

## Lipid Profile of Normal and Iodine Treated Albino Wistar Rats Following Ingestion of *Allium cepa* (Onion) and *Allium sativum* (Garlic)

Aletan, Uduak I.

Department of Pure and Applied Sciences, Faculty of Science, National Open University of Nigeria, Jabi, Abuja. Nigeria

Corresponding Author email: [ualetan@noun.edu.ng](mailto:ualetan@noun.edu.ng)

Received 13<sup>th</sup> September, 2018 Accepted 11<sup>th</sup> December, 2018

### Abstract

The effect of iodine fortification of the lipid profile is yet to be approached. This study investigated the lipid profile of normal and iodine treated rats administered with onion and garlic extract. Oral administration of aqueous extracts of garlic and onion at different doses, 1 ml of each extract containing 1.14 g of the sample of onion or garlic extract was designated as low dose while 1.5ml containing 1.70 g of the sample was designated as high dose, were done to eight groups of wistar albino rats. Four of these were treated with iodine in form of potassium iodide solution (0.8 mg/kg body weight) while the other groups were normal. Two control groups one for the normal rats, the other for the iodine treated rats which were not administered with the spices. There were no statistically significant ( $P < 0.05$ ) differences in total cholesterol and HDL-cholesterol due to treatment with iodine or oral administration of the extracts. The mean values of VLDL-cholesterol for the rats ranged between  $37.50 \pm 0.86$ mg/dl for the low dose garlic group treated with iodine and  $11.74 \pm 0.75$ mg/dl for low dose onion group treated with iodine. Oral administration of low dose garlic led to statistically significant ( $P < 0.05$ ) increases in triacylglycerol, LDL-cholesterol levels and consequently the LDL: HDL cholesterol ratio of iodine treated rats. From these results, orally administered garlic extract led to a rise in the triacylglycerol as well as the LDL-cholesterol in iodine treated animals.

**Keywords:** Onion, Garlic, Lipid profile, iodine

### Introduction

Iodine is a crucial microelement very important for normal growth and development. In 2009, Zimmermann (2009) estimated that iodine deficiency affected nearly 2 billion people globally and could easily be avoidable with the use of iodized salt in the diet. This has been implemented in most countries where iodine deficiency is a public health problem. Globally, UNICEF estimates that 66% of households now have access to iodized salt (WHO, 2017). Onion (*Allium cepa*) and garlic (*Allium sativum*) have been implicated in haematological effects (Fazlollahzadeh et al., 2011; Aletan, 2014), cardiovascular effects (Tende et al, 2015), changes in lipid profile (Tende et al, 2015), anti-microbial effects (Kyung, 2012), and hepatoprotective effects (Ugwu and Omale, 2011) among other health benefits. Alliums are widely used as food supplements (Akash et al, 2014) and have many health benefits that are related to their bioactive components. Elevated triglyceride (TG), total cholesterol (TC), and low-

density lipoprotein cholesterol (LDL-cholesterol) concentrations are well-known risk factors for cardiovascular disease (Ae et al., 2015). While some researchers have recorded decrease in lipid profile especially triglycerides and total cholesterol (Ae et al., 2015) due to administration of these Alliums others have recorded that these Alliums have failed to bring about statistically significant changes (Gazuwa et al., 2013) in these parameters. Regrettably, there is scarce information on the effect of these Alliums on the lipid profile of iodine treated animals and also the effect of iodine of these Alliums on the lipid profile of iodine treated animals and also the effect of iodine fortification on the lipid profile. This study investigated the lipid profile of normal and iodine treated albino wistar rats following ingestion of *Allium cepa* (onion) and *Allium sativum* (garlic).

### Materials and Methods

The onion and garlic sample used for this study were purchased from Ika Ika Qua Market in

Calabar, capital city of Cross River State of Nigeria. These vegetables are usually grown in the different parts of the Northern Nigeria and transported to the south. The dry scaly parts of the onion bulbs were removed and the fresh bulbs were properly washed. 300g of the onions were weighed and macerated in 300ml of deionized water using an electric blender. The homogenous mixture obtained after maceration was filtered through a cheese cloth and the residue removed, dried and weighed. The solution left behind weighing 455.7g was used as whole onion extract and from this stock; high and low doses were obtained for the experiments.

