THE EFFECT OF POLYHERBAL FORMULATED TEA ON HEMATOLOGICAL INDICES ON ATHEROGENIC DIET INDUCED HYPERLIPIDAEMIA IN WISTAR RATS.

BY

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FACULTY OF LIFE SCIENCES

UNIVERSITY OF BENIN

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A PROJECT WORK SUBMITTED TO THE DEPARTMENT OF SCIENCE LABORATORY TECHNOLOGY, FACULTY OF LIFE SCIENCES, UNIVERSITY OF BENIN. BENIN CITY, EDO STATE, NIGERIA, IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE AWARD OF BACHELOR DEGREE (BSc.) IN SCIENCE LABORATORY TECHNOLOGY (PHYSIOLOGY AND PHARMACOLOGY TECHNIQUES)

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CERTIFICATION

This is to certify that this work " THE EFFECT OF POLYHERBAL FORMULATED TEA (*Anthocleista djalonensis*, *Allium sativum*, *Zingiber officinale*, *Ageratum conyzoides* and *Thespesia garckeana*) ON HEMATOLOGICAL INDICES IN ANTHEROGENIC DIET INDUCED HYPERLIPIDEMIA WISTAR RATS" was carried out by Deborah Adesuwa OSAZEE (Miss), of the Department of Science Laboratory Technology, Faculty of Life Sciences, University of Benin, Benin City, Edo State, for the award of Bachelor Degree (B.Sc.). in Science Laboratory Technology, of the University of Benin.

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DEDICATION

This work is dedicated to God Almighty, the giver of knowledge, understanding and good health for his never ending grace and mercies, and to my Mum and Dad, Mr and Mrs. Osazee for their unconditional love and support throughout the period of my study.

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ABSTRACT

Medicinal plants have long been essential in traditional and alternative medicine due to their accessibility, affordability, and minimal side effects. Combining two or more herbs can provide diverse health benefits. This study aimed to evaluate the effects of a polyherbal formulated tea comprising *Anthocleista djalonensis, Zingiber officinale, Allium sativum, Ageratum conyzoides, and Thespesia garckeana* on haematological indices in Wistar rats *with hy*perlipidaemia induced by an atherogenic diet. Twenty-five rats were divided into five groups of five: group 1 served as the normal control, group 2 as the cholesterol control, groups 3 and 4 received polyherbal tea at doses of 20 and 40 mg/kg, respectively, and group 5 was treated with atorvastatin (5 mg/kg). Hyperlipidaemia was induced in groups 2 to 5 by administering 10 mg/kg of 1% cholesterol and 0.5% cholic acid. Treatments and the cholesterol diet were administered orally for 28 days. Blood samples were collected and analysed using a haematology auto analyser. The polyherbal tea at both 20 and 40 mg/kg doses significantly reduced platelet counts compared to the cholesterol control group ($p < 0.01$), while other haematological parameters remained unaffected ($p > 0.05$). These results suggest that the polyherbal tea may have antiplatelet and cardioprotective effects.

