

Total Dietary Fiber in Coconut Powder Cookies and Their Antioxidant Activity: A Healthy Snack Potentiality

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Abstract—Coconut kernel residue from coconut milk production usually used as an animal feed, however it contains various nutrients such as vitamin E, lipid and fiber. The nutrients in coconut kernel residue are of interest since they exhibit various health benefits. Coconut kernel residue derived from a local production in Chiang Mai was used in this study. The kernel residue was dried in hot air oven 85°C, until the moisture content was lower than 5% wet basis. Then the coconut flour was used for cookies production. The coconut flour was used to substitute wheat flour in cookies recipes at 50%, 75% and 100%. The coconut flour cookies were then measured for their antioxidant activity using DPPH (2,2-diphenyl-1-picryl-hydrazyl-hydrate) assay and their total dietary fibre using an In-house method TE-CH-076 based on AOAC (2010), 985.29. The antioxidant activity assay showed that coconut flour exhibited 93% radical scavenging activity however when the coconut flour was used in coconut cookies the percentage of radical scavenging activity decreased. Moreover, 75% coconut flour cookies had 12.5 g of total dietary fiber/ 100 g product. According to the findings, coconut flour exhibited antioxidant activity and high fiber content. It has a potential to be a healthy snack where further studies are required.

Index Terms—coconut flour, functional food, dietary fiber

I. INTRODUCTION

Coconut milk production leaves tons of coconut kernel residue which generally used for animal feed or fertilizer. Coconut kernel residue is high in fiber, protein and vitamins [1].

Dietary fiber found in plants mainly consists of cellulose, hemicellulose, pectin, lignin, gums and mucilage [2]. Regular consumption of dietary fiber showed various health benefits such as prebiotic activity, lower risk of coronary heart disease, hypertension, obesity and some gastrointestinal diseases [1]. Therefore, increase fiber consumption positively affects human health in general.

Normally human metabolism produces free radicals, molecules contain an unpaired electron. The free radicals are capable of damaging macromolecules in cells such as DNA, lipid or protein [3]. High number of free radicals

cause oxidative stress condition which lead to several pathologies. Antioxidants refer to molecules that donate electron to stabilize or normalize free radical preventing them from causing cell injury. There are evidences that consumption of diet high in antioxidants helped lower the risk of cardiovascular disease or some cancers [4]. One of the most prominent natural antioxidants is vitamin E (alpha-tocopherol) which is found abundantly in coconut [5]. Moreover, coconut contains various phenolic compounds that exhibit antioxidant activity [6]

Cookies are baked food which mainly consists of flour, sugar and oil/fat such as butter. They are one of the most favorable in-home snacks in western country [7]. Trend of cookies consumption is increasing which may subsequently lead to increasing risk of several health problems such as cardiovascular disease and type2 diabetes [8].

A trend of healthy diet is increasing around the globe. Since coconut kernel residue is a source of fiber and contains various compounds that might possess health benefits [9]. In this study, coconut kernel residue from coconut milk production was dried and grind to powder. The powder was used as a substitute for wheat flour in cookies production. Then antioxidant activity and dietary fiber content of coconut powder and cookies were evaluated. Apart from the health benefits of the coconut kernel residue, this study may add value to by-product from coconut milk production.

II. MATERIALS AND METHODS

A. Materials

1) Plant material

Coconut (*Cocos nucifera*) kernel residue was purchased from a local market in Chiang Mai, Thailand. It was a by-product from coconut milk production. After purchase, the kernel residue was rinsed in distilled water. Any black residue from coconut shell was handpicked and discarded.

2) Ingredients for cookies production

All ingredients used for cookies production including eggs, sugar, butter, coconut scents were obtained from a local supermarket.

3) Chemicals

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2,2-Diphenyl-2-picryl-hydrazyl (DPPH) was purchased from Sigma-Aldrich (Singapore). Methanol was purchased from Scientific Product (Thailand). All chemicals are analytical grade.

B. Methods

1) Preparation of coconut powder

The clean coconut kernel residue was spreaded on a cheese-cloth in a single layer with 2 cm thickness. The cloth was then placed on a grid then the kernel residue was dried using a hot-air oven at 85 °C for 90 minutes. The dried residue was grinded into powder using a coffee blender. The coconut powder was sifted through a standard sieve (250 µm). The sifted powder was collected and kept in cool and dry place for further experiment.

