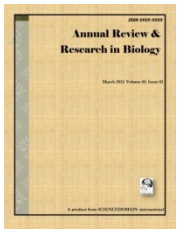

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Comparative Effects of Aqueous Garlic (*Allium sativum*) and Onion (*Allium cepa*) Extracts on Some Haematological and Lipid Indices of Rats

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ABSTRACT

The relationship between some haematological and lipid indices were studied and compared in white albino rats using aqueous garlic (*Allium sativum*) and onion (*Allium cepa*) extracts. The effect of garlic and onion extracts were each tested with 0.5, 1.0, and 1.5 mg/kg body wt. concentrations for 28 days. Biochemical parameters were assayed using standard methods. The extracts significantly ($P<0.05$) lowered the serum total cholesterol (TC), triacylglycerol (TG), low density lipoprotein-cholesterol (LDL) but increased the high density lipoprotein cholesterol (HDL) concentration when compared between the control and the test groups though there were no significant differences ($P>0.05$) when the effects of the extracts were compared at 0.5, 1.0, and 1.5 mg/kg body wt. equal treatments. The results show that there was no significant difference between the effects of the extracts on the haematological indices. The total cholesterol and triacylglycerols concentrations positively correlated to the haematological indices. The results collectively indicate that the extracts have hypolipidaemic effects which were not significant to each other. The results also show that though the extract lowered the TC and TG concentration, they indicated a direct relationship to the haematological indices.

Keywords: Allium sativum; Allium cepa; haematological indices; lipid indices; rats;

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1. INTRODUCTION

For several years, garlic (*Allium sativum*) and onion (*Allium cepa*) have enjoyed special reputation as therapeutic and prophylactic agents among the species in the genius Allium (Bordia et al., 1998). They are widely used as food supplements and have many health benefits that are related to their bioactive components (Okada et al., 2005; Gorinstein et al., 2006; Leelarungrayub et al., 2006; Corzo-Martinez et al., 2007). Their role in preventing diseases of the cardiovascular system is widely recognized.

Studies show that the consumption of garlic regulate plasma lipid and antioxidant levels (Phelps and Harris, 1993; Pierre et al., 2005; Gorinstein et al., 2006; Lau, 2006). Garlic and onion are known to posses hemodynamic and hemostatic (Brosche et al., 1990) as well as antiplatlet activities (Arora and Arora, 1981; Chutani and Bordia, 1981; Kiesewetter et al., 1990). Among the lipid regulating effects, reduction of serum cholesterol (Warshafsky et al., 1993; Durak et al., 2004) and triacylglycerols have been documented. Studies on onion are less advanced. Some investigations have demonstrated that onion also has compounds with capacity to reduce blood triacylglycerols levels and to inhibit rat hepatic cholesterol biosynthesis invitro (Effendy et al., 1997; Corzo-Martinez et al., 2007). There is no doubt that garlic and onion preparations posses lipid regulating abilities. However, there is still controversy regarding which of them has better lipid regulating properties. No further studies have been conducted to elucidate possible effects of garlic and onion extract consumption on the relationship between haematological indices and lipid profile. Therefore, this paper compared the effects of aqueous garlic and onion extracts on some haematological and lipid indices of rats.

2. MATERIALS AND METHODS

2.1 Animals

Male Wister rats weighing 200-250g were housed in clean cages with temperature (25-28^{o}C), 12-hour light/ 12hour dark cycle. The rats had continuous acess to food and to tap water. Permission for the study was obtained from the experimental animal ethics board of the Faculty of Natural Sciences, Kogi State University, Nigeria.

2.2 Preparation of Garlic and Onion Extracts

Fresh garlic and onion bulbs were purchased from a retail store (Kogi State, Nigeria) in April 2010. Aqueous garlic extract was prepared on fresh garlic by modified method of Martha et al. (1998). 50g of garlic was homogenized in 100 ml of cold distilled water. The homogenized mixture was filtered three times through cheese cloth. The mixture was centrifuged at 200 xg for 10 minutes and the clear supernatant was collected. The concentration of this garlic preparation was considered to be 500 mg/ml, on the basis of the weight of the starting material (50g/100 ml). Fresh extract was prepared each day before administration. The protocol was repeated for the onion.