CHAPTER ONE

INTRODUCTION

1.1. BACKGROUND STUDY

Historically, medicinal plants have played a crucial role in traditional and alternative medicine, primarily due to their accessibility, affordability, and minimal side effects (Ekweogu et *al*., 2019; Ikpeazu *et al*., 2018). These plants have long been essential sources of sustenance and medicine, with ancient civilisations such as Egypt, China, India, and Rome recognising their healing properties (Aslam *et al.,* 2016). Before modern medicine came along, people used traditional plant-based remedies to treat a wide range of illnesses (Popoola and Obernbe, 2013). Throughout history, nature has been integral to human development, providing essential resources such as food, shelter, clothing, and medicine. Among the natural kingdoms, plants stand out due to their self-sufficiency and diverse applications, including their role in traditional and modern medicine (Abubakar *et al.,* 2014). Plants remain a vital source of medicine due to their efficacy, accessibility, and safety, with approximately 11% of the World Health Organization's essential medicines derived from them (Sam, 2019). Polyherbal tea formulated from a blend of medicinal plants, including *Zingiber officinale* and *Allium sativum,* has been used as an alternative or complementary therapy for asthma management. Approximately 80% of the global population relies on herbal remedies for health issues (Joshi, 2013; Pant, 2014), with polyherbal formulations leveraging synergistic effects to enhance therapeutic outcomes (Houghton, 2019; Wang *et al.,* 2011). Such synergy allows for reduced doses of individual components while maintaining efficacy and minimising adverse effects (Jain *et al.,* 2011). Polyherbal formulations, which combine multiple herbs, offer advantages like reduced side effects, enhanced efficacy, and faster relief due to synergistic interactions (Aslam *et al.,* 2016). Herbal teas are becoming more popular because they are good for your health (Khan and Mukhtar, 2013). They are especially good for treating long-term illnesses like asthma (Builders, 2019). The pharmacological properties of these teas are attributed to secondary metabolites in the plants, such as alkaloids, flavonoids, and polyphenols (Cohen and Ernst, 2010; Park *et al.,* 2014). Scientific studies support these traditional practices by demonstrating improved bioavailability and reduced toxicity in herbal combinations (Jansen *et al.,* 2021).

1.2 AIM OF THE STUDY

To evaluate the effects of polyherbal formulated tea (*Anthocleista djalonensis*, *Zingiber officinale*, *Allium sativum*, *Ageratum conyzoides* and *Thespesia garckeana*) on haematological indices in atherogenic diet-induced hyperlipidaemia Wistar rats.

1.3. SPECIFIC OBJECTIVES OF THE STUDY

1. To induce hyperlipidaemia and atherosclerosis using the cholesterol and cholic acid method.

2. To analyze Haematology parameters using automated hematology analyzer.

CHAPTER TWO

LITERATURE REVIEW

2.1 Ageratum conyzoides (Goat weed)

2.1.1. Description of *Ageratum conyzoides (Goat weed)*

Ageratum conyzoides (Asteraceae), commonly known as billygoat-weed or goatweed, is an annual herbaceous plant that grows up to 1 m tall (Yadav *et al*., 2019). It is of the kingdom - Plantae; Plant Division - Angiosperms; Order - Asteralees; Family - Asteracae; Genus - *Ageratum* and Species - *Ageratum conyzoides.* The stems are erect, branched, and covered with fine white hairs, while the leaves are opposite, ovate to triangular, and possess serrated margins (Chahal *et al*., 2021). The inflorescence consists of dense terminal clusters (capitula) of small, fluffy, pale blue, pink, or white flowers (Agbafor *et al*., 2015). It is propagated by seed and germinate best at 20-25°C. The fruits are achenes, each bearing a pappus of bristles that aids in wind dispersal (Rioba and Stevenson 2017). The plant emits a strong, pungent odor due to the presence of essential oils, particularly precocene I and II (Singh *et al.*, 2013).

2.1.2. Distribution of *Ageratum conyzoides* (Goat weed)

Ageratum conyzoides is native to tropical Central and South America but has become naturalized in many tropical and subtropical regions worldwide (Thorat *et al.*, 2018). It is widely distributed in Africa, Asia, and the Pacific Islands, where it thrives in disturbed habitats, agricultural fields, roadsides, and wastelands (Yadav *et al*., 2019). In India, it is considered an invasive weed, often found in moist, fertile soils (Singh *et al*., 2013). Similarly, in Nigeria and other West African countries, it grows abundantly as a weed in farmlands (Amadi *et al*., 2012).

