Contents lists available at ScienceDirect

Asian Pacific Journal of Tropical Medicine

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

Document heading doi:

Effect of pineapple peel extract on total phospholipids and lipid peroxidation in brain tissues of rats

Erukainure OL[1*], Ajiboye JA[2], Adejobi RO[2], Okafor OY[1], Kosoko SB[1], Owolabi FO[1]

[1]*Food Technology Division, Federal Institute of Industrial Research, Oshodi, Nigeria*
[2]*College of Natural and Applied Sciences, Bells University of Technology, Ota, Nigeria*

ARTICLE INFO

Article history:
Received 20 December 2010
Received in revised form 27 January 2011
Accepted 15 February 2011
Available online 20 March 2011

Keywords:
Brain
Malondialdehyde
Total phospholipids
Alcohol

ABSTRACT

Objective: To investigate the ability of the methanolic extract of pineapple peel to attenuate alcohol-induced changes in total phospholipids and lipid peroxidation in brain tissues. **Methods:** Oxidative stress was induced by oral administration of ethanol (20% w/v) at a dosage of 5 mL/kg bw in rats. After 28 days of treatment, the rats were fasted overnight and sacrificed by cervical dislocation. Brain tissues were assayed for total phospholipid (TP) content and malondialdehyde (MDA). **Results:** Administration of alcohol significantly caused a reduction in TP content. Treatment with pineapple peel extract significantly increased the TP content. Significant high levels of MDA was observed in alcohol-fed rats, treatment with pineapple peel extract significantly reduced the MDA levels. **Conclusions:** Results obtained from this study indicates that pineapple peel extract protects against alcohol-induced changes in total phospholipids and lipid peroxidation in brain tissues.

1. Introduction

The brain is one of the organs rich in phospholipids, which provide the building blocks for different membrane structures[1]. Phospholipids are important components of mammalian cells with a variety of biological functions including provision of structural integrity for protein function, energy reservoir and precursors for various second messengers[2]. These phospholipids are rather rich in long-chain polyunsaturated fatty acids, particularly in docosahexaenoic acid (DHA) and arachidonic acid (AA)[3].

Alcohol has been reported to be the most frequently abused drug throughout the world[4]. Chronic alcohol consumption leads to several metabolic disorders including hepatic and extra hepatic diseases, which are instigated by reactive oxygen species (ROS) generation as found in liver, heart and brain, leading to cellular damage[5]. ROS damages many cellular components: cellular proteins, DNA and membrane phospholipids. Continuous administration of ethanol to mice have been shown to cause a reduction in the proportion of polyunsaturated fatty acids found in phospholipids of brain synaptosomes[6]. This can also be attributed to lipid peroxidation induced alcohol-generated free radicals. Lipid peroxidation degrades membrane polysaturated fatty acids with production of aldehydes such as malondialdehyde (MDA), 4-hydroxynonenal (HNE) and acrolein with disruption of membranes and alteration of their function[7].

Pineapple (*Ananas cosmosus*) is a popular fruit which grows in the tropics and sub-tropics. They are native to Central and Southern America and belong to the *Bromeliaceae*. Their nutritional and medicinal properties have been widely studied. They are rich in the antioxidants namely flavonoids, vitamin A and C[8]. The peels are well known ingredients in ethno medicine. Correia *et al*[9] established a relationship between antioxidant activity, β-glucosidase and total phenolic content in pineapple peel/soy flour extracts.

This paper reports the ability of the methanolic extract of pineapple peel to attenuate alcohol-induced changes in total phospholipids and lipid peroxides in rats.

2. Materials and methods

2.1. Plant materials

Pineapple peels were collected from a fruit seller at Oshodi, Lagos, Nigeria. They were rinsed in distilled

*Corresponding author: Erukainure OL, Food Technology Division, Federal Institute of Industrial Research, Oshodi, Nigeria.
Tel: +2348062179388
E-mail: loreks@yahoo.co.uk

water to remove dirt. They were air dried and grounded to fine texture with laboratory mill and were extracted with methanol for 8-10 hours, distilled and concentrated using steam bath and then stored for subsequent use.