2.3 Animal Treatment

The rats were fed normal diets (Vital feed, Nigeria) and were divided into 4 groups of six rats per group. A total of 48 rats were used. Group one served as the control group and received no extract. Groups 2, 3, and 4 received 0.5, 1.0, and 1.5 mg/kg body weight of the extract

respectively using an intragastric tube for 28 days. They were observed daily for any observable change. Overnight prior to treatment, the animals were starved of food. Blood was collected from the ocular median-cantus vein of the rats with the aid of capillary tubes and transferred to test tubes and allowed to clot and subsequently centrifuged to obtain serum component used for lipid analysis. Another portion of blood was collected and mixed with EDTA for analysis of haematological indices.

2.4 Biochemical Analysis

The lipid profiles were determined using kits manufactured by TECO Diagonostics Lakeview, Anaheim, CA, USA. Serum total cholesterol (TC) was determined by the method of Alain et al., (1974), while triacylglycerol was determined by the method of Burstein etal. (1986). The lipoproteins, very low density lipoproteins (VLDL), and high density lipoprotein (HDL) were precipitated using phosphotungstic acid and magnesium chloride. After centrifugation, the supernatant contained the HDL- cholesterol fraction, which was assayed for cholesterol (Grove, 1979). The low- density lipoprotein cholesterol (LDL-C) was estimated using the method of Fridewald etal. (1972). The packed cell volume (PCV) was measured by the microhaematocrit centrifuge and spinning for 5 minutes at 15,000 xg before reading with the haematocrit reader (Joun SA, Merck). Heparinized capillary tubes were supplied by British Drug house (BDH). The red and white blood cell counts were determined using the haemocytometer method.

2.5 Statistical Analysis

Data were subjected to analysis of variance (ANOVA). In order to test whether or not significant differences exist between groups, we analyzed the mean values with the paired T-test. The analysis was carried out on SPSS windows version 13.0.

3. RESULTS AND DISCUSSION

Results are shown in Tables 1, 2, and 3 for the lipid profiles, haematological indices, and correlation of the lipid and haematological variables, respectively. As shown in Table 1, the serum cholesterol, triacylglycerols and low-density lipoprotein cholesterol were reduced significantly($P<0.05$) when compared between the control and the test groups in both the garlic and onion treated rats. There were no significant differences ($P>0.05$) when the effects of the extracts were compared at equal concentrations except at the 1.5 mg/kg body weight treated groups on triacylglycerols.

The effects of the garlic and onion extracts consumption on some haematological indices were shown in Table 2. The results show that there were no significant differences ($P>0.05$) between the garlic and onion extracts consumption on the white blood cell(WBC), red blood cell(RBC), and packed cell volume (PCV) concentrations on equal treatments. The result also showed that the extracts reduced the PCV as its concentration was increased.

In the correlation analyses carried out between the haematological and lipid parameters before and after extract use, some relationships were observed (Table 3). For instance, there were positive correlations between TC-WBC, TC-RBC, TC-PCV, LDL-WBC, LDL-RBC and LDL-PCV. There were negative correlations between HDL-WBC and HDL-RBC values. There was also negative correlation before and after the onion extract consumption for the TG-WBC relationship.

Table 1. Effects of garlic and onion extract consumption on blood lipid profile of rats

