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Research Article
Development and Biochemical Analysis of Pumpkin Seed (Cucurbita Moschata Durch) Biscuits

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Abstract

Background and Objective: Pumpkin seeds are rich in nutritional and phytochemical content. However, pumpkin seeds are rarely consumed in Indonesia. Development of pumpkin seed-based foods, such as biscuits, may provide a nutritious supplemental food. This study aimed to identify the nutritional value of pumpkin seed-based biscuits. **Materials and Methods:** Five pumpkin seed biscuit formulas were developed from different wheat and pumpkin seed flour compositions as follows: Formula 1 (4:1), Formula 2 (3:2), Formula 3 (2:3), Formula 4 (1:4) and Formula 5 (0:1). The Luff-Schoorl, Kjeldahl, Soxhlet, X-ray fluorescence methods were used to analyze the nutritional content of Formula 1. **Results:** Formula 1 contained 48.16±0.007 g carbohydrates, 11.20±0.021 g protein, 33.05±0.049 g fat, 1.64±0.304 g crude fiber, 5.91±0.007 g water and 1.65±0.028 g ash. The highest mineral value was chlorine (46.23mg) and the lowest was molybdenum (0.5 mg). **Conclusion:** Pumpkin seed biscuits can be used as an alternative healthy snack for those who are undernourished.

Key words: Biscuits, healthy snack, pumpkin, seeds, supplemental food, zinc

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Competing Interest: The authors have declared that no competing interest exists.

Data Availability: All relevant data are within the paper and its supporting information files.

INTRODUCTION

Pumpkin seeds are a great source of protein, polyunsaturated fatty acids, vitamins, antioxidants (carotenoids and tocopherols) and micronutrients[1]. Moreover, pumpkin seed extract contains high quality and high levels of phytochemical sterols, which has great benefits for the immune system, reproductive health and other areas of health[2].

Snacks are small amounts of food consumed between meals and are popular among children and adolescents[3]. Snack foods play an important role in providing supplemental nutrition and therefore, snacks should contain complete nutrient content, including carbohydrates, protein, fat, vitamins and minerals[4].

Biscuits are dry snacks made from flour, fat and other ingredients that may be supplemented with additives[5]. Adding pumpkin seed flour to a biscuit formulation should increase the nutritional value of this snack.

Since pumpkin seeds are not commonly consumed in Indonesia, we aimed to formulate a pumpkin seed-based biscuit and determine its nutritional content to develop a nutritious supplemental food.

MATERIALS AND METHODS

Materials: This study was conducted in Makassar City, Indonesia and lasted for six months from the beginning of March to the end of August 2018. Pumpkin seed flour and biscuit formulations were developed in the Culinary Laboratorium, Nutrition Department of Public Health Faculty, Hasanuddin University, Makassar and nutritional content examination was carried out in the Integrated Laboratory of Animal Science Faculty, Hasanuddin University. Raw materials, such as pumpkin seeds, wheat flour, eggs and butter, were purchased form the local market.

Development of pumpkin seed biscuits: Preliminary research was carried out to make pumpkin seed flour formula using several methods[6-8]. First, pumpkin seeds were washed under running water and dried for ±7 h under the sun and in an oven at 80-100°C for 2 h. Then, the dried pumpkin seeds were crushed until they became smooth using a blender. Ground pumpkin seed were sieved using a 32-mesh sieve and stored in a clean container.

Pumpkin seeds biscuits were made using flour, egg yolks, refined sugar, margarine, baking soda and vanilla. Five pumpkin seed biscuit formulas were developed from different wheat and pumpkin seed flour compositions as follows: Formula 1 (4:1), Formula 2 (3:2), Formula 3 (2:3), Formula 4 (1:4) and Formula 5 (0:1).

