Available online at www.sciencedirect.com
ScienceDirect
Food Science and Human Wellness xxx (2016) xxx–xxx
Food Science and Human Wellness
www.elsevier.com/locate/fshw

Effect of Roselle calyces extract on the chemical and sensory properties of functional cupcakes

A.R. Abdel-Moemin *

Department of Nutrition and Food Science, Faculty of Home Economics, Helwan University, Bolak, Cairo 11221, Egypt

Received 17 March 2016; received in revised form 5 July 2016; accepted 15 July 2016

Abstract

Roselle calyces (RC) are a major crop for export and used to make a common drink in Egypt. Dried RC are commercially available and appreciated to obtain concentrated extracts which might be used in the food and pharmaceutical industries for color and heath benefits. The objective of this research was to determine the chemical and the sensory properties of cupcakes formulated with Roselle calyces extract (RCE). Proximate analysis, anthocyanins, ascorbic acid, titrable acidity, % retaining of anthocyanins, color and sensory evaluations were done. RC cupcakes had high sensory scores ($P < 0.05$) compared to control cupcakes. The parameter a^* was significantly red in the RC cupcakes compared to control cupcakes along with 77% retaining of anthocyanins. The consumption of 100 g of the RC cupcakes would provide 465 mg/100 g dry matter anthocyanin that is more than 2 folds of the minimum average of the daily intake of anthocyanins for Americans, along ~1/3 of the daily dietary fiber intake to achieve fiber adequacy according to the Scientific Advisory Committee on Nutrition. RC cupcake can be a functional food and would have a "clean" label with cost effective advantage.

Keywords: Roselle calyces; *Hibiscus sabdariffa* L.; Anthocyanins; Cupcakes; Fiber; Cost effective product

1. Introduction

To date, ~30,000 phytochemicals have been identified, of which 5000–10,000 are present in the food consumed in the human diet [1]. There is evidence that diets rich in fruit and vegetables could have a protective effect against a number of cancers [2] and other chronic health conditions such as cardiovascular disease [3].

Phytochemicals have many uses in the therapeutic, pharmaceutical, and food industries. Roselle calyces (RC) (*Hibiscus sabdariffa* L.) are a tropical plant in the Malvaceae family and is known in Egypt as *Karkadah*. It is probably a native of West Africa and is now widely cultivated throughout the tropics and subtropics, e.g., Sudan, China, Thailand, Egypt, Mexico, and the western part of India [4]. RC are one of the major Egyptian crops and is used in food, drinks, and cosmetics. Dried RC are commercially available and appreciated to obtain concentrated extracts which might be used in the food and pharmaceutical industries for color and heath benefits. It has been shown that ingestion of infusions of RC may help to reduce chronic diseases such as diabetes mellitus, dyslipidemia, and hypertension. This could be due to the activity of some compounds, mainly flavonoids and anthocyanins, found as natural antioxidants in Roselle calyces extract (RCE) [5].

RC anthocyanins might be used as a natural food colorant [6], as it is safer than most synthetic dyes that contain azo functional groups and aromatic rings, that may have negative effects on health including allergic and asthmatic reactions [7], DNA damage [8], and hyperactivity [9]. Some synthetic dyes are even considered to be potentially carcinogenic and mutagenic to humans [10].

Numerous researchers have pointed out that RC and its extracts possess functional properties from where advantages can be taken for developing new products with additional nutritious characteristics that may provide health benefits to

* Corresponding author at: Department of Nutrition and Food Science, Faculty of Home Economics, Helwan University, Bolak, Cairo 11221, Egypt. Fax: +20 233908130.
E-mail address: alymoemin@hotmail.com

http://dx.doi.org/10.1016/j.fshw.2016.07.003

consumers. In this sense, one of the main challenges that companies face today is the development of new value-added products to meet the consumer's demands [5]. Using RC into food products would also provide a cost effective products with "clean" label.

Cupcakes are a convenient bakery product for enrichment, is universal and easy to make. Therefore, the current study aimed to use Roselle calyx extracts as a natural source of color with its health benefits to enrich cupcakes.

2. Materials and methods

2.1. Cupcake ingredients

Cupcake ingredients included all purpose wheat flour (72% extraction), sun-dried loose dark red RC, caster sugar, unsalted butter, liquid skimmed milk, baking powder and iodized salt, eggs, pure white vanilla powder, were all purchased from local markets in Cairo, Egypt.