The dry scaly outer part of the garlic cloves was removed and the fresh cloves were properly washed. 300g of the garlic were weighed and macerated in 300ml of deionized water using an electric blender. The solution was used as whole garlic extract of 455.7g was used as whole garlic extract and from this; high and low doses were obtained for the experiment.

A quantity of 400 mg of potassium iodide was dissolved in 400mls of water. 0.8ml of the solution corresponding 0.8 mg/kg body wt was administered to the animals.

### **Experimental animals**

A total of 100 albino rats of the Wistar strain consisting of both male and females were obtained from the disease free stock of the departmental animal house of Biochemistry department, faculty of Basic Medical sciences, University of Calabar, Nigeria. These animals weighing between 80g-120g were used for the experiment. The animals were housed in Perspex cage, (North Kent Plastic Cages Ltd, England) with bottom grid and a stainless steel top. The animals were kept under adequate ventilation at temperature and relative humidity of  $26 \pm 2^{\circ}\text{C}$  and 46% respectively. Feed and water were provided *ad libitum*. Their weights were taken 3 times during the course of the 14 days.

### **Animal grouping and treatment**

The animals were grouped into ten study groups of ten animals each based on their average weight. The groups were treated as stated below:  
Group 1 - control – placebo- *deionized water*  
Group 2 - positive control – *potassium iodide solution only*

Group 3 - low dose of garlic only

Group 4 - high dose of garlic only

Group 5 - low dose of onion only

Group 6 - high dose of onion only

Group 7 - low dose of garlic + potassium iodide solution

Group 8 - high dose of garlic + potassium iodide solution

Group 9 - low dose of onion + potassium iodide solution

Group 10- high dose of onion + potassium iodide solution

### **Administration of the extracts**

The administration of the aqueous extracts to the different groups of animals was done for 14 days. 1 ml of both the onion and the garlic extracts containing 1.14 g of each sample of onion and garlic extract was designated as low dose while 1.5ml containing 1.70 g of each sample was designated as high dose.

An amount 0.8 mg/kg body wt of potassium iodide was administered orally to the animals taking potassium iodide at least 4hours before the respective extracts were administered to ensure iodine had been absorbed into the plasma (this is to ensure an iodine loaded state).

### **Sacrifice of animals**

Twenty-four hours after the last administration, the animals were removed, placed in a dessicator glass jar, anaesthetized in chloroform vapour and dissected.

### **Collection of samples for studies**

Whole blood sample obtained by cardiac puncture from each animal was collected into a sterile tube. The whole blood sample collected was allowed to stand for one hour to clot and serum was neatly separated from the clot by a gentle tap with syringe and needle down the side of the tubes. The serum obtained was further subjected to centrifugation using an MSE-table top centrifuge (Minor, England) set at 8000 revolutions per minute (rpm) for 15 minutes, and a clear serum devoid of any trace of hemoglobin obtained. The serum sample obtained from the animals was used for assays.

### **Lipid profile analysis**

The component lipids were estimated using enzymatic colorimetric diagnostic kits obtained from human laboratories (Human Gesellschaft fur Biochemica und Diagnostica) colorimetric diagnostic kits supplied by Randox laboratories (Randox Laboratories Limited, Admore, Diamond Road Crumlin Co, Antrim United Kingdom BT 294 QY) were used for HDL-cholesterol determination. *Estimation of triacylglycerol (Trinder 1969) as employed in Human kits.* The GPO-PAP method of Trinder (1969) was used for determination of triacylglycerol. *Estimation of total cholesterol (Richmond, 1973) as employed in Human Kits* The CHOD-PAP method of Richmond (1973) was used. *Estimation of HDL-cholesterol (Richmond, 1973) as employed by Randox Kits.* The phosphotungstate precipitation method was used for determination HDL-cholesterol.

*Estimation of VLDL cholesterol concentration (Burnstein and Samaille, 1960)* By dividing either the serum or plasma triacylglycerol value by 5, the VLDL cholesterol concentration is obtained. This factor of 5 is based on the understanding that in fasting subjects with triacylglycerol concentration of 400mg/dl, the VLDL to total plasma triacylglycerol ratio is fixed relatively at 1:5. *Estimation of LDL cholesterol (Friedwald et al., 1972)* By the Friedwald relationship, LDL cholesterol is derived from the difference between the total cholesterol and the sum of HDL-cholesterol and VLDL cholesterol.

