Nutrition, Metabolism & Cardiovascular Diseases (2014) **24**, 1330–1336

Available online at www.sciencedirect.com

Nutrition, Metabolism & Cardiovascular Diseases

journal homepage: www.elsevier.com/locate/nmcd

Baru almond improves lipid profile in mildly hypercholesterolemic subjects: A randomized, controlled, crossover study

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Received 19 February 2014; received in revised form 1 June 2014; accepted 8 July 2014
Available online 18 July 2014

KEYWORDS
Nuts;
Oxidative stress;
Cardiovascular diseases;
Dyslipidemias

Abstract *Backgroud and aim:* The usual consumption of nuts reduces cardiovascular diseases (CVD) risk by improving serum lipids and oxidation status. Baru almonds (*Dipteryxalata* Vog.), a native species of Brazilian Savannah, have considerable contents of monounsaturated fatty acids (MUFA), dietary fiber, vitamin E and zinc, which could exert positive effects in serum lipids and markers of oxidation. However, there is no study about the effect of their consumption on human health. Thus, the aim of this study was to evaluate the effect of baru almonds supplementation on lipid profile and oxidation of mildly hypercholesterolemic subjects.
Methods and Results: A randomized, crossover, placebo controlled study was performed with 20 mildly hypercholesterolemic subjects (total cholesterol (TC) mean ±SEM = 5.8 ± 0.2 mmol/L). The assay had 2 periods of 6 weeks each and a 4-week washout period between the treatments. Subjects were randomly allocated in alternated periods receiving the following treatments per period: supplementation with 20 g/day of baru almonds or placebo (1 corn starch capsule/day). Compared to placebo, supplementation of baru almonds reduced TC (−8.1 ± 2.4%, $P = 0.007$), low-density lipoprotein cholesterol (LDL-c) (−9.4 ± 2.4%, $P = 0.006$) and non-high-density lipoprotein cholesterol (non-HDL-c) (−8.1 ± 3.0%, $P = 0.013$). There were no significant changes on the oxidation biomarkers evaluated.
Conclusion: Dietary supplementation of mildly hypercholesterolemic subjects with baru almonds improved serum lipid parameters, so that this food might be included in diets for reducing the CVD risk.
Clinical Trial registry: Brazilian Registry of Clinical Trials (ReBEC) (website: http://www.ensaiosclinicos.gov.br). Register number: RBR-4zdy9p.

Abbreviations: Apo, apolipoprotein; BMI, body mass index; FRAP, Ferric Reducing Antioxidant Total; Hcys, homocysteine; HDL-c, high-density lipoprotein cholesterol; LDL-c, low-density lipoprotein cholesterol; Hcys, homocysteine; MUFA, monounsaturated fatty acid; PUFA, polyunsaturated fatty acid; SFA, saturated fatty acid; SOD, superoxide dismutase; TBARS, thiobarbituric acid reactive substances; TC, total cholesterol; TE, trolox equivalent; TG, triacylglycerol; VLDL, very low-density lipoprotein.

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http://dx.doi.org/10.1016/j.numecd.2014.07.002
0939-4753/

Introduction

Nuts and edible seeds consumption has shown an inverse association with CVD risk. Subjects that consumed more than 3 portions (84 g) of nuts per week presented a reduction of 55% in death risk by CVD when they were compared to those that never or rarely consumed those foods [1]. These results are related to the improvement of serum lipid profile and oxidative stress reduction, which were evidenced by studies with almonds [2,3], macadamias [4], pistachios [5], walnuts [6], peanuts [7] and Brazil nuts [8]. The effects on serum lipid and oxidative balance are attributed to fatty acid and bioactive compound contents of the oilseeds.