2.2. Animals

Thirty male albino rats weighing 95-120 g were used for the present investigation. They were reared at the Animal House of the Biochemistry Department of Bells University of Technology, Ota, Nigeria.

They were acclimatized for two weeks on normal diet of pelletized mouse chow, with water given *ad libitum* at room temperature with a 12-hour light and dark cycle before the commencement of the experiment. The rats were divided into six groups, each consisting of five animals.

Rates in Group 1 as control group were treated with distilled water only (5 mL/kg body weight (bw), Group 2 as negative control with ethanol only, Group 3 with ethanol+pineapple peel extract (2.5 mL/kg bw), Group 4 with ethanol + pineapple peel extract (5 mL/kg bw), Group 5 with pineapple peel extract only (5 mL/kg bw), Group 6 with ethanol+distilled water (5 mL/kg bw). Oxidative stress was induced by oral administration of ethanol (20% w/v) at a dose of 5 mL/kg bw. The treatment lasted for 28 days. The dose of ethanol, pineapple peel extract and the period of treatment were selected on the basis of previous studies by Faremi *et al*[10].

At the end of the treatment, the rats were fasted overnight and sacrificed by cervical dislocation. Brain tissue samples were collected by dissecting the skulls and stored at < 2 ℃ until further analysis.

The animals used in the present study were maintained in accordance with the approval of the Animal Ethical Committee, Bells University of Technology, Ota, Nigeria.

2.3. Lipid extraction

The total lipids were extracted with chloroform/methanol (2:1, v/v) as described by Folch *et al*[11]. Briefly, the stored brain tissues were homogenized, respectively. 3 g of each homogenates were taken and mixed with chloroform-methanol (2:1, v/v) in a mixer. Non-lipid contaminants in the extracted lipid were extracted into a 0.88% KCl solution. The extracted lipids were further evaporated on a rotary evaporator, and stored at -2 ℃.

2.4. Measurement of total phospholipids (TP) and MDA

MDA was measured as described by Chowdhury and Soulsby[12]. Total phospholipid content was determined according to Bartlett[13].

2.5. Statistical analysis

Statistical significance was measured using One-Way analysis of variance (ANOVA) and data were reported as mean±standard deviation. Statistical analyses were carried out using SPSS for Windows, version 14.0 (SPSS Inc. Chicago, IL.USA).

3. Results

Results for TP content are presented in Table 1. Administration of alcohol reduced the TP content by 13.75%. Treatment with pineapple peel extract at 2.5 mL/kg bw had no significant effect on the alcohol-induced reduction of TP. Rather it further reduced the TP content by 24.62%. But treatment with pineapple extract at 5.0 mL/kg bw significantly increased the TP content by 38.2%(P<0.05), indicating a dose dependent response.

Table 1
Effect of pineapple peel extract on TP in brain tissues in brain tissues of alcohol-induced oxidative stressed rats.

Group	Level (mg/g protein)
Group 1	0.53 ± 0.01
Group 2	0.46 ± 0.02
Group 3	0.35 ± 0.01
Group 4	0.84 ± 0.09*
Group 5	0.28 ± 0.02
Group 6	0.53 ± 0.01

* : P<0.05, comparing to Group 2.

Results for MDA content are shown in Figure 1. Alcohol significantly increased MDA level in brain tissues by 64.85%. Treatment with pineapple peel extract at 2.5 mL/kg bw significantly reduced the MDA level by 72.50%. Treatment with pineapple peel extract at 5.0 mL/Kg bw was observed to reduce the alcohol-induced MDA level by 25.00%. No significant difference was observed between alcohol fed rats (Group 2) and rats fed alcohol and distilled water (Group 6).