The ingredients in each formula were as follows:

- **Formula 1:** 60 g pumpkin seed flour, 240 g wheat flour, 40 g egg yolk, 50 g refined sugar, 180 g margarine, 4g baking soda and 3 g vanilla
- **Formula 2:** 120 g pumpkin seed flour, 180 g flour, 40 g egg yolk, 50 g refined sugar, 180 g margarine, 4 g baking soda and 3 g vanilla
- **Formula 3:** 180 g pumpkin seed flour, 120 g wheat flour, 40 g egg yolk, 50 g refined sugar, 180 g margarine, 4 g baking soda and 3 g vanilla
- **Formula 4:** 240 g pumpkin seed flour, 60 g wheat flour, 40 g egg yolk, 50 g refined sugar, 180 g margarine, 4 g baking soda and 3 g vanilla
- **Formula 5:** 300 g pumpkin seed flour, 40 g egg yolk, 50 g refined sugar, 180 g margarine, 4 g baking soda and 3 g vanilla

These formulas were analyzed using a hedonic test to determine the acceptability of each formula. The panelist selected Formula 1 as the most acceptable formula. Details on the development of pumpkin seed biscuits are described in Fig. 1.

Biochemical analysis: Biochemical analysis was performed to determine the micro- and macronutrient content of selected pumpkin seed biscuit formula (F1). Carbohydrate content was evaluated using the Luff-Schoorl method, protein content was evaluated using the Kjeldahl method, fat content was evaluated using the Soxhlet method and moisture, ash and crude fiber content was evaluated using the direct method. Vitamin A and C levels were examined by spectrophotometric methods and mineral levels were examined by X-ray fluorescence method. All biochemical analyses were conducted according to a previously described method[9].

RESULTS

Macro Nutrition, water, ash and fiber composition: F1 was rich in carbohydrate and fat (Table 1). The carbohydrate content in 100 g F1 was 48.16±0.007 g and fat content was 33.05±0.049 g. Protein content in 100 g F1 was 11.20±0.021 g. The crude fiber content in 100 g F1 was 1.64±0.304 g, while the moisture content in 100 g F1 was 5.91±0.007 g and the ash content in 100 g F1 was 1.65±0.028 g.

