INTERNATIONAL CONFERENCE ON FOOD INNOVATION 2014

Cornlettes Improves Dietary Content and Reducing Glycemic Index of Selected Baked Products

Wan Rosli W I*, Daniel S R, and Che Anis Jauharah C M Z

Nutrition Programme, School of Health Sciences, Universiti Sains Malaysia, 16150 Kubang Kerian, Kelantan, Malaysia, Tel: +6097677779, Fax: +6097677505

Abstract

Frequent ingestion of meal high in the amount and varieties of dietary fibre-containing foods can prevent many of chronic diseases. Baked-based products, particularly biscuits and cakes, appeared in the list of top ten daily consumed foods based on the Malaysian Adult Nutrition Survey. The effects of partial substitution of wheat flour with dietary fibre from cornlettes (CL) on nutrients composition and glycemic index (GI) of biscuit and chiffon cake were investigated. Dehydrated CL was added in biscuit and chiffon cake formulations to replace wheat flour partially at concentrations of 0, 10, 20 and 30%. Protein, ash and dietary fibre contents of biscuit and chiffon cake added with CL powder were increased in line with the levels of CL used. Even though protein content of CL-based cakes increased in line (13.3 to 15.7%) with the levels of CL (10 to 30%), but there was no significant different compared to control. Interestingly, addition of CL at 10% to partially replace wheat flour resulted in reduction of postprandial blood glucose response. The GI values for both biscuit and chiffon cake added with YCE were 46 and 49, respectively. These values were significantly lower than control biscuit and cake which recorded GI values at 61 and 59, respectively. Thus, CL can be incorporated in bakery products to enhance nutrient content while at the same time help in reducing the GI values. Further investigation on the addition of CL into other baked-based products in relation to nutrition and other glycemic responses can be also explored.

Keywords: Cornlettes; dietary fibre; glycemic index; baked-based products

1. Introduction

Baked-based products including biscuit and cake are among renowned food items popularly consumed by many populations around the world. People often enjoy it during snacks as well as during special occasions. There are many varieties of biscuits and cakes consumed by consumers. Presently, the consumption of refined wheat flour-based products has continuously skyrocketing [1]. Generally, bakery-based products made of refined wheat flour which is lack of natural dietary fibre. This may offer lowered health benefits compared with whole grain wheat products. A lack of dietary fibre in the meal or diet has been linked with diabetes, cardiovascular disease, cancer, constipation and other illnesses. Some bakeries produced a few products that have replaced wheat flour with dietary fibre in relation to wellness and health concern by consumers [2].

Presently, baked-based products, particularly biscuits, cakes and breads, appeared in the list of top ten daily consumed foods [3]. Possible reasons for such wide popularity are broad range of choices, easy availability and convenient to be enjoyed as a snack. However, as for Malaysia, the use of wheat flour as one of the major ingredients in bakery products is quite challenging because wheat is totally being imported. Increasing demand for wheat-based products will definitely increase importation of wheat flour. For that reason, searching

*Corresponding author. Tel.: +06-767-7779; fax: +09-767-7505. *E-mail address*: wrosli@usm.my

for other local source of alternative ingredient to partially substitute wheat flour in bakery products would give many advantages as it could reduce dependence on wheat while at the same time could significantly save foreign exchange. In the meantime, manipulating the ingredients used in bakery products preparation by replacing the refined wheat flour with potentially nutritive ingredients would also be beneficial to improve the nutritional quality of the bakery products since majority of them are high in carbohydrate, fat and calorie, but low in fibre contents [4].

Cornlettes (CL) are immature cobs of maize (*Zea mays*) which are containing significant amount of dietary fibre in dried form. It is often enjoyed as vegetable, perhaps due to its delicate flavour and crispiness. Although it commonly used as vegetable in some Asian cuisine, CL is now gaining its popularity in many parts of the world. In the previous study, CL was found to be as nutritious as other vegetables such as cabbage, cauliflower, tomato, eggplant and cucumber [5]. They reported that protein and minerals in CL were comparable with the other type of vegetables. However, there are limited researches to show the potential of cornlettes in controlling the postprandial blood glucose responses among normal individuals. Therefore, the present study was carried out with aims to develop bakery products incorporated CL and to compare the postprandial glucose responses produced by biscuits and chiffon cakes formulated with CL and without CL.