### Statistical Analysis

Results of all the studies were expressed as mean  $\pm$  standard deviation. Data between groups were analysed using SPSS 2003 (version 13).

## Results

**Table 1: Effect of oral administration of *Allium cepa* and *Allium sativum* extract on the lipid profile of normal and iodine treated Wistar rats.**

| Parameters<br>Groups | T-cholesterol     | TG                              | HDL              | VLDL             | LDL                             | LDL: HDL                     |
|----------------------|-------------------|---------------------------------|------------------|------------------|---------------------------------|------------------------------|
| Control              | 53.39 $\pm$ 10.33 | 78.92 $\pm$ 14.50               | 20.29 $\pm$ 4.81 | 15.79 $\pm$ 2.90 | 43.41 $\pm$ 11.15               | 2.22 $\pm$ 0.72              |
| LDG                  | 41.97 $\pm$ 2.57  | 113.83 $\pm$ 3.84               | 15.00 $\pm$ 0.47 | 23.03 $\pm$ 0.99 | 77.01 $\pm$ 3.60                | 5.14 $\pm$ 0.18              |
| HDG                  | 48.58 $\pm$ 2.41  | 106.50 $\pm$ 12.60              | 24.54 $\pm$ 1.80 | 21.30 $\pm$ 2.52 | 60.56 $\pm$ 9.41                | 2.48 $\pm$ 0.41              |
| LDO                  | 51.42 $\pm$ 1.35  | 92.65 $\pm$ 20.23               | 24.37 $\pm$ 2.16 | 18.53 $\pm$ 4.05 | 50.32 $\pm$ 16.44               | 2.07 $\pm$ 0.64              |
| HDO                  | 67.68 $\pm$ 1.55  | 160.13 $\pm$ 21.36 <sup>a</sup> | 24.75 $\pm$ 0.22 | 32.94 $\pm$ 4.71 | 106.17 $\pm$ 18.07 <sup>a</sup> | 4.35 $\pm$ 0.75              |
| KI treated           | 42.97 $\pm$ 6.60  | 110.66 $\pm$ 34.53              | 20.84 $\pm$ 2.89 | 22.13 $\pm$ 6.91 | 67.26 $\pm$ 26.16               | 2.98 $\pm$ 0.88              |
| KI + LDG             | 52.03 $\pm$ 2.13  | 187.50 $\pm$ 4.35 <sup>a</sup>  | 25.75 $\pm$ 0.23 | 37.50 $\pm$ 0.86 | 124.22 $\pm$ 3.62 <sup>a</sup>  | 4.83 $\pm$ 0.16 <sup>a</sup> |
| KI + HDG             | 51.42 $\pm$ 4.91  | 98.53 $\pm$ 19.31               | 18.90 $\pm$ 3.58 | 19.71 $\pm$ 3.86 | 60.00 $\pm$ 17.79               | 3.43 $\pm$ 1.48              |
| KI + LDO             | 54.07 $\pm$ 8.71  | 68.29 $\pm$ 19.91               | 21.28 $\pm$ 2.29 | 11.74 $\pm$ 0.75 | 25.56 $\pm$ 2.55                | 1.21 $\pm$ 0.19              |
| KI + HDO             | 53.33 $\pm$ 3.75  | 80.27 $\pm$ 15.13               | 17.90 $\pm$ 3.26 | 16.05 $\pm$ 3.03 | 46.36 $\pm$ 9.40                | 2.68 $\pm$ 0.84              |

The superscript a ... indicate the level of significance in with the control

a =  $P < 0.05$ . Values without superscripts are not statistically significant

Values are presented as mean  $\pm$  SD

LDG = Low dose garlic, HDG = High dose garlic, LDO = Low dose onion, HDO = High dose onion, KI = Potassium iodide, TG = Triacylglycerol,

HDL= High density lipoprotein-cholesterol, VLDL=Very low density lipoprotein-cholesterol

The effect of orally administered onion and garlic extract on the lipid profile of normal and iodine treated albino wistar rats have been studied. The mean values for the total cholesterol ranged between 67.68  $\pm$  1.55mg/dl for the normal rats administered with high dose onion extract while the least value of 41.97  $\pm$  2.57mg/dl was obtained for the normal rats with low dose garlic. There was no statistically significant ( $P < 0.05$ )

difference in total cholesterol due to treatment with iodine or oral administration of onion and garlic extract.

