Effect of Black Pepper and Vitamin E on Some Liver Biomarkers of Wistar Rats Treated with Acrylamide

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ABSTRACT
Background to the study*: Acrylamide is a chemical compound produced following exposure of carbohydrate based foods to high temperatures. The aim of the present study is to determine the effect of black pepper on some liver markers (liver enzymes, albumin and total protein) of wistar rats exposed to acrylamide.*
Methodology*: The study involved 20 male wistar rats separated into 4 groups of 5 rats each as follows; Group 1 served as control. Animals in groups 2, 3 and 4 respectively received a daily oral dose of 30mg/kg of Acrylamide (ACR) throughout the experiment. Group 2 remained untreated (ACR only). Animals in groups 3 and 4 received in addition, 50mg/kg/day of black pepper and 150mg/kg/day of vitamin E respectively. All treatments were given orally for 14 days and thereafter animals were sacrificed and blood samples collected to determine the concentrations of some liver markers (liver enzymes, albumin and total protein) in the blood using standard methods.*
Results*: Our results showed no significant differences in the concentrations of aspartate transaminase (AST), alanine transaminase (ALT), alkaline phosphatase (ALP), total protein and albumin in the group that received black pepper compared to the ACR only group. Oral administration of vitamin E caused significant reduction in the ALT and albumin concentrations compared to the ACR only group. There was also significant elevation in the ALT concentration following oral administration of black pepper compared to the vitamin E supplemented group.*
Conclusion*: Conclusively, oral administration of black pepper to acrylamide treated wistar rats caused no significant changes in the plasma liver biomarkers. However, vitamin E supplementation significantly reduced ALT levels in acrylamide treated wistar rats. This suggests a possible ameliorative potential of vitamin E in preventing acrylamide toxicity.*

Key words: *Black pepper, Liver Enzymes, Albumin, Total Protein, Acrylamide, Wistar rats.*

INTRODUCTION

Acrylamide is a toxic substance present in thermally processed carbohydrate-based foods such as deep-fried potatoes. Although, consumption of these foods can to some degree increase exposure to acrylamide toxicity [1, 2, 3], some individuals are additionally exposed in industries where it is utilized in manufacturing. Studies have shown that acrylamide induces oxidative stress and its resultant toxicity on different organs [4, 5]. Acrylamide toxicity has been reported in the liver, kidneys, nervous system as well as reproductive system in both human and animals. Therefore, humans are consistently being exposed to acrylamide without being aware [6] especially in developing countries where the level of awareness of acrylamide in foods is still low. However, there are only a few interventions aimed at reducing the level of

acrylamide in our daily diets. These interventions would be particularly effective when affordable and accessible to the vulnerably exposed populations. Nutrition-based interventions using popular components of our daily meals may be suitable. Black pepper is a commonly used food spice containing piperine. It is nearly a regular spice in many food cultures due to its pungent taste. Studies have shown that black pepper has many dietary and medicinal benefits including; antioxidant, anti-inflammatory and lipid lowering effects [7, 8, 9, 10, 11]. It has also been used in management of some gastrointestinal disorders. The present study investigated the effect of black pepper on the liver markers of wistar rats treated with acrylamide.

MATERIALS AND METHODS

This study was carried out in the department of Human Physiology, Faculty of Basic Medical Sciences, Rivers State University with ethical approval number: RSU/FBMS/REC/24/104. The experiment involved 20 male wistar rats separated into 4 groups of 5 rats each which were acclimatized for a period of two weeks being provided with standard animal chow and water *ad libitum*. Acrylamide was procured from a chemical shop (Joechem ventures) while black pepper was purchased from the mile 3 market in Port Harcourt and processed according to the method described by Charles et al., 2024. The groups include; Group 1 which served as control and received distilled water and animal chow throughout the period of the experiment. A daily oral dose of 30mg/kg of Acrylamide was respectively used to induce toxicity [12] in Groups 2, 3 and 4. Group 2 remained untreated (Acrylamide only). Group 3 received in addition, 50mg/kg/day of black pepper while Group 4 received in addition, 150mg/kg of vitamin E [13]. All treatment were given orally for 14 days and thereafter animals were sacrificed and blood samples collected to determine the concentrations of some liver biomarkers in the blood. All the parameters were determined using standard methods and values recorded.

Data were analyzed using SPSS vs 23 and presented in Tables. Continuous variables were expressed as mean ± SEM. The differences between each group were analyzed using paired sample t-test and ANOVA. Values of $p< 0.05$ were considered significant with a confidence level of 95%.