2. Materials and methods

2.1. Preparation of Cornlettes

Fresh cornlettes (CL) were purchased from Pasar Siti Khadijah, a local wet market in the central of Kota Bharu town, Kelantan, Malaysia. The CL were processed by drying at 55^{o}C in oven (Memmert GmbH & Co. KG, Germany) and grinding (National MX-895M, Malaysia) to acquire fine powder of size approximately 125 microns (Endecotts Ltd., England). The CL powder was stored in Scott bottles at 4^{o}C before use. The CL was used at different concentration to partially replace wheat flour in preparation of biscuit and chiffon cake.

2.2. Preparation of Baked-based Products

Four formulations of biscuit and chiffon cake were prepared. To begin with, the flour was placed in a bowl together with CL, two third of the sugar (100 g), baking powder and sodium chloride. They were uniformly mixed. The egg yolks, oil and vanilla essence were then added to the mixture. The mixture was then mixed at speed 3 using electric hand mixer for approximately 1 min. Meanwhile, the egg whites were beat in a separate bowl at maximum speed of 5 for about 30 sec. Cream of tartar was then put into the mixture. Mixing was continued for another 2 min to obtain foam with soft peaks. Next, the remaining one third of the sugar (50 g) was gradually added and mixing was kept on until foam with stiff peaks was acquired. The foam was combined with the batter by gently folding the former into the latter. The combined batter was poured into ungreased tube pan. The cake was baked at 170^{o}C in oven for 30 min.

Meanwhile, the biscuits were prepared by adding 10 g of CL to 90 g of wheat flour, 21 g cornflour, 46 g margarine, 37 g sucrose, 31 g egg and 1 g baking powder. For the control biscuits, CL was not added. Initially, fat and sucrose was combined using hand mixer at speed 5. Egg was then added and mixing was continued for 2 minutes. Wheat flour, corn flour, baking powder and CL were then added into the creaming mixture. They were mixed to obtain uniform dough. The dough was rolled out to a height of 5 mm and cut into square shape 2.5 x 2.5 cm using biscuit mould. The biscuits were then baked at 160^{o}C in oven for 20±3 min.

2.3. Analyses of nutrient contents

Moisture, protein, fat, ash and total dietary fibre (TDF) contents of biscuits and chiffon cakes containing CL were analyzed according to AOAC [6]. Total carbohydrate was calculated by difference.

2.4 Determination of Glycemic Index (GI)

Standard methodology described by Brouns [7] for GI determination was followed. Eleven healthy human subjects (five males and six females) were randomly selected. Inclusion criteria for selection of the subjects were: age between 18 to 75 years, BMI of 18.5 to 24.9 kg/m^2, non-pregnant, non-lactating, non-smoker, having no history of acute or chronic illnesses and do not undergo any surgical procedures during the past 6

months. All subjects who voluntarily agreed to participate in the study were given written informed consent. A clinical examination was done by a physician. Ethical aspect for the study was approved by Human Research Ethics Committee of Universiti Sains Malaysia.

3. Results and Discussion

Protein content of CL cakes significantly higher than control. The protein values were increased from 12.47 (control) to 15.71% (30% CL addition), and in line with the level of CL used. Even though protein content of CL-based cakes increased in line (13.3 to 15.7%) with the levels of CL (10 to 30%), but there was no significant different compared to control. Fat contents in chiffon cake added with CL (11.34-11.57%) showed no significant variation compared to control (11.73%). In addition, ash content was found in the increasing order of control < 10 < 20 < 30 g/100 g samples. There were significant differences in total dietary fibre (TDF) content of all CL-based chiffon cakes. The TDF were also increased proportionally with the level of CL incorporation (Table 1). The TDF content increased from 0.74 (control) to 6.26% (30% CL addition).