2.1.3 Ethnomedicinal uses of *Ageratum conyzoides* (Goat weed)

Ageratum conyzoides has been extensively used in traditional medicine across various cultures. In Brazil, the leaves are crushed and applied topically to treat wounds, burns, and skin infections due to their antimicrobial properties (Kato-Noguchi and Kato, 2024). In Nigeria, an infusion of the leaves is used to manage fever, diarrhea, and gastrointestinal disorders (Chauhan and Rijhwani, 2015). The plant is also employed in Indian Ayurvedic medicine for its anti-inflammatory and analgesic effects, particularly in treating rheumatism and arthritis (Chahal *et al.,* 2021). In Ghana, a decoction of the whole plant is administered to alleviate respiratory conditions such as asthma and bronchitis (Agbafor *et al*., 2015). Additionally, in the Philippines, the leaves are used as a poultice for headaches and as an antiseptic for cuts (Thorat *et al.,* 2018). Recent pharmacological studies have validated its ethnomedicinal uses, demonstrating its antibacterial, antifungal, anti-inflammatory, and wound-healing properties (Singh *et al*., 2013).

2.2 *Anthocleista djalonensis*

2.2.1. Description of *Anthocleista djalonensis*

Anthocleista djalonensis is a tropical evergreen tree or shrub that typically grows up to 10–15 meters in height (Okor *et al*., 2019). It belongs to the Kingdom - Plantae; Phylum - Streptophyta; Class - Equisetopsida; Order - Gentianales; Family - Gentianaceae; Genus - *Anthocleista* and Species - *Anthocleista djalonensis*. The plant is characterized by its large, glossy, obovate leaves that are arranged in a whorled pattern and can reach up to 50 cm in length (Okoro *et al*., 2017). The genus *Anthocleista* belonging to the family Gentianaceae comprises of 14 species of shrub-like plants and trees dispersed in tropical Africa, Madagascar and on the Comoros (Anyawu *et al.,* 2015). *The* bark is greyish-brown and rough, while the flowers are white or cream-colored, fragrant, and tubular, arranged in terminal inflorescences (Adebayo and Olamide, 2022). The fruit is a green, ovoid capsule containing numerous small seeds (Okeniyi *et al.,* 2016).

2.2.2. Distribution of *Anthocleista djalonensis*

Anthocleista djalonensis is native to West Africa, predominantly found in countries such as Nigeria, Ghana, Ivory Coast, Guinea, and Sierra Leone (Okor *et al*., 2019). It thrives in tropical rainforests, swampy areas, and gallery forests, often growing near water bodies (Oluwayomi*et al*., 2020). In Nigeria, it is commonly referred to as "Sapo" or "Cabbage tree," while in Ghana, it is known as "Ako denkyem" (Adebayo and Olamide, 2022).

2.2.3. Ethnomedicinal uses of *Anthocleista djalonensis*

Anthocleista djalonensis is traditionally used to treat malaria, fever, and diabetes due to its antimalarial, antipyretic, and hypoglycemic properties (Olubomehin *et al*., 2013), while its bark and leaves are applied to wounds, ulcers, and skin infections for their antimicrobial and anti-inflammatory effects, and it is also employed in managing hypertension, gastrointestinal disorders, and as a diuretic (Okeniyi *et al*., 2016), with the roots being used for pain relief, rheumatism, and as an anthelmintic (Anyawu *et al.,* 2015), and also leaf extracts promote wound contraction and epithelialization, supporting its traditional use in accelerating wound healing (Okoro *et al*., 2017), and the plant is further utilized in rituals and as a purgative in some African cultures (Enoghase and Innih, 2025). These plants are traditionally used in the treatment of diseases such as diabetes, obesity, hypertension, malaria, typhoid fever, abdominal pain, diarrhea, hyperprolactinemia, jaundice, ulcer, asthma, cancer, wounds, hemorrhoids, chest pains, rheumatism, inflammations, including infertility, sexually transmitted diseases, and skin diseases and also help as an anthelmintic, a laxative, and diuretic (Anyanwu *et al*., 2015).

2.3. *Zingiber Officianale* (Ginger)

2.3.1. Description of *Zingiber Officianale* (Ginger)

Zingiber officinale commonly named ginger is a perennial herbaceous plant belonging to the Kingdom - Plantae; Order - Zingerberales, family - Zingiberaceae; Genus - Zingibe, and Species - *Zingiber Officianale.* It is characterized by its aromatic rhizomes, which are widely used as a spice and medicine (Shamsi *et al*., 2010). The plant grows up to 1 m in height, with narrow lanceolate leaves arranged alternately on the stem and yellowish-green flowers with purple tips that grow in dense spikes (Gupta *et al.,* 2015). The rhizome, the most economically significant part, is thick, knotty, and beige-colored, containing bioactive compounds such as gingerols, shogaols, and zingerone, which contribute to its medicinal properties (Dissanayake *et al*., 2020).