Experimental Group	Garlic	Onion	(P- value)
Total cholesterol concentration (Mg/dl)			
A (control)	314.25±5.23	314.25±5.23	
B (0.5 mg/kg/ body weight)	308.87±4.85	319.52±6.01	0.822
C (1.0 mg/kg/body weight)	288.65±2.98	260.90±4.38	0.560
D (1.5 mg/kg/body weight).	193.35±3.24	219.8±94.00	0.577
Triacylglycerols (mg/dl)			
A (control)	270.69±3.10	270.69±3.10	
B (0.5 mg/kg/ body weight)	276.40±7.34	271.70±3.56	0.084
C (1.0 mg/kg/body weight)	258.33±5.21	236.55±2.00	0.280
D (1.5 mg/kg/body weight).	249.07±2.89	209.94±4.33	0.024
High density lipoprotein cholesterol (mg/dl)			
A (control)	38.49±2.01	38.49±2.01	
B (0.5 mg/kg/ body weight)	41.76±3.81	58.76±6.34	0.001
C (1.0 mg/kg/body weight)	51.34±2.96	61.99±3.28	0.145
D (1.5 mg/kg/body weight).	71.11±4.44	65.38±4.06	1.000
Low density lipoprotein cholesterol (mg/dl)			
A (control)	197.87±4.01	197.87±4.01	
B (0.5 mg/kg/ body weight)	196.11±3.19	194.44±2.31	0.660
C (1.0 mg/kg/body weight)	186.77±5.38	190.99±3.36	0.368
D (1.5 mg/kg/body weight).	156.79±2.18	178.66±3.44	0.865

Table 2. Effects of garlic and onion extract consumption on some haematological indices

Experimental group	Garlic	Onion	(P- value)
White blood cell count (WBC) X 10^3 mm^3			
A (control)	3.73±1.02	3.73±1.02	
B (0.5 mg/kg/ body weight)	2.00±0.45	2.57±1.51	0.351
C (1.0 mg/kg/body weight)	4.08±0.88	3.63±1.25	0.458
D (1.5 mg/kg/body weight).	2.42±0.83	3.38±1.05	0.116
Red blood cell count (RBC) X 10^6			
A (control)	3.77±0.74	3.77±0.74	
B (0.5 mg/kg/ body weight)	2.27±0.35	2.82±1.36	0.276
C (1.0 mg/kg/body weight)	4.37±0.28	3.70±0.85	0.188
D (1.5 mg/kg/body weight).	3.07±0.76	3.70±1.22	0.211
Packed cell volume (PCV) (%)			
A (control)	71.11±4.44	71.11±4.44	
B (0.5 mg/kg/ body weight)	51.34±2.96	65.38±4.06	0.085
C (1.0 mg/kg/body weight)	41.76±3.81	61.99±3.28	0.267
D (1.5 mg/kg/body weight).	38.49±2.01	58.76±6.34	0.043

Table 3. Correlation between the lipid parameters and some haematological indices before and after administration of extracts

Parameter	Before Administration	Garlic After Administration	Onion After Administration
TC-WBC	+0.601	+0.386	+0.106
TC – RBC	+0.581	+0.262	+0.548
TC – PCV	+0.539	+0.314	+0.175
TG – WBC	-0.387	+0.246	-0.223
TG – RBC	+0.539	+0.052	-0.072
TG – PCV	+0.539	+0.095	-0.019
HDL – WBC	+0.985	-0.479	-0.459
HDL – RBC	+0.969	-0.541	-0.142
HDL- PCV	+0.969	-0.71	+0.145
LDL-WBC	NC	+0.349	+0.307
LDL-RBC	+0.075	+1.318	+0.781
LDL-PCV	+0.075	+0.454	+0.772

NC = No correlation,TC= Total cholesterol, WBC= White blood cell count, RBC= Red blood cell count, PCV= Pack cell volume, TG= Triacylglycerol, HDL= High density lipoprotein cholesterol, LDL=Low density lipoprotein cholesterol.

The biological activity of an extract of onion or garlic depends on its mode of preparation (Shashikanth et al., 1986; Kleijnen et al., 1989; Corzo-Mart et al., 2007). Organic solvent extraction or steam distillation can cause inactivation of active ingredients present in garlic and onion (Kleijnen, 1989). In the present study, the aqueous extracts of onion and garlic were separately prepared as was previously described by Ali and Mohammed (1986) for garlic. This choice of preparation method is supported by the observation that the anti-platelet activity of garlic is greater in aqueous extract than in extracts prepared with alcohol or acetone (Mohammed and Woodward, 1986).