Table 1. Nutritional compositions of chiffon cake with varied levels of CL powder

	CL content (g/100 g of wheat flour)			
	0	10	20	30
Moisture (%)	$34.29^{a} \pm 0.05$	$31.94^{b} \pm 0.17$	$31.92^{b} \pm 0.05$	$30.27^{c} \pm 0.12$
Protein (%)	$12.47^{b} \pm 1.31$	$13.28^{ab} \pm 1.47$	$14.12^{ab} \pm 1.80$	$15.71^{a} \pm 2.00$
Fat (%)	$11.73^{a} \pm 0.03$	$11.57^{a} \pm 0.19$	$11.42^{a} \pm 0.02$	$11.34^{a} \pm 0.03$
Ash (%)	$0.71^{c} \pm 0.02$	$0.93^{b} \pm 0.01$	$1.19^{a} \pm 0.02$	$1.24^{a} \pm 0.04$
Carbohydrate (%)	$40.80^{a} \pm 2.41$	$42.28^{a} \pm 3.84$	$41.35^{a} \pm 3.89$	$41.44^{a} \pm 3.18$
Total Dietary Fibre (TDF)	$0.74^{d} \pm 0.07$	$2.07^{c} \pm 0.18$	$4.11^{b} \pm 0.03$	$6.26^{a} \pm 0.07$
Energy (kcal/100g)	$318.65^{b} \pm 3.99$	$326.37^{ab} \pm 4.64$	$324.66^{ab} \pm 3.01$	$430.66^{a} \pm 4.62$

[a-d] Mean in the same row with different letter differ significantly ($p<0.05$)

On the other result, mean glucose responses of chiffon cake added with 10% CL were lower than the control cake (Table 2). The test meals were well tolerated and the test sessions were successfully completed by all subjects. The difference between mean area under the curve (AUC) of CL-added cakes and without CL (control) was not statistically significant ($p>0.95$). The GI value for chiffon cake added with CL was 49 lower than control cake which recorded GI value at 60. Based on GI classification, control cake had an intermediate GI (56 to 70) while 10% CL-based cake had a low GI value (≤55).

Table 2. Glucose responses and GI of chiffon cakes added with CL powder

Test foods	AUC mmol x min/l	GI value
Control chiffon cake	72 ± 7^{b}	60 ± 6^{b}
10% CL chiffon cake	69 ± 7^{b}	49 ± 4^{c}
Control biscuit	81 ± 11^{b}	61 ± 13^{b}
10% CL biscuit	63 ± 12^{b}	46 ± 11^{c}
Glucose	$154^{a} \pm 9^{a}$	100^{a}

[a-c] Different superscript letters within same column indicate significant differences ($p<0.05$) between the test foods

Comparisons of the mean blood glucose response of the control foods and the CL added biscuit is shown in Table 2 and Figure 1. The difference between mean area under the curve (AUC) of control biscuits and CL-added biscuits was not statistically significant ($p>0.95$). However, the glycemic responses of the control biscuits was significantly less than that of reference glucose ($p=0.04$). Likewise, the glycemic responses of the CP-added biscuits was also significantly less than that of glucose ($p=0.01$). The control biscuits had an intermediate GI value (61±13) while the CP-added biscuits had a low GI value (46±11).

There are various factors of foods that affect GI include gross and cellular structures, type of sugar, nature of starch, organic acid and dietary fibre contents [8]. In the present study we purported that the dietary fibre content might have influenced the glycemic responses of the biscuit and chiffon cake. Addition of dietary fibre to carbohydrate-based foods can affect the GI of the food although the dietary fibre itself does not have a GI value [9]. The presence of dietary fibre can delay gastric emptying and slows digestion and absorption rate of available carbohydrates. In addition, CL seemed to be more effective in reducing the postprandial glycemic response when added to the chiffon cakes. In accordance with other studies, we found that protein had inverse relationship with GI. Protein also well helps reduce postprandial glycemia by promoting secretion of insulin and delaying gastric emptying [10].