2) Preparation of coconut powder cookies

The cookies production started by mixing eggs, sugar and butter together. Then all dried ingredients were added. The ingredients were mixed thoroughly until the cookie's dough was form. The dough was wrapped in a plastic wrap then kept in at 4C for 30 minutes. The oven was warm at 180C. After 30 minutes, the dough (8 g) was made into a small ball and placed on a baking tray. The dough was baked for 15 minutes. Coconut powder was used as a substitute for wheat flour in cookies production at different ratio. The recipes of each experimental group are shown in Table I.

TABLE I. RECIPES FOR COOKIES PRODUCTION

Ingredients	Wheat cookies	50% substitute	75% substitute	100% substitute
Coconut powder	-	25 g	37.5 g	50 g
Wheat flour	50 g	25 g	12.5 g	-
Butter	75 g	75 g	75 g	75 g
Sugar	50 g	50 g	50 g	50 g
Baking powder	1 tsp	1 tsp	1 tsp	1 tsp
Egg	1	1	1	1
Coconut scent	2 tsp	2 tsp	2 tsp	2 tsp

3) Extraction of coconut powder and coconut cookies for antioxidant activity assay

Sample (5 g) was placed in a 250 mL Erlenmeyer flask and 50 mL methanol was then added. The flask was shake on a rotary shaker at 40 rpm for 12 hours. The methanolic extract was then dried under vacuum and the residue was kept at -20 °C until further analysis.

4) Determination of antioxidant activity with 2,2-Diphenyl-2-picryl-hydrazyl (DPPH) radical scavenging method

The coconut extract from the previous section was dissolved in methanol to achieve final concentration at 100 mg/mL. The antioxidant activities of the coconut powder and coconut powder cookies were measured using DPPH assay [10]. The solutions were then used for DPPH assay. Briefly, 0.1 mM DPPH methanolic solution (1 mL) was mixed with each coconut extract (50 µL). The mixture was incubated at room temperature in an

absent of light for 30 minutes. Then, an absorbance of each mixture was measured using a UV-Vis spectrophotometer at 517 nm. A mixture of DPPH solution (1mL) and methanol (50 µL) was used as a control. The percentage of the DPPH inhibition was calculated as follow:

$$\% \text{ DPPH inhibition} = \frac{(\text{Abs.}_{\text{control}} - \text{Abs.}_{\text{sample}})}{\text{Abs.}_{\text{control}}} \times 100$$

5) Determination of dietary fiber of coconut powder and coconut cookies.

Total dietary fiber of dried coconut powder and coconut cookies were analyzed using an In-house method TE-CH-076 based on official method AOAC 985.29.

6) Sensory evaluation of coconut flour cookies in elderly consumers

Satisfactory assessment of coconut cookies products was carried out. One hundred and twenty untrained panelists were participated in the assessment. Panelists were either male or female with 60 year of age or higher. They panelists had to be a regular consumption of cookies or bakery products. Color, taste, texture and overall acceptability were grading using 9-points hedonic scale with, 1 for unacceptable sample and 9 for excellent sample.

7) Statistical analysis

All measurements were taken in triplicate and expressed as mean±S.D. All statistical analysis was performed on Minitab software (version 15; Minitab Inc., Pennsylvania, USA).

III. RESULTS AND DISCUSSION

Coconut kernel residue was dried in a hot- air oven until the moisture content in the final product was less than 5%. the dried coconut residue was grinded. The color of the dried coconut powder was slightly brown which may due to Maillard's reaction, a reaction between a carbonyl group of sugars and an amino group of amino acids or proteins with a present of heat causing non-enzymatic browning in food [11]. An appearance of coconut powder was shown in Fig. 1.



Figure 1. Dried coconut powder from coconut kernel residue.

A. Percentage DPPH Inhibition of Coconut Powder and Coconut Cookies

The coconut powder and cookies extract exhibited DPPH inhibition as the color of the mixture turn yellow after 30 minutes incubation. The findings showed that the percentage of DPPH inhibition was highest in coconut powder at 96% DPPH inhibition. Cookies with coconut

powder addition had higher percentage of DPPH inhibition than traditional cookies made from wheat flour. However, there is no significant different in the percentage of DPPH inhibition among coconut cookies groups (Table II)

Antioxidant activity of coconut powder in this study is attributed to phenolic compound and vitamins. Prominent phenolic compounds in coconut kernel are gallic acid, caffeic acid, *p*-coumaric acid and salicylic acid along with catechin, chlorogenic acid, ellagic acid and apigenin [6]. Moreover, coconut meat contains high amount of vitamin E, a natural antioxidant [6]. However, when coconut powder was used for cookies production which required high temperature, the % DPPH inhibition of three cookies at different levels of substitution were not significantly different. The observed result may due to heat-sensitivity of vitamin E and phenolic compounds [12].