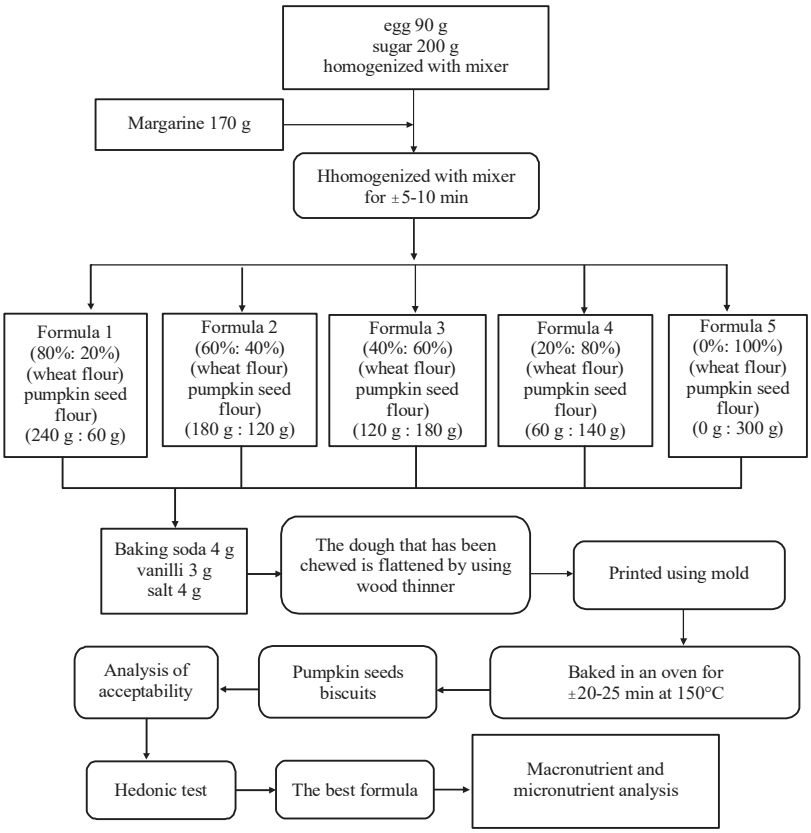

Fig. 1: The development of pumpkin seed biscuits

Table 1: Macronutrient content of pumpkin seed biscuits

Nutritional Content (g)	Pumpkin seed biscuits (100 g)	Pumpkin seed Biscuits (36 g)
Moisture	5.91±0.007	2.12±0.007
Ash	1.65±0.028	0.59±0.028
Protein	11.20±0.021	4.03±0.021
Fat	33.05±0.049	11.89±0.049
Carbohydrate	48.16±0.007	17.33±0.007
Fiber	1.64±0.304	0.59±0.304

Table 2: Micro nutrient content of pumpkin seed biscuits

Nutritional Content (mg)	Pumpkin seed Biscuits (100 g)
Vitamin A	0.027
Vitamin C	8.220
Calcium	6.080
Potassium	36.770
Chlorine	46.230
Molybdenum	0.500
Zinc	1.520

For water, ash, protein, fat, carbohydrate and crude fiber content, analyses were carried out twice and the average and standard deviation of each nutrient were calculated.

Micro Nutrient content: The main micro nutrient content in F1 was chlorine (46.23 mg per 100 g F1) and potassium (36.77 mg per 100 g F1) (Table 2). F1 also contained Vitamin A (0.027 mg per 100 g F1) and molybdenum (0. 5mg per 100 g F1).

DISCUSSION

In this study, one portion of F1 (36 g) contained 17.33 g carbohydrates and 11.89 g fat. This carbohydrate content would fulfil 6.8% of the Recommended Daily Allowance (RDA) of Indonesian children, as the RDA for carbohydrate and fat in Indonesian children aged 7-9 years old are 220-254 g and 62-72 g per person per day, respectively. The carbohydrate content of pumpkin seeds is 10.71g/100 g; therefore, the F1 pumpkin seed biscuit formulation had a higher carbohydrate content (48.16±0.007 g) compared to pumpkin seeds alone, which is likley due to the addition of other ingredients, such as flour and refined sugar.

Adding fat-free soy flour to biscuits can increase moisture, ash and protein content and adding flax seeds can increase fiber and fat content[10]. A previous study found that a

combination of wheat and soybean flour can significantly increase the nutrition content of biscuits[11]. Another study found that a combination of brown rice, sardine fish and tilapila flour can also increase the macronutrient content of biscuits[12].

Biscuits made from wheat flour, peanuts, pumpkin and moringa leaves have higher levels of calcium, phosphorus, copper, iron and zinc compared to biscuits made from maida flour, hydrogenated fat and sugar; however, biscuits made with pumpkin have lower fat, carbohydrate and calories and contain vitamin A[13].

The F1 formulation of pumpkin seed biscuits was rich in minerals, especially calium and chlorine. One hundred grams of F1 contained 46.23 mg of chlorine and 36.77 mg of potassium, as well as Vitamin A (0.027 mg/100 g) and Vitamin C (8.22 mg/100 g F1). Our pumpkin seed biscuit formula contained higher protein and fat and lower carbohydrates compared to a previous study which reported that 100 g of a different biscuit formulation (with 5% mixture of pumpkin seed and pumpkin pulp) contained 4.80 g moisture, 1.60 g ash, 6.56 g protein, 20.66 g fat, 0.90 g crude fiber, 66.38 g carbohydrate, 0.95m g beta carotene, 0.87 g zinc and 2.5 g iron[6].

This study has applications to improve the nutrition of school children through pumpkin seed-based biscuit snacks to increase supplemental nutritional intake. However, the limitation of this study is that it was conducted in several locations. Therefore, it is possible that there could have been a loss of quality in product and cross-contamination during transfer and storage, which could have affected the results of the biochemical analysis.

CONCLUSION

Pumpkin seeds can be developed into a snack food, such as biscuit, as they are rich in carbohydrate, fat, chlorine and calium. Therefore, pumpkin seed biscuit can be a healthy snack choice for undernourished children and people with calium or chlorine deficiency.

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