2.3.2 Distribution of *Zingiber Officianale* (Ginger)

Zingiber officinale is believed to have originated in Southeast Asia, particularly in regions of India and China, where it has been cultivated for over 3,000 years (Kumar and Sharma, 2014). Today, it is widely distributed across tropical and subtropical regions, including countries like Nigeria, Bangladesh, Jamaica, and Nepal, due to its adaptability to warm, humid climates (Zhang *et al.,* 2022). India remains the largest producer of ginger, contributing over 30% of global production, followed by China and Indonesia (Ansari *et al.,* 2021).

2.3.3. Ethnomedicinal uses of *Zingiber Officianale* (Ginger)

Zingiber officinale is widely used in ethnomedicine to treat nausea, vomiting, and motion sickness by inhibiting serotonin receptors (Enoghase and Innih, 2025), as an anti-inflammatory agent to alleviate osteoarthritis and rheumatoid arthritis due to its inhibition of prostaglandin and leukotriene synthesis (Agrahari *et al.,* 2015), for digestive disorders like dyspepsia and flatulence by stimulating digestive enzymes (Ashraf *et al.,* 2017). As an antimicrobial agent against pathogens like Escherichia coli and Staphylococcus aureus and to manage cardiovascular health, treat minor heart disease, by reducing cholesterol and blood pressure through its antioxidant properties (Ansari *et al*., 2021).

2.4.1. *Allium Sativium* (Garlic)

2.4.2. Description of *Allium Sativium* (Garlic)

Allium sativum commonly known as garlic is a perennial bulbous plant belonging to the family Amaryllidaceae (subfamily Allioideae) (Alarm and Uddin, 2016). The plant is characterized by its underground bulb, which consists of multiple cloves enclosed in a thin, papery sheath (Londhe *et al*., 2011). The leaves are long, flat, and linear, while the inflorescence is an umbel that may contain small bulbils and white to pinkish flowers (Sobenin *et al.,* 2019). Garlic is renowned for its pungent aroma and flavor, primarily due to sulfur-containing compounds such as allicin, which is formed when the cloves are crushed or chopped (Shang *et al*., 2019).

2.4.2. Distribution of *Allium Sativium* (Garlic)

Allium sativium is believed to have originated in Central Asia, particularly in regions spanning modern-day Kazakhstan, Uzbekistan, and western China (Wu *et al.,* 2015). It has since been naturalized and cultivated worldwide, thriving in temperate and subtropical climates (Papu *et al*., 2014). Major garlic-producing countries include China, India, South Korea, Egypt, and Russia (Capasso, 2013). Wild relatives of *Allium sativum* are found across the Mediterranean, Middle East, and parts of Europe, indicating its historical spread through trade and migration (Alarm and Uddin, 2016).

2.4.3. Ethnomedicinal uses of *Allium Sativium* (Garlic)

Allium sativium has been used for millennia in traditional medicine systems, including Ayurveda, Traditional Chinese Medicine (TCM), and Unani (Choudhary *et al.,* 2022). In Ayurveda, garlic is referred to as Rasona and is used to treat cardiovascular disorders, digestive ailments, and respiratory infections (Guldawa *et al*., 2021). Modern studies confirm its antimicrobial properties, showing efficacy against bacteria such as Staphylococcus aureus and Escherichia coli (Sobenin *et al*., 2019). It is also employed in managing hypertension and hyperlipidemia due to its ability to reduce blood pressure and LDL cholesterol levels (Shang *et al*., 2018). Allicin and other organosulfur compounds in garlic exhibit antioxidant and anti-inflammatory effects, making it useful in preventing chronic diseases like atherosclerosis and diabetes (Papu *et al.,* 2014). Additionally, garlic has been traditionally used as an immune booster, particularly during seasonal infections (Alam and Uddin, 2016). In Traditional Chinese Medicine, garlic is prescribed to expel cold, alleviate diarrhea, and detoxify the body (Wu *et al*., 2015). Ethnobotanical studies in the Mediterranean region highlight its use in wound healing and as an anti-parasitic agent (Lanzotti *etal*., 2019). Furthermore, garlic extracts have demonstrated potential anticancer properties, particularly in reducing the risk of gastric and colorectal cancers (Nicastro *etal*., 2015).