The fruit of baru tree (*Dipteryx alata* Vog.), a typical plant from Brazilian Savanna, is a light brown drupe that contains an elliptical dark brown edible seed, commonly named almond. This seed has great regional importance and has attracted recent scientific interest because of its nutritional composition. Baru almonds have higher contents of MUFA (51.1%) and lower contents of saturated fatty acid (SFA) than peanuts (edible seed) and Brazil nuts, true nuts from Brazil which are consumed worldwide [9]. It should be highlighted that the ω-6:ω-3 fatty acid ratio of baru almonds (13.6:1) [9] is close to the IOM recommendation (5–10:1) [10]. Furthermore, baru almonds present high vitamin E (21.4 mg/100 g) [11], zinc (6.7 mg/100 g) [12], tannin (472.2 mg/100 g) and phytate (1073.6 mg/100 g) [13] contents. Several reports have explored the antioxidant role of these nutrients and bioactive compounds and their benefits for the human health [see review in [14]].

Experimental studies carried out with rats showed benefits of baru almonds consumption on serum lipids and oxidation [11,15]. Nevertheless, there are no reports about the effect of baru almonds consumption on human health. Therefore, the aim of this study was to evaluate the effect of baru almonds consumption on serum lipid parameters and oxidation biomarkers of mildly hypercholesterolemic subjects.

Methods

Study population

Twenty-five individuals aged 21–57 were included in the study. Subjects were recruited via flyers distributed on the University campus and emails sent to students and professors. Subjects were reasonably healthy with no major comorbidities. The eligibility criteria were: body mass index (BMI): 18.5–29.99 kg/m^2 and TC: 50–95th percentile (5.2–7.3 mmol/L) [16], assuming, however, a minimum concentration of 4.9 mmol/L. Exclusion criteria included smoking, history of chronic diseases, participation in weight loss program, use of lipid-lowering medication or other medications known to affect lipid concentrations, history of frequent nut consumption (>2 times per week) and nut aversion or allergy. The Federal University of Goiás Research Ethics Committee's approved the study protocol (reference number 212/2012) and this assay was registered in the Brazilian Registry of Clinical Trials as RBR-4zdy9p. All participants gave written informed consent.

Study design

A randomized, controlled, 2-period crossover design was employed with 2 treatments: 20 g/day of baru almonds supplementation and placebo (one corn starch capsule/day). Subjects were randomly assigned to receive 1 of the 2 treatments in alternated periods for 6 weeks each one. A 6-week period was chosen because it is considered sufficient to stabilize diet-induced lipoprotein changes [17]. A 4-week washout period was incorporated between treatments in order to eliminate residuals effects (carryover) of the first period. All volunteers were informed that they would receive a supplemental dietary intake composed of baru almonds in two forms: capsule and roasted.

Baru almonds, derived from Pirenópolis city, were obtained from local commerce in Goiânia city, state of Goiás, Brazil. They were roasted in an electric oven at 140° C for 30 min to inactivate anti-nutritional factors [18] and to investigate the effect in their usual consumption form. After roasting, portions of baru almonds were weighed and stored in vacuum packs.

The serving of baru almonds (20 g) was determined based on portions of seeds, peanuts and Brazil nuts established by Jenab et al. [19]. It was recommended that the 20 g of baru almonds were consumed as snacks or with meals, on a daily base. Supplementation compliance was monitored weekly by the staff and by reviewing the dietary records. Table 1 summarizes nutrient composition of baru almonds serving used in this assay.

All participants were instructed to maintain their usual dietary intake and level of physical activity and not to consume other nuts or edible seeds throughout the study. Dietary records, anthropometry and laboratory analysis were assessed at baseline and after 6 weeks in each period.

Dietary assessment

Participants were asked to complete a 3-day dietary record in nonconsecutive days, with at least one weekend day. A trained researcher provided subjects with detailed instructions on how to fill the dietary records. A researcher reviewed all diet records upon return for accuracy. All dietary records were analyzed to provide an estimation of daily average energy and nutrient intake by using the software Avanutri (Rio de Janeiro, Brazil).

Body composition

All measurements were collected with participants barefoot and wearing light clothing. Subjects' height was measured at baseline by using a stadiometer graduated in centimeters (CardioMed®; Curitiba, Brazil). Body weight and composition were assessed by dual-energy x-ray absorptiometry using Lunar DPX-NT (General Electric Medical Systems Lunar; Madison, EUA).