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BIOCHEMICAL AND ANTHROPOMETRIC PROFILE OF WISTAR RATS TREATED WITH PALM OIL (*ELAEIS GUINEENSES*)

[1]Jane Celi do Nascimento Rodrigues, [1]Bianca Borges Magalhães, [1,2,]*Sandra Maria Barbalho, [1]Adriana Ragassi Fiorini, [3]Ricardo de Alvares Goulart, [2]Claudemir Gregório Mendes, [1]Marie Oshiiwa, [1,2]Claudia C. T. Nicolau, [1,2]Elen Landgraf Guiguer and [2]Adriano Cressoni Araujo

[1]Department of Biochemistry and Nutrition, Faculty of Food Technology of Marília, Marília, São Paulo, Brazil
[2]Department of Biochemistry and Pharmacology, School of Medicine, University of Marília (UNIMAR), Avenida Higino Muzzi Filho, 1001, Marília, Sao Paulo, Brazil
[3]Gastroenterologist, University Hospital - ABHU – UNIMAR, Marília, São Paulo, Brazil

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Corresponding author:
Sandra Maria Barbalho

ABSTRACT

Obesity is considered a pandemic and is associated with numerous health risks such as dyslipidemia, hypertension, overweight/obesity and metabolic syndrome, which are risk factors for cardiovascular diseases (CVD). The bioactive compounds present in fruits, vegetables and oilseeds have biological effects on glycemic control, cholesterol levels, body weight, and therefore on CVD prevention. *Elaeisguineenses* is a palm of African origin, and from its fruits, it is possible to extracted oil. The fruits have an excellent repertoire of phytochemicals, carotenoids, tocopherols, and tocotrienols. Two groups of Wistar rats were used, which were kept under controlled conditions of time, temperature, relative humidity. Animals received food and water*ad libitum* andwere separated according to G1, control group, which received water and feed *ad libitum*; and G2, group that were fed*ad libitum*, alternating water (48h) and palm oil (12h). The results showed that treatment with palm oil did not produce changes in the visceral fat weight and the Lee index, but significantly reduced the percentage of body weight. Biochemical parameters showed that the animals treated with palm oil had a significant reduction in levels of total cholesterol, LDL-c, triglycerides and VLDL-c, andan increase of HDL-c. We can concluded that the use of palm oil can bring metabolic benefits acting as a coadjuvant in the prevention of chronic non communicable diseases such as CVD.

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INTRODUCTION

Obesity is considered a pandemic and is associated with several conditions such as dyslipidemia, hypertension, overweight/ obesity and metabolic syndrome, which are risk factors for cardiovascular diseases (CVD). In addition to the numerous comorbidities related to hyperglycemia and resistance to insulin, there is also the generation of inflammatory processes and the production of reactive species that trigger oxidative stress. This leads to a vicious circle as oxidative stress and inflammation increase insulin resistance and is related to CVD and cancer, which are the leading causes of mortality in the world, accounting for 60% of all deaths (Ma *et al.,* 2018; Lee *et al.,* 2018). The bioactive compounds present in fruits, vegetables and oilseeds have biological effects in the control of glycemia, cholesterol levels, body weight, and therefore in the prevention of CVD (Csepanyi *et al.,* 2018; Veeramini *et al.,* 2018; Abdel-Tawwab *et al.,* 2018). Such compounds may protect against diseases due to antioxidant properties. Studies also indicate that unsaturated fats can contribute to low cholesterol and blood pressure levels and, therefore, prevent the occurrence of complications due to hyperglycemia, dyslipidemia, obesity, and hypertension (Campesi *et al.,* 2018; Rodriguez Lanzi *et al.,* 2018; Pivetta *et al.,* 2016). *Elaine Guineans* is a palm tree of African origin that arrived in Brazil in the 16th century and adapted on the coast of southern Bahia. Of its fruits are extracted two types of oil, the palm oil, extracted from the pulp or mesocarp; and that of palm kernel, obtained from the almond or endosperm. Both have an essential repertoire of phytochemicals, carotenoids, tocopherols and tocotrienols (Utomo *et al.,* 2018; Chen *et al.,* 2018; Weinberg *et al.,* 2018; Jim *et al.,* 2018; Suframa, 2003).