RESULTS

Table 1: Effect of black pepper on some liver biomarkers in wistar rats treated with acrylamide

GROUP	**AST** (IU/l)	**ALT** (U/l)	**ALP** (U/l)	**Total protein** (g/l)	**Albumin** (g/l)
Control	32.60 ± 3.54	22.80 ± 2.94	26.40 ± 0.68	67.80 ± 1.46	43.60 ± 1.08
ACR Only	31.60 ± 7.67	31.20 ± 4.71	28.40 ± 0.68	70.00 ± 0.89	46.60 ± 0.66
ACR + Black Pepper	38.80 ± 3.20	28.00 ± 1.50**	27.80 ± 1.50	68.20 ± 2.33	44.80 ± 0.80
ACR + Vitamin E	33.20 ± 0.74	19.00 ± 1.27*	26.80 ± 1.32	67.40 ± 1.60	43.20 ± 0.80*

Values are expressed as Mean ± SEM (n = 5);
* Significantly different when compared to ACR only.
** Significantly different when compared to ACR + Vitamin E.

DISCUSSION

The liver enzymes, total protein and albumin are some of the known biomarkers of liver function. Our results showed no significant differences in the concentrations of aspartate transaminase (AST), alanine transaminase (ALT), alkaline phosphatase (ALP), total protein and albumin in the group that received black pepper compared to the ACR only group. Oral administration of vitamin E caused significant reduction in the ALT and albumin concentrations compared to the ACR only group. There was also significant elevation in the ALT concentration following oral administration of black pepper compared to the vitamin E

supplemented group. The findings of the present study suggest that oral administration of 50mg/kg/day of black pepper had no significant effect on the liver enzymes, total protein and albumin of ACR treated wistar rats. This result is similar to a previous study which reported no significant effect of black pepper on the liver enzymes of high-fat diet fed wistar rats [14].

AST and ALT are hepatocellular enzymes usually released into the systemic circulation in response to hepatocellular injury [15, 16]. Cellular leakages and loss of functional integrity of hepatocytes or hepatocellular dysfunction caused by acrylamide can result in a slight rise in albumin concentration [17]. Vitamin E supplementation presented significant hepato-protective potentials in ACR induced toxicity. Acrylamide is a known organo-toxic agent which induces oxidative stress [18] and causes hepatic and renal injuries [19, 20, 21]. The result therefore suggests that the antioxidant activity of vitamin E possibly prevented hepatocellular injury and thus could be beneficial when consumed together with acrylamide in food [13, 22, 23] suggesting possible ameliorative effect of vitamin E on the toxic effects of acrylamide in the liver as shown by the reduction of ALT levels.

Conclusively, oral administration of black pepper to acrylamide treated wistar rats caused no significant changes in the plasma liver biomarkers (AST, ALT, ALP, total protein and albumin). However, vitamin E supplementation significantly reduced ALT levels in acrylamide treated wistar rats. This suggests a possible ameliorative potential of vitamin E in preventing acrylamide toxicity.