TABLE II. PERCENTAGE OF DPPH INHIBITION

Samples	% DPPH inhibition
Coconut powder	96.03 \pm 0.66 ^a
Wheat cookies	10.98 \pm 0.15 ^c
Cookies with 50% substitute	31.89 \pm 0.57 ^b
Cookies with 75% substitute	32.05 \pm 0.23 ^b
Cookies with 100% substitute	29.61 \pm 0.78 ^b

Notes: Mean \pm standard deviation (n = 3). Means within a column bearing the same superscript letter were not significantly different (p > 0.05).

B. Dietary fiber Content in Coconut Powder and Coconut Cookies

In this study, dried coconut powder has approximately 60% of dietary fiber. Our finding was within the range of others research [1]. Dietary fiber in cookies substitute with coconut powder varied significantly. Total dietary fiber in a traditional wheat cookie was 6.2g/ 100g product while cookies substituted with 50%, 75% and 100% coconut powder contained 11.2g, 12.5g and 15.1g per 100g product, respectively.

Coconut powder was used in several studies to enhance level of dietary fiber in food products. Incorporation of coconut flour in wheat flour noodle improved nutritional values of the noodle. However, more than 20% of coconut flour substitution negatively affected appearance, texture and overall acceptability of the final product [13] that incorporation of coconut flours up to 15% did not affect overall acceptability in sensory evaluation. Moreover, biscuit with 15% coconut flour contains 15 times more fiber than the wheat biscuits [9].

C. Satisfactory Assessment in Elderly Consumers

The finding showed that the traditional cookies prepared from wheat flour received the highest score in every testing parameter while the cookies with 100% coconut flour substitute received the lowest score. An overall acceptance score of 50% and 75% coconut flour substitute was slightly different but it was not statistically significant (P = 0.05) (Fig. 2).

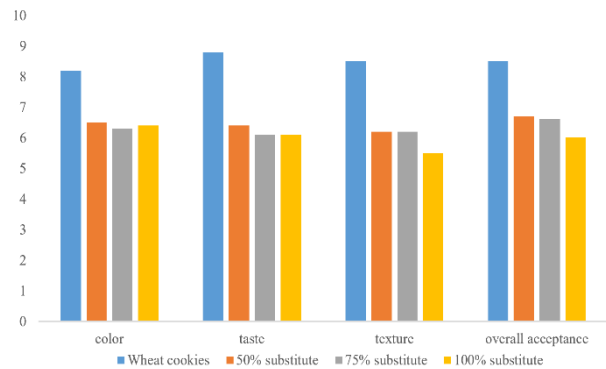


Figure 2. Sensory evaluation score in all experimental group.

Cookies with coconut flour substitution were slightly darker than the wheat cookies which was a result of the process of making coconut flour. Grinding process generates heat which subsequently cause a non-enzymatic browning reaction of an amino group in protein and a carbonyl group of sugar called Millard's reaction [11].

Coconut flour has distinct flavor. When incorporate the flour in cookies, it changed the taste of the cookies which subsequently resulted in lowering the sensory evaluation scores.

Moreover, coconut powder incorporated in the study showed that incorporation of coconut flour in biscuits above 15% negatively affected all sensory parameters [9]

Recommended dietary fiber intake in human is 20-30g per day. In elder adult (age 60 or more), an average fiber intake was 18.3g per day which slightly lower than recommendation value. Low fiber intake not only affected digestive system but also relate to mineral intake. Therefore, consumption of adequate amount of fiber improved the mineral intake significantly [14]. From the finding, a partaking of 75% coconut flour cookies equals to approximately 50% of recommended dietary fiber per day. However, further experiments are required to create more sensory acceptable snacks and evaluation of their health benefits.

IV. CONCLUSION

Dried coconut powder exhibited high antioxidant activity. Cookies substituted with coconut flour contained more fiber than the traditional wheat flour cookies however incorporation of coconut flour affected sensory evaluation scores. Overall acceptance score of 50% and 75% substitution of coconut flour were not significantly different therefore 75% substitution cookies has a potential to be a healthy snack for elderly.

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