



Effect of *Allium sativum* (Garlic) Extract on Hematological Parameters in Diabetes-induced Male Wistar Albino Rats

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

Allium sativum popularly known and called garlic is known for its many medicinal properties, and it is used in most African homes as a spice and flavoring agent. This study was designed to investigate the effect of *Allium sativum* (garlic) extract on hematological parameters in diabetes-induced male wistar Albino rats. Sixty (60) healthy male Wistar albino rats weighing 90g-120g were used. Diabetes was induced in the rats by a single intraperitoneal dose of Alloxan monohydrate. The rats were grouped into six groups: Group A (un-induced, normal control), Group B (Untreated Diabetes-induced), Group C (Diabetes-induced treated with 5mg/kg glibenclamide), Group D, E, and F which are Diabetes-induced, treated with 200mg, 400mg and 600mg of ethanol extract of *Allium sativum* respectively. After the treatment period, blood samples were collected through

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cardiac puncture from each rat for hematological parameters. Hematological parameters were analyzed using mindray hematology auto analyzer. Results showed a significant increase in the red blood cells as well as the white blood cells and their differentials in the extract-treated groups when compared with the untreated group; thereby improving oxygen supply to tissue and helping to boost the cells' immune system.

Keywords: *Allium sativum*; diabetes; hematology; health.

1. INTRODUCTION

Garlic (*Allium sativum*) is a species of flowering plant belonging to the genus *Allium* [1]. This edible plant is extensively used for seasoning and flavouring, and its medicinal properties have been documented in several human and animal studies [2,3,4]. Garlic has been shown to contain several bioactive compounds such as allicin, vinyldithiols, diallyl sulfide among others, which has been largely attributed to their pharmacological activities. These bioactive compounds have been shown to reduce reactive oxygen species and therefore, may play a crucial role in immune enhancement and fighting chronic diseases, especially diabetes [5]. Although several therapeutic effects of garlic including anti-infective [6], antioxidant [7], antimicrobial [8], anti-ulcer [9], and hepato-protective [4] activities have been reported in previous studies, its effect on hematological parameters have not been well documented.

Hematology is a branch of medicine that deals with the study of blood, blood-forming organs, and blood-related disorders and diseases. Hence, hematological tests are used to detect and diagnose diseases such as hemophilia, anemia, leukemia, sickle-cell anemia, lymphomas, and several infections [10]. Hematological parameters including the white blood cell and its differentials such as lymphocytes and neutrophils are important in fighting against foreign substances in a biological system while the red blood cells have been saddled with the responsibilities of delivering oxygen to the body tissues via blood flow through the circulatory system [11]. Impairment in the functionality of these parameters could therefore exert a detrimental effect on the general wellbeing of a biological system. Hence, there is a need for a study to focus on the effect of substances on hematological parameters in a biological system. To this end, this study was designed.

2. MATERIAS AND METHODS

2.1 Sample Collection and Preparation

The *Allium sativum* (garlic) used for the study was purchased from Eke market in Awka, Anambra State, Nigeria. Identification and authentication of the plant was done by a taxonomist at the Department of Botany, NnamdiAzikiwe University, Awka, with herbarium number NAUTH-17F and a sample was deposited at the herbarium of the Department for future reference. The garlic was peeled, chopped, and dried at room temperature, milled into powder, and stored in an air-tight container, until needed for extraction.

2.2 Preparation of Sample Extract

The pulverized sample (Exactly 500g) was soaked in 2 liters of 70% ethanol (by maceration) for 48 hours with constant stirring at an interval of two (2) hours. At the lapse of 48 hrs, the solution was filtered using muslin cloth and then with Whatmann No 1 filter and the filtrate gotten were concentrated using a water bath at 50°C to obtain the crude extract which was thereafter stored in an airtight container and kept in a refrigerator until it was needed.

2.3 Procurement of Experimental Animals

Sixty (60) mature male wistar albino rats weighing between (90-120g) were obtained from Chris Farm Ltd Mgbakwu, Awka, Anambra State. They were sorted and housed in standard cages with housing conditions of 12:12 light: dark cycles. They were fed with standard grower's mash pellets and water *ad libitum*.

2.4 Induction of Diabetes to the Experimental Animals

Diabetes was induced in the experimental animals by a single intraperitoneal injection of Alloxan monohydrate using distilled water as the vehicle. OneTorch glucometer was used to

measure the fasting blood glucose of the animals after induction and animals with fasting blood glucose of 200mg/dl and above were considered to be diabetic and were subsequently used for the study [13].