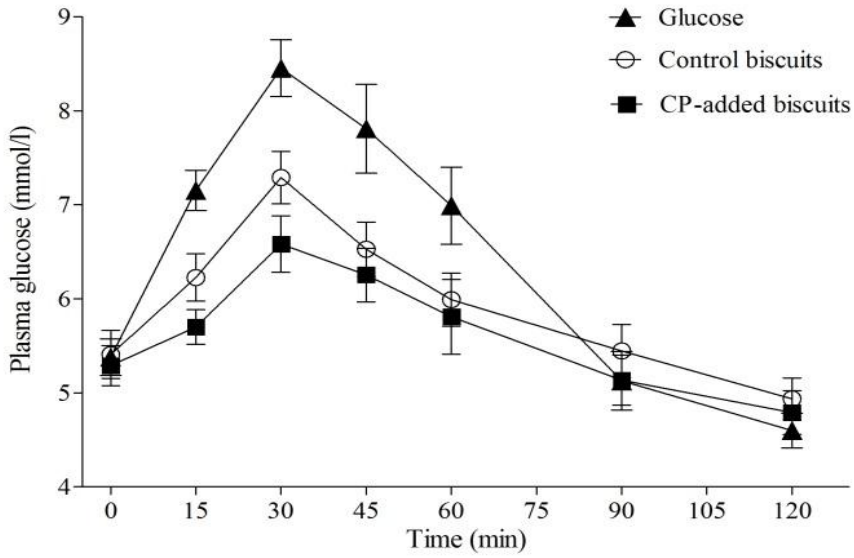

Figure 1. Mean blood glucose responses to biscuits containing cornlettes powder (CP)

4. Conclusions

Both protein and dietary fibres content of chiffon cakes added with CL at higher percentage were significantly higher than control. Addition of CL at 10% to partially replace wheat flour resulted in reduction of postprandial blood glucose response, thereby enhances the functional quality of the baked-based product. The present study shows that novel food ingredients like CL can be incorporated in selected baked-based products to enhance nutrient content while at the same time facilitate in reducing the GI value. The ability of CL in improving nutrition and glycemic responses in other food products can be investigated further.

Acknowledgements

We thank the funding supported by Universiti Sains Malaysia (1001/PPSK/813057), staffs of Nutrition and Dietetics Laboratory and Food Preparation Laboratory, School of Health Sciences for their technical supports.

References

[1] Kim JH, Lee HJ, Lee HN, Lim EJ, Suh HJ. Physical and sensory characteristics of fibre-enriched sponge cakes made with *opuntia humifusa*. *LWT - Food Science and Technology* 2001; 47: 478-484.

[2] Huh K. Woorimil (Korean wheat) bread without antibiotics. 2006. Available from http://newsnavercom/news/(cited 21/7/2013).

[3] Norimah AK, Safiah M, Jamal K, Haslinda S, Zuhaida H, Rohida S, Fatimah S, Norazlin S, Poh BK, Kandiah M, Zalilah MS, Manan WM, Fatimah S, Azmi Y. Food consumption patterns: findings from the Malaysian adult nutrition survey (MANS). *Malaysian Journal of Nutrition* 2008; 14(1): 25-39.

[4] Mishra N, Chandra R. Development of functional biscuit from soy flour &rice bran. *International Journal of Agricultural and Food Science* 2012; 2(1): 14-20.

[5] Hooda S, Kawatra, A. Nutritional evaluation of baby corn (*Zea mays*). *Nutrition and Food Science* 2013; 43: 68-73.

[6] AOAC. Official method of analysis of the association of official analytical chemists, ed 16th. Arlington, Virginia, AOAC International, 2000.

[7] Brouns F, Bjorck I, Frayn K, Gibbs A, Lang V, Slama G, Wolever T. (2005). Glycaemic index methodology. *Nutrition Research Reviews* 2005; 18(1): 145-150.

[8] Arvidsson-Lenner R, Axelsen M, Bryngelsson S, Haapa E, Jarvi A, Karlstrom B, Raben A, Sohlstrom A, Thorsdottir I, Vessby B. Glycaemic index: Relevance for health, dietary recommendations and food labelling. *Scandinavian Journal of Nutrition* 2004; 48: 84-94.

[9] Jenkins AL, Jenkins DL, Wolever TM, Rogovik AL, Jovanovski E, Bozikov V, Rahelic D, Vuksan V. Comparable postprandial glucose reductions with viscous fiber blend enriched biscuits in healthy subjects and patients with diabetes mellitus: Acute randomized controlled clinical trial. *Croatian Medical Journal* 2008; 49: 772-776.

[10] Hatonen KA, Virtamo J, Eriksson JG, Sinkko HK, Sundvall JE, Valsta LM. Protein and fat modify the glycaemic and insulinaemic responses to a mashed potato-based meal. *British Journal of Nutrition* 2011; 106: 248-253.