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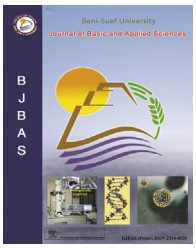

Full Length Article

Consumption of thermally oxidized palm oil diets alters biochemical indices in rats

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ARTICLE INFO

Article history:
Received 2 August 2014
Accepted 7 April 2015
Available online 19 May 2015

Keywords:
Thermally oxidized palm oil
Liver function markers
Lipid profile
Malondialdehyde

ABSTRACT

Palm oil is thermally oxidized to increase its palatability and this has been a usual practice in most homes. This study sought to assess the biochemical responses of rats to thermally oxidized palm oil diets. Therefore, Wistar strain albino rats (*Rattus norveigicus*) were fed with fresh palm oil (control) and thermally oxidized palm oil (test groups) diets and water ad libitum for 30 days. Then, the malondialdehyde (MDA) contents and total protein of the plasma and liver were determined. Subsequently, the plasma liver function markers [alanine transaminase (ALT), aspartate transaminase (AST), alkaline phosphatase (ALP), albumin (ALB) and total bilirubin (TBIL)] and the lipid profile [triglyceride (TRIG), total cholesterol (T-CHOL), high density lipoprotein (HDL-CHOL) and low density lipoprotein (LDL-CHOL)] were assayed. The results of the study revealed that there was a significant decrease ($P < 0.05$) in the plasma and liver total protein, ALB, TRIG and HDL-CHOL of the test groups when compared with the control. Conversely, there was a significant increase ($P < 0.05$) in the activities of ALT, AST and ALP, TBIL, T-CHOL, LDL-CHOL and plasma/liver MDA of the test groups when compared with the control. These effects were most pronounced in rats fed with 20 min-thermally oxidized palm oil diet. Hence, consumption of thermally oxidized palm oil diets had deleterious effects on biochemical indices in rats. Therefore, cooking with and/or consumption of palm oil subjected to heat treatment for several long periods of time should be discouraged in our homes as this might have deleterious effects on human health.

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Peer review under the responsibility of Beni-Suef University.
http://dx.doi.org/10.1016/j.bjbas.2015.05.009

1. Introduction

Palm oil, the most widely produced edible vegetable oil in the world, is obtained from the pulp of the fruit of the oil palm *Elaeis guineensis*. Palm oil contains a high proportion of the saturated palmitic acid, but considerable quantities of oleic and linoleic acids, which give it a higher unsaturated content than coconut oil and palm kernel oil (the minor oil obtained from the oil palm) (Gunstone et al., 1986). Crude palm oil is considered to be the richest natural source of carotenoids (about 15 times more than in carrots) (Mukherjee and Mitra, 2009). The major carotenoids in palm oil are α- and β-carotene, which account for 90% of the total carotenids (Yap et al., 1997). Palm oil and its fractions contain less than 1.5% of the hypercholesterolemic lauric and myristic acids. Furthermore, Palm oil and its fractions contain tocopherols. It is especially rich in Y- tocotrienol. These substances, which are physiologically active as vitamin E, are useful antioxidants (Sundram and Top, 1994). They delay the time when oxidation in the oil will have proceeded far enough to produce off-flavours and/or odours (Gunstone and Norris, 1983). In addition, they possess free radical scavenger properties, serving to protect biological systems against oxidative and carcinogenic stress (Krinsky, 1994; Manorama et al., 1993; Nesaretnam et al., 1993).