2.5. *Thespesia garckeana* (Goron tula)

2.5.1. Description of *Thespesia garckeana*

Thespesia garckeana commonly known as "African chewing gum tree" or "snot apple," is a small to medium-sized deciduous tree belonging to the family Malvaceae (Mongalo and Makhafola, 2018). The tree typically grows up to 3–10 meters in height, with a rounded crown and greyish-brown bark that becomes rough and fissured with age (Maroyi, 2017). Its leaves are alternate, simple, ovate to heart-shaped, and measure 5–15 cm long, with a velvety texture due to dense stellate hairs (Stavrides, 2016). The flowers are solitary, bell-shaped, yellow with a maroon center, and about 5–7 cm in diameter, resembling those of hibiscus (Bruschi *etal*., 2017). The fruit is a globose, woody capsule, about 2–4 cm in diameter, containing several seeds embedded in a sticky, sweet mucilaginous pulp that is edible (Chinsembu, 2016).

2.5.2. Distribution of *Thespesia garckeana* (Goron tula)

Thespesia garckeana is widely distributed across sub-Saharan Africa, occurring in countries such as South Africa, Zimbabwe, Botswana, Namibia, Zambia, Mozambique, Tanzania, Kenya, and Malawi (Maroyi, 2017). It thrives in savanna woodlands, dry forests, and riverine areas, often found at altitudes ranging from 200 to 1,500 meters above sea level (Stavrides, 2016). The species is drought-resistant and adapts well to sandy or loamy soils, making it common in arid and semi-arid regions (Bruschi et al., 2017).

2.5.3. Ethnomedicinal uses of *Thespesia garckeana* (Goron tula)

Thespesia garckeana has been extensively used in African traditional medicine for treating various ailments. The fruit pulp is consumed as a remedy for gastrointestinal disorders, including diarrhea and stomachaches, due to its high mucilage content (Chinsembu, 2016). In Zimbabwe, a decoction of the bark is used to treat respiratory infections, coughs, and tuberculosis (Maroyi, 2017). The leaves are applied as poultices for wounds, boils, and skin infections, owing to their antimicrobial properties (Mongalo and Makhafola, 2018). In South Africa, root infusions are administered to manage diabetes and hypertension, with studies confirming their hypoglycemic and hypotensive effects (Bruschi *et al*., 2017). Additionally, the plant is used in some cultures to treat sexually transmitted infections (STIs) and as an aphrodisiac (Stavrides, 2016). Recent pharmacological studies have validated its anti-inflammatory, antioxidant, and antimicrobial activities, supporting its traditional uses (Mongalo and Makhafola, 2018).

Plate 1: *Ageratum conyzoides* (Chahal *et al*., 2021)

Plate 2: *Anthocleista djalonensis* (Okeniyi *et al.,* 2016)

Plate 3: *Zingiber Officianale* (Ginger) rhizome (Zhang *et al.,* 2021)

Plate 4: *Allium sativium* (Garlic bulb) (Shang *et al.,* 2022)

Plate 5: *Thespesia garckeana* (Goron tula) (Mongalo and Makhafola, 2018).