The characteristic color of crude palm oil is due to the abundance of carotenoids (500-700 mg/L). α and β-carotenes are the major components with γ-carotene, lycopene, and xanthophylls present in minor amounts (Leow *et al.,* 2011). Palm oil is rich in tocotrienols, the only vegetable available on the world market in appreciable amounts which are rich in these compounds which are related to the inhibition of cholesterol biosynthesis and platelet aggregation (Edem, 2002). As chronic noncommunicable diseases are increasing sharply in the world population and are related to the increase in the number of deaths, the objective of this study was to evaluate the metabolic profile of Wistar rats treated with palm oil.

METHODS

Animals: This study obtained approval of the Animal Research Ethics Committee of the Faculty of Food Technology (FATEC), Marília, São Paulo State, Brazil (protocol number 001/2016). The Wistar rats were fed and watered *ad libitum* during the experimental period and were treated according to the recommendations of the "Guide to the Care and Use of Experimental Experiments of the Canadian Council." Wistar rats were kept at the FATEC Marília - São Paulo under controlled conditions (12/12 hours light / dark cycle and 22 ± 2°C ambient temperature, and relative humidity of 60 ± 5%). After seven days of adaptation to the laboratory conditions, the animals were randomized into two groups of eight animals, and identified according to the treatment to be administered:

G1: Control group, which received water and feed *ad libitum*;
G2: Group that was fed*ad libitum*, alternating water (48h) and palm oil (12h).

The experimental protocol was extended for 40 days and after this period, the animals suffered euthanasia with overdose of anesthetic. After death, anthropometric measurements, visceral fat and blood samples were taken to determine glycemia, triglycerides, total cholesterol, LDL-c and HDL-c

RESULTS

The results showed that the treatment with palm oil did not produce changes in visceral fat weight and the Lee index, but significantly reduced body weight (Table 1).

Table 1. Data on weight gain, Lee index and visceral fat of the control group (G1) and the group treated with palm oil (G2)

Parameter	G1	G2
Weightgain (%)	138.99 ± 26.58 (A)	108.95 ± 27.32 (B)
Lee Index	2.97 ± 0.09 (A)	2.94 ± 0.06 (A)
Visceral fat (g)	11.91 ± 5.88 (A)	12.26 ± 3.03 (A)

[1]Different letters indicate a significant difference between the treatments at a level of 5%.

Table 2. Results of biochemical parameters of animals treated with palm oilcompared with the control group

Parameter	G1	G2
Glycemia	140.63 ± 19.84 (A)	157.50 ±9.97 (A)
Total Cholesterol	67.75 ± 8.21 (A)	51.25 ± 5.80 (B)
Tiglycerides	141.13 ± 47.66 (A)	55.75 ± 25.57 (B)
HDL-c	45.75 ± 4.77 (B)	55.38 ± 4.50 (A)
LDL-c	16.50 ± 4.04 (A)	16.75 ± 4.53 (A)
VLDL-c	12.13 ± 3.04 (A)	9.00 ± 2.14 (B)

[1]Different letters indicate a significant difference between the treatments at a level of 5%. HDL-c: High-Density Lipoprotein; LDL-c: Low-Density Lipoprotein; VLDL-c: Very Low-Density Lipoprotein.

The results of the biochemical parameters show that the animals treated with palm oil had a significant decrease in the amounts of triglycerides, total cholesterol, LDL-c, and VLDL and increased levels of HDL-c (Table 2).