Despite some controversial studies on the protective role of garlic in the atherosclerotic diseases, it has been suggested that garlic could have beneficial effects in reducing atherosclerotic process (Durak et al., 2004). Some unique properties of onion and garlic such as antilipidaemic and antioxidant potentials have been studied (Lewin and Popov, 1994; Prasad et al., 1996; Corzo-Martinez et al., 2007) and although large studies were done to elucidate their mechanism of action (Rahman and Billington, 2000; Lau, 2001; Dillon et al., 2003), no further studies have been conducted to elucidate possible effects of garlic and onion extracts consumption on the relationship between some haematological and blood lipid parameters. This study was designed to clarify these issues.

Ischemic heart disease and stroke are diseases related to arteriosclerosis and are associated with increased serum lipids. Most results from studies using rabbits and rats and garlic essential oil and raw garlic have shown that garlic consumption reduces significantly the content of total serum cholesterol (Chang and Johnson, 1980), LDL and very low density lipoproteins (VLDL) and also increases significantly the level of HDL. Effendy et al. (1997) studied the effects of aged garlic extracts (AGE) on cholesterol-fed rabbits. Their results showed that the AGE lowered vessel wall cholesterol accumulation and arteriosclerotic plaques development in arterial wall. Some studies on onion have demonstrated that onion

also contains compounds with capacity to reduce blood triacylglycerols levels and to inhibit rat hepatic cholesterol biosynthesis *in vitro* (Effendy et al., 1997) though studies on onion are less advanced.

The hypolipidaemic and hypocholestrolemic activities of onion and garlic on experimental animal models and humans can be attributed to allicin and its derivatives compounds (liu and Yeh, 2002). Other non-sulphur components of garlic, like the steroid saponins, have also shown to reduce serum cholesterol levels. Garlic and onion may exert their hypolipidemic effect by limiting hepatic cholesterol biosynthesis (Gebhardt and Beck, 1996; Gupta and Porter, 2001; Singh and Porter, 2006), enhancing cholesterol turnover to bile acids and its excretion through gastrointestinal tract (Scrinivasan and Sambaiah, 1991), or in the case of plant saponins, by inhibiting cholesterol absorption from intestinal lumen without changing HDL-cholesterol levels in hypercholesterolemic animal models (Slowing et al., 2001).

The results from the present study show that the garlic and onion extracts have hypolipidaemic effects which are in line with the above studies although Gardner et al. (2007), have reported that raw, powdered or AGE supplements, in reasonable doses, have statistically significant effects on LDL cholesterol or other plasma lipid concentrations in adults with moderate hypercholesterolemia. Our results also demonstrate that though the two extracts have hypolipidaemic activities none induced a higher statistically significant effect to the other.

The study of hematological status is one of the important ways for diagnosis of the root cause of diseases. Haematological parameters namely PCV, WBC, and RBC were monitored in this study because of their diagnostic significance and to correlate their serum values with the lipid indices. Alteration in blood parameters may be due to changes in cellular integrity, membrane permeability, and metabolism, or even due to exposure to toxic chemicals (Asearvatham et al., 2010). The result from this study showed that it was only the PCV that was decreased by the extracts with the garlic extract having a significantly higher effect than the onion. The PCV is known to be reduced in anaemia while the profile of the WBC count reflects the balance between the rate of granulocyte production and that of WBC. Increased WBC count is seen during acute infections, inflammation, metabolic disorders and poisons etc. The result from this study showed non-significant decrease in the WBC and RBC counts. Our results also show that garlic and onion extract can lower serum lipids and some haematological indices of rats. However, it has not been established in details whether there is any relationship between haematological indices and lipid parameters. Some meaningful correlations were observed between some parameters. The positive correlations observed between TC-WBC, TC-RBC, TC-PCV, and between LDL-RBC, LDL-PCV in both extracts indicates a direct relationship between total cholesterol, low density lipoprotein and the haematological indices. However, the negative correlation recorded in TG-WBC relationship in the onion treated groups indicates an inverse relationship between TG and WBC. .The results from this study could not establish any direct relationship between HDL and the haematological indices. However, possible molecular mechanisms related to these events still need to be investigated further.

4. CONCLUSION

The results confirmed that the extracts possess hypolipidaemic activity though none possesses a significantly higher effect than the other as regards to the parameters studied. This may be due to the fact that both extracts contain similar bioactive compounds. Further

studies should be undertaken on the possible effects of combining the extracts on the variables studied.

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