Palm oil is consumed fresh and/or at various levels of thermal oxidation. It is thermally oxidized when the fresh form is subjected to heating at high temperatures and at different time intervals. Generally, palm oil is thermally oxidized to increase its palatability and this has been a usual practice in most homes. However, thermal oxidation has a deteriorative effect on dietary oils (Perkins and Van Akkerren, 1965; Peers and Swoboda, 1982). Ingestion of thermally oxidized oil has been reported to cause a concomitant evolution of very cytotoxic and destructive by-products (Plea, 1975; Frankel, 1980; Ziombski, 1982) which are injurious to cells, tissues and organs (O'sara et al., 1969; Tappel, 1973; Gabriel et al., 1979; Meredith, 1984). Furthermore, long term consumption of oxidized oils and fats has been reported to cause growth retardation, thrombosis, fatty livers, essential fatty acid deficiency, nucleic acid deficiency and micronutrient malnutrition leading to deactivation of key metabolic enzymes (Hill et al., 1982; Izaki et al., 1984; Golden and Ramdath, 1987; Isong et al., 1992; Osim et al., 1992). Chronic consumption of thermoxidized palm oil diets has also been reported to cause adverse effects on some haematological indices (RBC, WBC, Hb, PCV) in rat (Mesembe et al, 2004). The free radicals that are generated may be involved in the etiology of diseases such as cancer, diabetes, arthritis, and cataract formation (Sun, 1990; Pryor, 1991; Lunec, 1992). Therefore, this study sought to investigate the effect of consumption of thermally treated palm oil on some biochemical parameters in rats.

2. Materials and methods

2.1. Materials

Chemicals and reagents used were of analytical grades while the water was glass distilled. All the kits used for bioassay were obtained from RANDOX Laboratories Ltd., (Crumlin, Co. Antrim, UK).

Table 1 – Diet formulation (g/100 g).

	Control	Test groups
Skimmed milk	44.8	44.8
Corn starch	41.2	41.2
Premix	4.0	4.0
Fresh palm oil	10.0	–
Thermally oxidized palm oil	–	10.0

1 g of the premix contains: 3200i.u vitamin A, 600i.u vitamin D3, 2.8 mg vitamin E, 0.6 mg vitamin K3, 0.8 mg vitamin B1, 1 mg vitamin B2, 6 mg niacin, 2.2 mg pantothenic acid, 0.8 mg vitamin B6, 0.004 mg vitamin B12, 0.2 mg folic acid, 0.1 mg biotin H2, 70 mg choline chloride, 0.08 mg cobalt, 1.2 mg copper, 0.4 mg iodine, 8.4 mg iron, 16 mg manganese, 0.08 mg selenium, 12.4 mg zinc, 0.5 mg antioxidant.

2.1.1. Oil sample preparation

The sample was prepared according to the method of Oboh et al. (2014). Fresh palm oil (1 L) was purchased in a local market, in Akure metropolis, Nigeria and divided into four equal portions (250 ml). Three portions were oxidized by subjecting each to heating {1000 W electric hot plate (Guangzhou D.G.H. Electrical Appliances Co., Ltd., Guangdong, China)} in a stainless steel fry-pan for 10, 15 and 20 min respectively at 180 °C while the other portion was used fresh. The generated oil samples were used in diet formulation (Table 1) for wistar albino rats using the modified method of Oboh (2005).

2.2. Methods

2.2.1. Experimental animal grouping

Thirty-two (32) wistar strain albino rats weighing 40–50 g were purchased from the biochemistry department, University of Ibadan, Nigeria, and acclimatized for 2 weeks, during which period commercial diet and water were given *ad libitum* before the commencement of the experiment. Subsequently, the rats were divided into four treatment groups of eight rats each; the control group was fed diet with fresh palm oil, while the remaining three groups (test groups) were placed on thermally oxidized palm oil (varied time of heating) diets and water *ad libitum* for 30 days, during which the body weight and daily feed intake were monitored. The experimental groups and diets fed are as follows:

Control Rats fed with fresh palm oil diet
10tpo Rats fed with 10 min-thermally oxidized palm oil diet
15tpo Rats fed with 15 min-thermally oxidized palm oil diet
20tpo Rats fed with 20 min-thermally oxidized palm oil diet

All authors hereby declare that "principles of laboratory animal care" (NIH Publication No 85-23, revised 1985) were followed and all experimental procedures have been examined and approved by the appropriate ethics committee.