The triacylglycerol values for the experimental animals ranged between 187.50  $\pm$  4.35mg/dl for the low dose garlic group treated with iodine and 68.28  $\pm$  19.91 mg/dl for the low dose onion group treated with iodine. There was a statistically significant ( $P < 0.05$ ) increase in

triacylglycerol due to the administration of low dose garlic extracts iodine treated rats. The mean values for the (high density lipoprotein) HDL-cholesterol ranged between  $25.75 \pm 0.23$ mg/dl for the low dose garlic group treated with iodine and  $15.00 \pm 0.47$  mg/dl for low dose garlic group normal rats. There was no statistically significant ( $P < 0.05$ ) alteration in HDL-cholesterol in both normal and iodine treated rats due oral administration of onion and garlic extract.

The mean values of very low density lipoprotein (VLDL)-cholesterol for the experimental animals ranged between  $37.50 \pm 0.86$ mg/dl for the low dose garlic group treated with iodine and  $11.74 \pm 0.75$ mg/dl for low dose onion group treated with iodine. Though oral administration of low dose garlic led to an increase in iodine treated rats this was not statistically significant ( $P < 0.05$ ).

The highest and least mean values for the serum LDL- cholesterol were  $124.22 \pm 3.62$  mg/dl and  $25.56 \pm 2.55$ mg/dl for iodine treated low dose garlic group and low dose onion group respectively. Oral administration of low dose garlic led to a statistically significant increase in LDL- cholesterol of iodine treated rats. There was also an increase in LDL-cholesterol of normal rats due to the administration high dose onion.

The LDL: HDL cholesterol ratio for the experimental animals ranged between  $5.14 \pm 0.18$  for the low dose garlic group normal rats and  $1.21 \pm 0.19$  for low dose onion group treated with iodine. There was a statistically significant ( $P < 0.05$ ) increase in the LDL: HDL cholesterol ratio of both normal and the iodine treated rats administered with low dose garlic and normal rats administered with high dose onion.

## Discussion

The effect of orally administered onion and garlic extract on the lipid profile of normal and iodine treated albino wistar rats have been studied. The results showed that there was no significant difference in the Total Cholesterol and HDL-Cholesterol due to oral administration of onion, garlic or treatment with iodine. This is in agreement with the work of Islam and Choi (2008) on garlic which showed no significant difference in the lipid profile of normal rats

administered with garlic. Bang *et al.* (2009) in their studies using onion also noted onion did not affect serum total lipid, triglyceride and HDL-cholesterol in the normal rats. Conversely, Ugwu and Omale (2011) however recorded a decrease in serum Total cholesterol and an increase in HDL-Cholesterol due to oral administration of onion and garlic extract.

Oral administration of low dose garlic led to a statistically significant increase in the triacylglycerol and LDL and consequently the LDL: HDL ratio levels of iodine treated rats which were not noticed in the normal rats administered with the garlic extract. This observation contradicts the observation of Prasad *et al.* (2009) which recorded a decrease in triacylglycerol and LDL in poultry using garlic powder. Omer *et al.* (2015) in their study using various doses of potassium iodide on hyperglycemic rats also recorded a reduction in triglyceride level which is contrary to the results in this study using normal rats. While treatment with iodine in form of potassium iodide may cause a decrease triacylglycerol, LDL of diabetic rats an increase was observed when administered to normal rats. There is however need for studies into the detailed mechanism through which the action of garlic affects the triacylglycerol, LDL and consequently the LDL: HDL cholesterol ratio of iodine treated Wistar albino rats.

## Conclusion

In this study, administration of onion and garlic was not seen to cause any significant changes in the Total Cholesterol levels in both normal and iodine treated rats. Oral administration of garlic, however, caused increases in the triacylglycerol and LDL in iodine treated animals which were not observed in normal rats.

