colony observed in both WB and CB of fresh samples. Bacterial count was found as $6.8 \times 10^2$ CFU/g and $2.3 \times 10^2$ CFU/g for WB and CB after 1 month of storage period. After 2 months of storage period, bacterial count was found as $9.6 \times 10^2$ CFU/g and $3.6 \times 10^2$ CFU/g for WB and CB respectively. Fungal growth was not
observed during 2 months of storage period. The safe level of bacterial count for biscuits should be below $1 \times 10^3$ CFU/g. This safe limit was satisfied by both WB and CB samples up to 2 months of storage period.

**CONCLUSION**

Biscuit is an important baked product which can be prepared by partially substituting wheat flour with non wheat materials of malted flour of finger millet and mungbean with improved nutritional value through the process of malting. Substitution of wheat flour with malted flour blend at 30% level had better performance in nutritional, sensorial quality and microbial stability than the wheat flour biscuit. This malted flour blend incorporated biscuit is valuable for children as it contains nutritionally better and easily digestible forms of sugars and amino acid. Thus, the locally available raw materials of finger millet and mungbean seeds could be used in biscuit preparation as a convenient value added food product in terms of handling, packing and storage stability.

**REFERENCES**