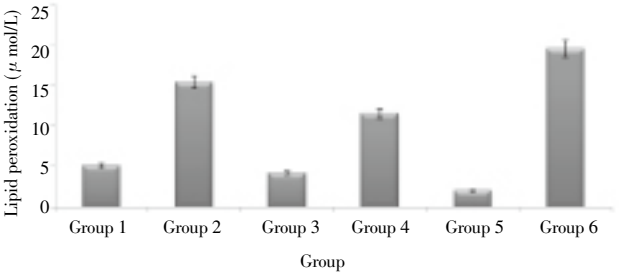

Figure 1. Effect of pineapple peel extract on MDA in brain in brain tissues of alcohol-induced oxidative stressed rats.

4. Discussion

Plants have been recognized for their ability to produce a wealth of secondary metabolites and which is responsible for their use in disease treatment and management for several generations[14]. This paper reports the protective properties of pineapple peel extract against alcohol-induced changes in total phospholipids and lipid peroxidation of brain tissues.

Brain phospholipids, such as EFA's, are fundamental

to neuronal function, and are already being studied in developmental neuropsychiatric disorders such as attention deficit hyperactivity disorder and Schizophrenia[15]. Administration of alcohol was observed to significantly reduced total phospholipids in brain tissues. Alcohol could bring about this effect possibly by generating ROS thereby inducing oxidative stress which has been reported to be involved with several neuropsychiatric ailments[16]. Brain tissues are rich in phospholipids which make them susceptible to the damage by ROS[17]. Changes in total phospholipids content can also have dramatic effects on the physicochemical properties of membranes (in particular causing membrane fluidity to vary substantially), which in turn would alter the biological function of the membrane, notably having a powerful effect on neurophysiological sensitivity[18]. Treatment with pineapple peel extract at 5.0 mL/Kg increased the TP content of alcohol-fed rats, indicating the protective properties of the peel against alcohol-induced alteration of total phospholipids in brain tissues.

Lipid peroxidation (LPO) has been reported to be a marker of oxidative stress[19-20]. It alters the organization of the membrane by inducing changes in fluidity and permeability[21]. Alcohol consumption has been reported to increase lipid peroxide content in tissues[22]. Lipid peroxidation results in the production of reactive molecules such as MDA and HNE. In this present study, increased MDA level was observed in alcohol-fed rats. Pineapple peel extracts at 2.5 mL/kg significantly reduced the MDA level. This findings corresponds to reports by Guliaeva *et al*[23] that increased lipid peroxidation results to decrease in phospholipid content in rat brain.

Results obtained from this study indicate that pineapple peel extract can protect against alcohol-induced changes in total phospholipids and lipid peroxidation in brain tissues. The extracts may have protective potentials against neuropsychiatric ailments.

Conflict of interest statement

We declare that we have no conflict of interest.

References

[1] Barcelo -Coblijn G, Hogyes E, Kitajka K, Puskas LG, Zvara A, Hackler L, et al. Modification by docosahexaenoic acid of age-induced alterations in gene expression and molecular composition of rat brain phospholipids. *PNAS* 2003; **100**(20): 11321-11326.

[2] Adibhatla RM, Hatcher JF. Role of lipids in brain injury and diseases. *Future Lipidol* 2007; **2**(4): 403-422.

[3] Bourre JM, Dumont OS, Piciotti MJ, Pascal GA, Durand GA. McNamara RK, et al. Gender differences in rat erythrocyte and brain docosahexaenoic acid composition: role of ovarian hormones and dietary omega-3 fatty acid composition. *Psychoneuroendocrin* 2009; **34**(4): 532-539.

[4] Lieber CS. Medical disorders of alcoholism. *New Engl J Med* 1995; **333**(16): 1058 - 1065.

[5] Lieber CS. Alcohol and the liver: metabolism of alcohol and its role in hepatic and extrahepatic diseases. *Mount Sinai J Med* 2000; **67**: 84-94.