## References

- Ae, W., H., Tian, Y. and Woo, K. K.(2015): The effects of black garlic (*Allium sativum*) extracts on lipid metabolism in rats fed a high fat diet *Nutrition Research Practice*.9(1): 30-36.
- Akash, M.S., Rehman, K. and Chen, S. (2014): Spice plant *Allium cepa*: dietary supplement for

- treatment of type 2 diabetes mellitus. *Nutrition*. 30(10):1128-37.
- Aletan, U. I. (2014): Hematological Effects Following Ingestion of *Allium cepa* (Onion), *Allium sativum* Garlic and Treatment with Iodine in Albino Wistar Rats. *Pakistan Journal of Nutrition* 13 (8): 457-461.
- Bang, M, Kim, H. and Cho, Y. (2009): Alterations in the blood glucose, serum lipids and renal oxidative stress in diabetic rats by supplementation of onion (*Allium cepa*. Linn) *Nutr Res Pract*. Autumn;3 (3):242-246.
- Burnstein, M. and Samaille, J.(1960): A rapid determination of cholesterol bound to  $\alpha$  and  $\beta$  lipoproteins. *Clin. Chem. Acta*. 5: 609-635.
- Fazlolahzadeh, F., Keramati, K., Nazifi, S., Shirian, S. and Seifi, S. (2011): Effect of garlic (*Allium sativum*) on hematological parameters and plasma activities of ALAT and ASAT of rainbow trout in temperature stress. *Australian Journal of Basic and Applied Science*. 5(9), 84-90.
- Friedwald, W.T., Levy, R.T. and Fredrickso, D.S. (1972): Estimation of the concentration of LDL cholesterol in plasma without use of ultra-centrifuge. *Clin. Chem*. 18: 499-520.
- Gazuwa, S.Y., Makunjuola, E. R., Jaryum, K. H., Kutshik, J.R. and Mafulul, S.G. (2013): The phytochemical composition of *Allium cepa* and *Allium sativum* and the effect of their aqueous extracts (cooked and raw forms) in the lipid profile and other hepatic biochemical parameters in female Albino Wistar rats. *Asian Journal Exp.Bio Sci* 4(3)406-410.
- Kyung, K.H. (2012): Antimicrobial properties of *Allium* species. *Current Opinion in Biotechnology* 23(2): 42-47.
- Omer, E.I, Omer, M. and Ahmed, R.H. (2015): Effect of Potassium Iodide on Glucose, Cholesterol and Triglycerides Levels in Glucose Loaded Rats *International Journal of Pharmacy and Biological Sciences* 5 (1) 96-99.
- Prasad, R., Rose, M.K., Virmani. M., Garg, S.L and Puri, J.P. (2009): Lipid Profile of Chicken (*Gallus domesticus*) in Response to Dietary Supplementation of Garlic (*Allium sativum*) *International Journal of Poultry Science* 8 (3) 270-276.
- Richmond, W. (1973): Cholesterol enzymatic colorimetric test (CHOD-PAP) for estimation of total and HDL cholesterol in serum. *Clinical. Chemistry*. 19: 1350-1356.
- Schaefer, E.J. (2002): Lipoproteins, nutrition, and heart disease. *American Journal of Clinical Nutrition*; 75:191-212.
- Tende, J.A., Ayo, J.O., Mohammed, A. and Zezi, A.U. (2015): Blood pressure lowering effects of garlic (*Allium sativum*) and ginger (*Zingiber officinale*) extracts in some laboratory animals. *International Journal of Medicine and Medical Sciences Vol* 7(1) 8-13.
- Trinder P (1969): Triglycerides estimation in serum. *Annals of Clinical Biochemistry* 6: 26-27.
- Ugwu, C.E. and Omale, J. (2011): Comparative Effects of Aqueous Garlic (*Allium sativum*) and Onion (*Allium cepa*) Extracts on Some Haematological and Lipid Indices of Rats *Annual Review & Research in Biology* 1 (3): 37-44.
- WHO Nutrition (2017): Micronutrient deficiencies  
<http://www.who.int/nutrition/topics/idd/en/>  
 Retrieved 3/22/2017 Iodine deficiency in Europe and its control: current status, progress and recent trends. In: Anderson M, de Benoist B, Damton-Hill I, Delange F, (eds). Iodine deficiency in Europe, a continuing public health problem. Geneva, Switzerland; WHO Press, 20-33.
- Zimmermann, M.B. (2009): Iodine deficiency. *Endocrine Review*, 30:376-408.

