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Original Research Article

Effect of Oral Administration of Common Pepper Types on the Liver Enzymes of Wistar Rats Fed with High-fat Diet

Onyebuchi Obia[1*], Furo Dawari Emmanuel[1]

[1]Department of Human Physiology, Faculty of Basic Medical Sciences, College of Medical Sciences, Rivers State University, Nkpolu-Oroworukwo, Port Harcourt, Nigeria

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Abstract: The prevalence of metabolic syndrome is rising steadily due to increased consumption of high-fat diet. This study evaluates the effects of red, green, and black pepper varieties on the liver enzymes of wistar rats fed with a high-fat diet. The study involved 35 wistar rats separated into seven groups of five rats each. The animals were fed with high-fat diet consisting of butter throughout the period of the experiment. Group 1 is untreated and received only high-fat diet. Groups 2 and 3 received additional 50mg/kg and 75mg/kg of red pepper respectively, Groups 4 and 5 received additional 50mg/kg and 75mg/kg of green pepper respectively, Groups 6 and 7 received in addition 50mg/kg and 75mg/kg of black pepper respectively. The experiment lasted for 28days and thereafter, blood samples were collected to determine the serum concentrations of aspartate transaminase (AST), alanine transaminase (ALT) and alkaline phosphatase (ALP). The results showed that of all the pepper types used in our study, only the high dose of black pepper significantly increased all the liver enzymes measured. The AST and ALT concentrations were not altered by administration of red pepper, low dose of black pepper and high dose of green pepper. At both concentrations (50mg/kg and 75mg/kg) the three pepper types respectively increased ALP levels and this is possibly attributable to intestinal stimulation. Conclusively, red, green and low dose black pepper possibly exhibited no deleterious effect on the liver. However, our study suggests that consumption of high dose of black pepper might be hepato-toxic. Further research is needed to elucidate underlying mechanisms and optimize therapeutic strategies.

Keywords: Pepper Types, Liver Enzymes, Wistar Rats, High-Fat Diet.

INTRODUCTION

The prevalence of metabolic syndrome and its complications is rising both globally and in Nigeria [1-6]. This trend may not be unconnected with the increase in the consumption of diets with high concentration of lipids. High-fat diets are increasingly prevalent in modern societies, resulting in increasing incidence of dyslipidemia, obesity, and non-alcoholic fatty liver disease (NAFLD) [7, 8]. Dietary choices are mainly determined by the taste and texture of foods [9]. These high-fat diets are usually flavorful and served in most appetizing manner, thus making them more attractive to consumers despite their negative health implications [10]. While peppers may be added to high-fat foods primarily for flavor, some of their compounds have additional anti-inflammatory and antioxidant properties [11]. Other beneficial effects of peppers include; improved digestion, lipid-lowering potential, enhanced thermogenesis and intestinal motility [12-14].

The liver plays a central role in the metabolism of dietary carbohydrates, lipids, proteins and vitamins; in the synthesis of plasma proteins; and in the detoxification and biliary excretion of endogenous wastes and xenobiotic compounds. The liver also functions as an important organ of the innate immune system, integrated into the complex system of defense against foreign macromolecules. It is therefore important to note that hepatic disorders have far-reaching consequences because of the dependence of other organs on the metabolic functions of the liver [15].

As the consumption of high-fat diet remains a lifestyle even in the low socioeconomic societies [10, 16], it is therefore increasingly important to device measures that could mitigate these impacts. Food-based approach would seem to be cheaper and of lesser side effects than the continual use of synthetic drugs [11]. Determining if commonly consumed pepper varieties offer protective effects against lipid or liver dysfunction

***Corresponding Author:** Onyebuchi Obia
Department of Human Physiology, Faculty of Basic Medical Sciences, College of Medical Sciences, Rivers State University, Nkpolu-Oroworukwo, Port Harcourt, Nigeria

could empower public health policy, guiding consumer food choices for improved outcomes. This study thus aimed to determine and compare the effects of different pepper species (green, red and black) on liver enzymes [Aspartate transaminase (AST), Alanine transaminase (ALT), Alkaline phosphatase (ALP)] of wistar rats fed with high fat diet.

METHODOLOGY

The present study involved a total of 35 male Wistar rats purchased from the animal house of department of Human Physiology, faculty of Basic Medical Sciences, Rivers State University. The rats were separated into 7 groups of 5 rats each and kept in suitable conditions, including proper ventilation and temperature levels. They were housed in clean disinfected wooden cages with saw dust as beddings and maintained in standard conditions of light/dark cycle and fed *ad libitum* with animal feed and clean water. The rats were then allowed to acclimatize for a period of one week. The three pepper species; red, green and black were purchased from Mile 3 market in Port Harcourt and properly identified. Ethical approval was obtained from the faculty of Basic Medical Sciences Research Ethics Committee with approval number; RSU/FBMS/REC/24/063.