2.5 Dose Preparation and Treatment

The hydro-ethanolic extract of *Allium sativum* was prepared with distilled water in three divided doses (200, 400, and 600) mg/kg, glibenclamide (5mg/kg) was used as a reference drug, and distilled water was administered to the untreated group. The animals were grouped into six different groups of ten (10) rats per group per cage and administered the extract and drug for twenty-eight (28) consecutive days with feed *ad libitum* as shown in Table 1.

2.6 Collection of Blood Samples for Bioassay

At the end of 28 days, the rats were fasted overnight and then anaesthetized with chloroform vapor, and sacrificed. A 5 ml sterile syringe with a needle was used for the collection of blood via cardiac puncture from each of the rats into well-labeled EDTA for hematological assays.

2.7 Assay of Hematological Parameters

Collected blood samples were analyzed at WeCare diagnostic center, Zik Avenue, Awka, Anambra State using Mindray hematology auto analyzer (BC 5300).

2.8 Data Analysis

The results obtained in this research were expressed as Mean \pm S.D. One way analysis of variance (ANOVA) was carried out on the results and significance was accepted at $p < 0.05$.

3. RESULTS AND DISCUSSION

Medicinal plants, over time, have shown to play a key role in the discovery and development of an array of synthetic drugs. This has been partly attributed to the many bioactive compounds embedded in them [12]. Essentially, overweight and obesity have severally been attributed to be major risk factors for a number of chronic diseases, including diabetes across the world [13]. Hence, controlling excess weight will be a strategy to combat this menace. As shown in Fig 1, administration of the plant extract significantly increases the percentage body

weight of the experimental animals when compared with the untreated control. This is in contrast with the findings of Ezeigwe et al. [13] who reported a decrease in body weight of alloxan-induced diabetic rats treated with *Citrus aurantium* juice. The increase in body weight of these animals could plausibly be attributed to the satiation/satiety mechanism [14]. The plant extract could have possibly inhibits the gut hormones (cholecystokinin and glucagon-like peptide) which play a crucial role in food intake control. Since the release of cholecystokinin and glucagon-like peptide hormones leads to a delay in gastric emptying and a decrease in food consumption, the plant extract could have therefore inhibits the release of these hormones and subsequently enhance food intake, thereby leading to increased body weight.

Table 1 presents the effect of *Allium sativum* (Garlic) extract on hematological parameters of experimental animals. Results show a significant increase in the hemoglobin, packed cell volume (PCV), and red blood cell (RBC) levels of the extract-treated groups compared with the untreated control in a dose-dependent manner. This is consistent with the findings of Oladejo and Osukoya [11], Ezeigwe et al. [13], and Oladejo et al. [10] in their separate studies. Hemoglobin (Hb) is the protein in red blood cells that is responsible for delivery of oxygen to the tissues. Hence, a sufficient hemoglobin level is essential for tissue oxygenation. The ability of the extract to bring the haemoglobin level of the animals to normal range (14 - 18) g/dl implies that the plant could aid the oxygenation of the tissues in a biological system.

Similarly, PCV is the measure of the ratio of the volume occupied by the red blood cells to the volume of the whole blood in a sample of capillary, venous, or arterial blood. PCV is used in detecting anemia or polycythemia and can be useful in estimating changes in hemodilution or hemoconcentration. A PCV level below 38%, as seen in the untreated diabetic group indicates an anemic condition. Red blood cells are the most common type of blood cell and the vertebrate's principal means of delivering oxygen to the body tissues. Insufficient production of red blood cells therefore could lead to tissue damage owing to inadequate oxygen supply. As depicted in this study, the plant extract was able to improve the red blood cell levels of the extract-treated groups and could therefore enhance tissue health.

Table 1. Grouping and dose administration of experimental animals

Group	Treatment
A (Normal)	Un-induced plus distilled water
B (Diabetic untreated)	Induced plus distilled water
C (Standard control)	Induced plus standard drug (5mg/kg glibenclamide)
D (Treatment)	Induced plus 200 mg/kg <i>Allium sativum</i> extract
E (Treatment)	Induced plus 400 mg/kg <i>Allium sativum</i> extract
F (Treatment)	Induced plus 600 mg/kg <i>Allium sativum</i> extract