[6] Kode A, Rajagopalan R, Penumathsa SV, Menon VP. Effect of ethanol and thermally oxidized sunflower oil ingestion on phospholipid fatty acid composition of rat liver: Protective role of *Cuminum cyminum* L. *Ann Nutr Metab* 2005; **49**: 300-303.

[7] Kim YT, Kim JY, Choi JS, Kim SH, Choi EK, Cho NH. Relation between deranged antioxidant system and cervical neoplasia. *Int J Gynecol Cancer* 2004; **14**: 889-895.

[8] Wood R. *The whole foods encyclopedia.* New York, Prentice-Hall Press; 1988.

[9] Correia RTP, Mccue P, Vattem DA, Magalhães MMA, Macêdo GR, Shetty K. Amylase and *Helicobacter pylori* inhibition by phenolic extracts of pineapple wastes bioprocessed by *Rhizopus oligosporus*. *J food biochem* 2004; **28** (5): 419 - 434

[10]Faremi TY, Suru SM, Fafunso MA, Obioha UE. Hepatoprotective potentials of *Phyllanthus amarus* against ethanol-induced oxidative stress in rats. *Food Chem Toxic* 2008; **46**(8): 2658-2664.

[11]Folch J, Lees M, Sladane-Stanley GHA. Simple method for the isolation and purification of total lipids from animal tissues. *J Biol Chem* 1957; **226**: 497-509.

[12]Chowdhury P, Soulsby M. Lipid peroxidation in rat brain is increased by simulated weightlessness and decreased by a soy-protein diet. *Annals Clin Lab Sci* 2002; **32**(2): 188-192.

[13]Bartlett GR. Phosphorus assay in column chromatography. *J Biol Chem* 1959; **234**:466-468

[14]Bawankule DU, Pal A, Gupta S, Yadav S, Misra A, Rastogi S, et al. Protective effect of *Ocimum sanctum* on ethanol-induced oxidative stress in swiss albino mice brain. *Toxicol Int* 2008; **15**: 121-125

[15]Peet M, Glen I, Horrobin DF. Phospholipid spectrum disorder in psychiatry. Carnforth: Marius Press; 1999.

[16]Ademiluyi AO, Oboh G. Antioxidant properties of methanolic extracts of mistletoes (*Viscum album*) from cocoa and cashew trees in Nigeria. *Afr J Biotechnol* 2008; **7**: 3138-3142.

[17]Buffone MG, Verstraeten SV, Calamera JC, Doncel GF. High cholesterol content and decreased membrane fluidity in human spermatozoa are associated with protein tyrosine phosphorylation and functional deficiencies. *J Androl* 2009; **30**: 552-558.

[18]Miñarro J, Rodríguez-Arias M, Pérez-Iranzo N, Restall CJ, Brain PF. Developmental and neurochemical effects of early postnatal exposure to flumazenil in female and male mice. *Psicothema* 2000; **12**(4): 648-653.

[19]Onyema OO, Farombi EO, Emerole GO, Ukoha AI, Onyeze GO. Effect of vitamin E on monosodium glutamate induced hepatoxicity and oxidative stress in rats. *Indian J Bioc Biophys* 2005; **43**: 20-24.

[20]Okafor OY, Erukainure OL, Ajiboye JA, Adejobi RO, Owolabi FO, Kosoko SB. Pineapple peec extract modulates lipid peroxidation, catalase activity and hepatic biomarker levels in blood plasma of alcohol-induced oxidative stressed rats. *Asian Pac J Trop Biomed* 2011; **1**(1):12-14.

[21]Nigam S, Schewe T. Phospholipase A_2s and lipid peroxidation. *Biochim Biophys Acta* 2000; **1488**, 167-181.

[22]Tuma DJ, Casey CA. Dangerous byproducts of alcohol breakdown-focus on adducts. *Alc Res Health* 2003; **27** (4): 285-290.

[23]Yeh M, Chen H, So EC, Liu C. A study of serum malondialdehyde and interleukin-6 levels in young women with dysmenorrhea in Taiwan. *Life Sci* 2004; **75**(6) 669-673.