The animals were grouped as follows; all the animals were fed with high-fat diet consisting of butter throughout the period of the experiment. Group 1 is untreated and received only high-fat diet. Groups 2 and 3 received in addition, 50mg/kg and 75mg/kg of red pepper respectively, Groups 4 and 5 received in addition, 50mg/kg and 75mg/kg of green pepper respectively, Groups 6 and 7 received in addition 50mg/kg and 75mg/kg of black pepper respectively. The pepper species were administered in their respective daily oral dosages and the experiment lasted for 28days. Thereafter, the animals were sacrificed under anesthesia and blood samples collected from each animal to determine plasma concentrations of the liver enzymes. Statistical package for social sciences (SPSS) version 22.0 was used for data analysis. Results were presented in tables and graphs. Continuous variables were expressed as mean ± standard error of mean (SEM). Statistical difference was determined using analysis of variance (ANOVA) and significant differences noted at $p < 0.05$.

RESULT

Table 1: Effects of the three varieties of pepper on the Liver enzymes of Wistar rats fed with high-fat diet.

Group	AST (IU/l)	ALT (IU/l)	ALP (IU/l)
High fat diet (HFD)	33.20 ± 1.28	20.60 ± 1.66	27.60 ± 1.29
HFD + 50mg/kg of Red pepper	37.40 ± 0.75	17.40 ± 1.22	49.80 ± 3.87$^{\#}$
HFD + 75mg/kg of Red pepper	35.60 ± 2.02	16.00 ± 1.34	37.40 ± 0.75$^{\#}$
HFD + 50mg/kg of Green pepper	40.60 ± 1.83$^{\#}$	24.40 ± 2.75	64.80 ± 1.50$^{\#}$
HFD + 75mg/kg of Green pepper	37.80 ± 2.22	20.60 ± 1.81	61.40 ± 1.36$^{\#}$
HFD + 50mg/kg of Black pepper	28.40 ± 2.56	16.40 ± 1.89	50.40 ± 4.19$^{\#}$
HFD + 75mg/kg of Black pepper	44.80 ± 1.28$^{\#}$	30.60 ± 1.91$^{\#}$	55.80 ± 4.73$^{\#}$

$^{\#}$Significantly different compared to High fat diet (H FD) only group

DISCUSION

Liver enzymes are known to be conventional biomarkers of hepatic function, even though their presence in serum can also be derived from other sources. The enzymes are therefore not completely confined to the liver [17], but a rise in their serum concentrations may suggest hepatic dysfunction. Previous studies have linked the consumption of HFD with some abnormalities in liver function [7-18]. So that a rise in the liver enzymes compared to the HFD only group could imply that when the extract is consumed together with HFD, it may cause further derangement in liver function.

The results from our study showed that oral administration of red pepper (50mg/kg and 75mg/kg) did not have any significant effect on the AST and ALT concentrations but significantly increased the ALP compared to HFD only group. This probably implies that red pepper did not increase the deleterious effects of HFD on the physiology of the liver. This is supported by a study by Lee *et al*., [19], which showed that red pepper seed inhibited hepatic lipid accumulation. Oral administration of 50mg/kg of green pepper caused significant increase in AST and ALP concentrations but no significant effect on ALT compared to the HFD only group. 75mg/kg of green pepper caused no significant change in both AST and ALT levels but significantly increased the ALP levels compared to HFD only group. The rats that received 50mg/kg of black pepper showed no significant change in their AST and ALT levels but significant increase in their ALP concentrations compared to the HFD only group.

In the present study, 75mg/kg of black pepper significantly increased all the three liver enzymes measured. The findings of this study therefore suggest that higher doses of black pepper may exacerbate HFD induced hepatic toxicity. Other studies have implicated piperine (the most predominant bioactive component of black pepper) in this possible hepatic injury [20]. Our study agrees with a previous study in which significant elevation of liver enzymes was reported following

administration of piperine in HFD fed mice [20]. In contrast, studies on human subjects with NAFLD and on acetaminophen-induced hepatotoxicity in animal studies showed a decrease in liver enzymes suggestive of possible hepato-protective potential of piperine [21-23]. The antioxidant and anti-inflammatory properties of piperine may play a role in its hepato-protective potential [24], by mitigating oxidative stress and inflammation in the liver. Although, the possible mechanism of piperine induced hepatic toxicity in HFD fed wistar rats in our study is not very clear but administration of a high dose may be contributory since the lower dose did not significantly alter the AST and ALT levels. This would require further studies to determine its interactions with hepatic pathways. The variability among pepper types underscores the importance of considering specific pepper varieties and doses in evaluating their effects on liver function. Further research is needed to elucidate the differential effects of pepper varieties on liver enzymes and to identify the underlying mechanisms responsible for these effects.

The ALP found in liver is often described as tissue non-specific [25]. Tissue-specific ALP might originate from the intestines when they are stimulated. In our study, all concentrations of the three pepper varieties used (red, green and black) respectively caused increase in ALP levels. The elevated ALP levels with different pepper types may be related to their stimulatory effects on the intestines [13, 14]. However this does not exclude its effect on the biliary and hepatocellular tissues [26, 27].

Conclusively, of all the pepper types used in our study, only the high dose of black pepper significantly increased all the liver enzymes measured which signifies possible hepatotoxicity. The AST and ALT concentrations were not altered by administration of red pepper. However, at both concentrations (50mg/kg and 75mg/kg) the three pepper types respectively increased ALP levels attributable to intestinal stimulation.

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