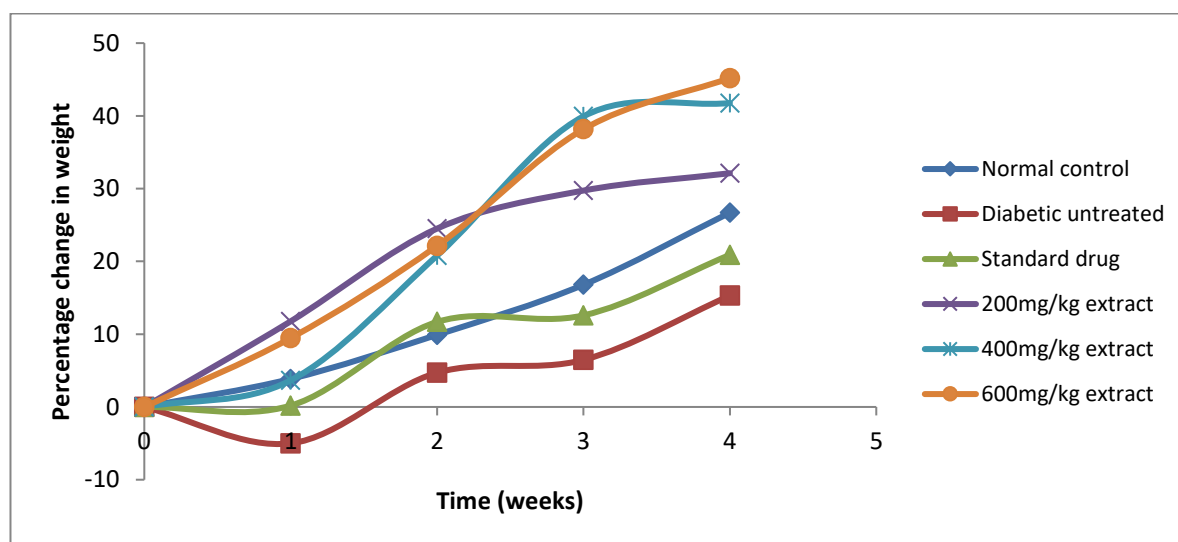


Fig. 1. Effect of *Allium sativum* (Garlic) Extract on body weight of experimental animals

Table 2. Effect of *Allium sativum* (Garlic) extract on hematological parameters of experimental animals

Parameters	Normal control	Diabetic untreated	Standard drug	200 mg/kg extract	400 mg/kg extract	600 mg/kg extract
Hb (g/dl)	13.78±0.30	12.00±0.00	14.04±0.21	14.85±0.70	15.15±0.38	16.34±0.55
PCV (%)	41.40±0.90	36.00±0.00	42.20±0.66	44.67±2.12	45.50±1.12	49.12±1.65
TWBC (mm ³)	4.20±0.02	4.25±0.05	5.32±0.05	5.40±0.04	5.32±0.04	4.36±0.04
RBC (mm ³)	5.84±0.30	4.10±0.00	6.08±0.21	6.88±0.68	7.21±0.39	8.35±0.56
Neutrophils (%)	53.30±0.60	52.50±1.50	52.00±0.84	52.17±0.98	52.25±0.67	52.25±0.70
Lymphocytes (%)	39.60±0.87	37.50±1.50	38.00±0.84	39.50±1.20	37.75±0.67	37.75±0.70
Eosinophils (%)	3.20±0.44	5.00±0.00	5.00±0.32	3.50±0.56	5.00±0.27	5.12±0.29
Monocytes (%)	3.70±0.54	4.50±0.50	4.40±0.24	4.33±0.67	4.50±0.19	4.62±0.18
Basophils (%)	1.00±0.00	1.00±0.00	1.00±0.00	1.00±0.00	1.00±0.00	1.00±0.00

White blood cells (WBC) and their differentials (lymphocytes and neutrophils) and other haematological parameters are measurable indices of the blood, which can be used to evaluate hematopoietic function [15]. WBCs are essential for the protection of the animal against

foreign invaders [11]. Elevation in their levels, as observed in this study; is indicative of a response to an immunological challenge. Neutrophils are important phagocytic cells normally elevated in the early disease state [16], while lymphocytes are subtypes of leucocytes critically essential for

providing cell-mediated immunity. In addition, an increase in WBC and neutrophil counts suggests the ability of the extract *Allium sativum* to boost the cells' immune system since they function as active phagocytic agents against foreign compounds [17]. This may explain its use in the management of ailments.

4. CONCLUSION

The observations from the present study showed that the extract of this plant is capable of protecting the cells and tissues from damage and consequently enhancing general well-being. This could partly be attributed to many bioactive compounds present in the extract which could be synthesized to produce new plant-based products to fight diabetes and other chronic diseases with little or no side effects.

CONSENT

It is not applicable.

ETHICAL APPROVAL

All the experimental procedures and protocols used for this study were in accordance with the guidelines and principles of Animal Research Ethics Committee of Nnamdi Azikiwe University, Awka.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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