2.2. Chemicals

Cyanidin-3-glucoside, delphinidin-3-sambubioside, cyanindin-3-sambubioside, and delphinidin-3-glucoside were purchased from Sigma–Aldrich (Steinheim, Germany). Heat stable α-amylase (*Bacillus licheniformis*, solution, A3306), protease (*B. licheniformis*, lyophilized powder, P3910), and amyloglucosidase (*Aspergillus niger*, solution, A9913) were purchased from Sigma–Aldrich (St. Louis, MO, USA). All other chemicals and solvents were Analar grade.

2.3. Preparation of Roselle calyces extract (RCE)

A 100 g of dried loose RC were cleaned by removing visually observed non-calyces matter, then dried in a vacuum dryer (Remplissage evacuation, Arthermo Gessate MI and Density Guide, Rome, Italy) at 28 °C for 3 h, cooled at room temperature (23 °C), weighed and ground to fine powder (0.55 mm) according to the optimized particle size measurement to produce more anthocyanins as described by Ref. [11], using a stainless steel Spray Veyco MPV mill model 100 (Shanghai, China). The fine powder was soaked overnight in 200 mL distilled water (DW). In the morning, the suspension was heated at 80 °C for 1 h after adding 450 mL (DW) in a 2 L Erlenmeyer flask. The suspension was strained, and added to the RC cupcake ingredients.

2.4. Batter preparation

The basic formulation, modified from Ref. [12], was used for the preparation of 250 g of each cupcake batter and is shown in Table 1. The dry ingredients were sieved together and then the melted butter, eggs, vanilla, and skimmed milk or RCE (replacing the milk) were mixed together for 5 min. Cupcake papers were fitted into each of 12 wells cupcake tray (34 × 26 cm). Four cupcake papers were filled with the batter on a balance and 60 g batter added, and then baked in a preheated gas oven at 175 °C for ∼20 min. After baking, cupcakes were left to cool and then packed in polyethylene bags and stored for 12 h (overnight) in a dry place before sensory testing began. Both moisture determination and sensory testing were begun that morning.

Table 1
The ingredients used in the cupcake batter formulations.

Ingredient (g)	Cupcake batter formulation	
	Control cupcake	Roselle cupcake
Egg	40.0	40.0
Pure vanilla powder	1.0	1.0
Caster sugar	55.0	55.0
Wheat flour	80.0	80.0
Salt	0.25	0.25
Milk	50.0	0.0
Butter	21.0	21.0
Baking powder	2.75	2.75
Roselle extract	0.0	50.0 (20%)
Total	250.0	250.0

2.5. Analytical methods

2.5.1. Proximate analysis

Proximate analysis of the samples was done in triplicate for protein, lipid, ash, moisture, and fiber contents. The crude protein was determined according to the Kjeldahl, official method 991.20 [13]. Hydrolysis was done using a Tecator Digestion System 20, 1015 Digestor (Tecator, Höganäs, Sweden) with modification by using a nitrogen factor of 5.70 as recommended by Ref. [14].

Total lipids were extracted by using the [15] method (Soxhlet extraction apparatus, extraction tube id 40 mm, Cat. No. 09-551 B, Fisher, Pittsburgh, PA, USA). Ash was determined gravimetrically in a muffle furnace (Nabertherm, D2804, Lilenthial-Bremen, Germany) by heating at 550 °C until constant weight [16] official method 930.30 for 6 h [17]. The carbohydrate was estimated by difference according to Ref. [18].

Moisture was determined using an Infrared Moisture Determination Balance (FD-610-Kett Electric Laboratory, Tokyo, Japan) by weighing 5 g of each cupcake crumb and measured at 80 °C for 60 min.

The water loss was calculated according to the following equation:

$$\%\ \text{ML (Moisture loss)} = W_1 - W_2 / W_1 \times 100$$

where W_1 is the weight of cupcake batter actually transferred into each cupcake paper (∼60 g) and W_2 is the weight of the baked cupcake 12 h after baking [19].

Total dietary fiber of cupcake samples was determined according to Ref. [20] method 960.52. Cupcakes samples were lyophilized (Snijders Scientific, Tilburg, Holland, capacity 3 kg ice). After lyophilization cupcakes were weighed again, ground, sieved through a 40-mesh sieve, and stored at −20 °C for up to 15 days until analysis. Total dietary fiber was the weight of the residue less the weight of the protein and ash.

Please cite this article in press as: A.R. Abdel-Moemin, Effect of Roselle calyces extract on the chemical and sensory properties of functional cupcakes, Food Sci. Hum. Wellness (2016), http://dx.doi.org/10.1016/j.fshw.2016.07.003