DISCUSSION

The modern diet is associated with a large number of sugars and saturated fats, which relate to increased blood pressure, dyslipidemias and cardiovascular complications. Palm oil may reduce levels of total cholesterol, triglycerides, LDL-c and thrombotic eicosanoids involved in various pathophysiological processes of the cardiovascular system (Assam *et al.,* 2018; Parr *et al.,* 2018; Edem, 2002). Atherogenesis is a phenomenon that occurs slowly and may begin before clinical manifestation. For this reason, many researchers are motivated to study and develop new therapeutic methods with plants that can improve risk factors before the atherosclerotic process becomes an irreversible condition (Fiorini *et al.,* 2017). The results of this study indicate that palm oil may bring benefits to the metabolic profile of treated animals since they have reduced some parameters such as total cholesterol, triglycerides, LDL-c, and improved HDL-c levels. Many studies have shown that levels of HDL-c, total cholesterol and triglycerides may be useful in assessing cardiovascular risk. HDL-c levels are also directly associated with CVD once their levels are reduced, triggering the process of atherogenic plaque formation (Wu *et al.,* 2018; Bañuelos-Chavez *et al.,* 2017). Changes in lipoprotein profile may be related to overweight and obesity. Studies show that altered lipid levels are significantly associated with body adiposity in children and adolescents. The relationship between obesity and dyslipidemias is associated with systolic and diastolic blood pressure, and inadequate levels of total cholesterol, triglycerides, HDL-c and LDL-c, with the extension of lesions in the aorta and coronary arteries. This fact underscores the importance of the prevention of cardiovascular risk factors in the different stages of life (Florencio *et al.,* 2017). Our results show that the regular use of palm oil can positively influence some lipid parameters and reduce body weight, thus being a possibility as a coadjuvant in the prevention of heart disease.

In addition to oil, the leaves of *Elaeisguineensis* are also rich in flavonoids and catechins. Catechins are phenolic compounds that have antioxidant activity and can promote vascular relaxation, reduce glycemia and lipid peroxidation. Kalman *et al.* (2013) used this plant in pre-diabetic subjects for 8 weeks and showed a significant reduction in glycemia and insulin levels, and reduction of waist circumference, indicating that this plant can improve insulin sensitivity and improve the secretory pattern of the adipose tissue (reduced release of inflammatory cytokines due to reduced abdominal fat storage). Tan et al (2011) showed that leaf extract reduced blood glucose and lipid peroxidation regardless of the dose used, possibly by inhibiting the secretion of dipeptidyl peptidase-4 (DPP-4). Varatrarajan and Rajavel (2012) also used the extract of leaves of *E. guineensis* in diabetic animals and observed improvement in renal function and markers of oxidative stress by increasing the levels of glutathione that is part of the endogenous antioxidant system. Larb, Zhao, Wu (2018) supplemented Nile tilapia with palm oil and showed an increase in cholesterol and triacylglyceride levels, contrary to our findings in Wistar rats. According to Leow *et al.* (2011), palm oil contains very significant amounts of lipid-soluble antioxidants such as carotenoids, tocopherols, and tocotrienols in addition to the water-soluble folic acid rich complex that can be obtained from the palm through a series of laboratory processes. This complex, which includes caffeoylshikimic acid isomers, protocatechuic acid, and p-hydroxybenzoicacid has antioxidant properties without associated toxicity. In mice, these authors found numerous biological activities of this complex mainly in the liver, spleen, and heart. In the liver, there was a reduction in the activity of enzymes related to cholesterol biosynthesis, indicating that this complex may be a promising nutraceutical in the prevention of CVD. Leow *et al.* (2012) have also used the above-described complex in mice and have shown that it can reduce the atherogenic effects of a pro-atherogenic diet by reducing oxidative stress, inflammation, and increased turnover of metabolic metabolites in the liver, heart, and spleen. According to Edem (2002), palm oil is safe and non-toxic, easily digestible, efficiently used and well absorbed, and does not contain trans fatty acids. As it is a rich source of antioxidants, it can aid in reducing the risk of CVD and protect against cancer.

Conclusion

The use of palm oil may have significant benefits once promoted a reduction in total cholesterol, triglycerides, and VLDL-c levels, and increase the levels of HDL-c, and may act as a coadjuvantin the prevention of occurrence of chronic non-communicable diseases such as CVD. However, further studies are needed to assess whether these same effects can occur in humans.

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