REFERENCES

1. Rifai, L., & Saleh, F. A. (2020). A review on acrylamide in food: Occurrence, toxicity, and mitigation strategies. *International journal of toxicology*, *39*(2), 93-102.
2. Timmermann, C. A. G., Mølck, S. S., Kadawathagedara, M., Bjerregaard, A. A., Törnqvist, M., Brantsæter, A. L., & Pedersen, M. (2021). A Review of Dietary Intake of Acrylamide in Humans. *Toxics*, *9*(7), 155. https://doi.org/10.3390/toxics9070155
3. Zhang, N. N., Zhou, Q., Fan, D. M., Xiao, J., Zhao, Y. L., Cheng, K. W, *et al* (2021). Novel roles of hydrocolloids in foods: Inhibition of toxic maillard reaction products formation and attenuation of their harmful effects. *Trends in Food Science and Technology*. 111:706-715.
4. Simeonne, A.H. and Archer D.L. (2014). Acrylamide in foods: a review and update, university of Florida, *IFAS Extraction*. FCS 8759. http://edis.ifas.ufl.edu/fy578
5. Zheng, J., & Xiao, H. (2022). Editorial: The Effects of Food Processing on Food Components and Their Health Functions. *Frontiers in nutrition*, *9*, 837956. https://doi.org/10.3389/fnut.2022.837956
6. Kacar S, and Sahinturk V. (2021). The protective agents used against acrylamide toxicity: an in vitro cell culture study-based review. Cell J. 23(4): 367-381. doi:0.22074/cellj.2021.7286.
7. Hervert-Hernández, D., Sáyago-Ayerdi, S. G., &Goñi, I. (2010). Bioactive Compounds of Four Hot Pepper Varieties (Capsicum annuum L.), Antioxidant Capacity and Intestinal Bioaccessibility. *Journal of Agricultural and Food Chemistry*, 58(6), 3399–3406.
8. Ludy, M. J., Moore, G. E., & Mattes, R. D. (2012).The effects of capsaicin and capsiate on energy balance: critical review and meta-analyses of studies in humans. *Chemical senses*, 37(2), 103–121.
9. Charles, C., Obia, O., Emmanuel, F. D., Ogba, A.,& Ojeka, S. O. (2024). Effects of red, green, andblack pepper on intestinal motility and post-prandialbicarbonate concentration in guinea pigs. *EAS Journal of Nutrition and Food Sciences*, 6(4), 125-129.
10. Emmanuel, F. D., Obia, O., Charles, C., Okari, K. A., Otto, J. B., Reuben, E., & Onyeso, G. (2025). Comparative Assessment of Red, Green and Blackpepper species on Plasma and Fecal Lipid Profile ofHigh-fat diet fed wistar rats. *International Journal of Biochemistry Research & Review*, 34(1), 153-163**.**
11. Obia, O., & Emmanuel, F. D. Effect of Oral Administration of Common Pepper Types on the Liver Enzymes of Wistar Rats Fed with High-fat Diet. East African Scholars Journal of Medical Sciences, 2025; 8(3): 92-95.
12. Mahmood, S. A. F., Amin, K. A. M., & Salih, S. F. M. (2015). Effect of Acrylamide on Liver and Kidneys in Albino Wistar Rats. *International Journal of Current Microbiology and Applied Sciences*, 4(5), 434-44.
13. Ebuehi, O. A. T., Ogedegbe, R. A. and Ebuehi. O. M. (2012). Oral administration of vitamin C and Vitamin E ameliorates lead-induced hepatotoxicity and oxidative stress in rat brain. Nig Q J Hosp Med. 22(2), 85-90. PMID: 23175903**.**
14. Obia, O., Kalio, R. O., Tee, P. G. P., & Onyeso, G. Plasma Lipid Lowering Potential of Carrot (Daucus carota) Extract in Male Wistar Rats. Asian Journal of Research in Medical and Pharmaceutical Sciences, 2025; 14(1): 18-23.
15. Lakshmi, B.V.S., Sudhaka,r M., and Aparna M. (2013). Protective Potential of Black Grapes against Lead Induced Oxidative Stress in Rats. *Environ. Toxicol.Pharmacol*.35, 361–368.

16. Sun R., Chen W., Cao X., Guo J., Wang J. (2020). Protective Effect of Curcumin on Acrylamide-Induced Hepatic and Renal Impairment in Rats: Involvement of CYP2E1. *Nat. Prod. Commun.*15, 1934578X20910548.
17. Shrivastava S.; Chhavi Uthra; Mohd. Salim, Reshi and Sangeeta, Shukla (2017). Protective Role of Kaempferol Against Acrylamide Intoxication. Free Radicals and Antioxidants, 7(1), 36-42.
18. Hajimohammadi, B., Athari, S. M., Abdollahi, M., Vahedi, G., & Athari, S. S. (2020). Oral Administration of Acrylamide Worsens the Inflammatory Responses in the Airways of Asthmatic Mice Through Agitation of Oxidative Stress in the Lungs. Frontiers in immunology, 11, 1940. https://doi.org/10.3389/fimmu.2020.01940.
19. Belhadj Benziane, A., Dilmi Bouras, A., Mezaini, A., Belhadri, A., & Benali, M. (2019). Effect of oral exposure to acrylamide on biochemical and hematologic parameters in Wistar rats. *Drug and chemical toxicology*, 42(2), 157–166.
20. Ibrahim, D. S. (2024). Effect of vinpocetine against acrylamide-induced nephrotoxicity in rats. *Journal of biochemical and molecular toxicology*, *38*(2), e23658. https://doi.org/10.1002/jbt.23658
21. Quasmi, M. N., Kumar, D., & Jangra, A., (2025). Effects of dietary acrylamide on kidney and liver health: Molecular mechanisms and pharmacological implications, *Toxicology Reports*, 14, 101859.
22. Mahan L. K., Escott-Stump S., Raymond J. L. and Krause M. V. (2012). Krause's Food and the Nutrition Care Process. 13th ed. St. Louis (Mo.), Elsevier/ Saunders.
23. Eid, R. A., Zaki, M. S. A., Alghamd, M. A., Wares, A., Eldeen, M. A., Massoud, E. E. S., & Haidara, M. A. (2020). Ameliorative Effect of Vitamin E on Biochemical and Ultrastructural Changes in Artemether-induced Renal Toxicity in Rats. *Int. J. Morphol*., 38(2), 461-471.