2.6. Hyperlipidemia

Hyperlipidemia is modifiable risk factor for atherosclerosis and related cardiovascular diseases, including coronary heart disease, cerebral stroke, myocardial infarction and renal failure are becoming a major health problem in the world recent (Karam *et al.,* 2018). Hyperlipidemia is a heterogeneous group of disorders characterized by an excess of lipids in the blood stream, the term hyperlipidemia refers to increased concentrations of lipids (triglycerides, cholesterol, or both) in the blood (Singh *et al.,* 2022). These lipids include cholesterol, cholesterol esters, phospholipids, and triglycerides and are transported in the blood as large lipoproteins (Stewart *et al.,* 2020). Increased blood concentrations of triglycerides are referred to as hypertriglyceridemia, while increased blood concentrations of cholesterol are referred to as hypercholesterolemia (Karam *et al.,* 2018). Hypercholesterolaemia and hypertriglyceridemia significantly contribute to the development of atherosclerosis, which is a pathological condition characterised by the accumulation of lipids, inflammatory cells, and fibrous tissue in the walls of arteries (Raal *et al*., 2020). Atherosclerosis is a generalized disease of the arterial wall, characterized by thickening of the intimal layer and accumulation of fat, partly caused by hyperlipidemia (high concentration of lipids and/or lipoproteins) and lipid oxidation (as low-density lipoprotein [LDL] oxidation) (Tanczos *et al.,* 2021). Statins (such as Artovastatin, Simvastatin, Lovastatin and Pravastatin) as a first- line treatment of hyperlipemia and fibrates (such as Gemifibrozil, Fenofibrate, Bezafibrate and Clofibrate) are the agents of choice in the hyperlipidemia treatment (Sikora*et al*., 2013).

2.7. Haematological parameters

Haematology refers to the study of the numbers and morphology of the cellular elements of the blood – the red cells (erythrocytes), white cells (leucocytes), and the platelets (thrombocytes) and the use of these results in the diagnosis and monitoring of disease (Etim *et al.,* 2014). Haematological parameters are those parameters that are related to the blood and blood forming organs (Tanczos *et al.*, 2021). Haematological parameters serve as essential biomarkers in clinical practice. Reference ranges for these parameters are indispensable tools for diagnosing diseases, monitoring treatment efficacy, identifying drug toxicity, and staging illness progression. It is crucial to recognize that these ranges are not absolute; they are influenced by a multitude of factors including age, sex, genetic heritage, ethnicity, and environmental exposures (Vincent *et al.*, 2016; Xian *et al.*, 2015). Deviations from established norms can be the first indicator of underlying pathologies such as anaemia, immune system dysfunction, infection, or systemic poisoning (Ashaolu *et al.*, 2011; Kone *et al.*, 2017).

2.7.1. Platelet

Platelets, also known as thrombocytes, are tiny, disc-shaped blood cell fragments measuring between 2 to 4 µm. They play a crucial role in hemostasis, the process that stops bleeding after a blood vessel is injured (Koupenova *et al.*, 2018). These anucleate cells originate from the cytoplasm of megakaryocytes in the bone marrow through a complex maturation and fragmentation process (French *et al.*, 2020). Once released into the bloodstream, platelets have a lifespan of around 7 to 10 days, after which they are eliminated by phagocytic cells in the spleen and liver (Lefrançais *et al.*, 2017). The main role of platelets is to quickly attach to damaged areas of blood vessels. This process is triggered by the exposure of subendothelial collagen and von Willebrand factor (VWF) (Jiang *et al.,* 2019). The adhesion is facilitated by surface receptors like glycoprotein (GP) Ib-IX-V, which interacts with VWF, and GPVI, which directly binds to collagen (Nurden, 2018). Once adhered, platelets are activated, undergoing significant shape changes and releasing powerful signaling molecules such as adenosine diphosphate (ADP), thromboxane A2, and serotonin from their granules (Herster *et al.,* 2021). These released substances function in both paracrine and autocrine fashions, helping to recruit and activate more platelets to the developing thrombus (Vallance *et al*., 2019).

2.7.2. White blood cells

White blood cells also known as leukocytes are part of the immune system and participate in innate and humoral immune responses, they are gotten from the Greek word leucko meaning white and cyte meaning cell. They circulate in the blood and mount inflammatory and cellular responses to injury or pathogens system, constituting approximately 1% of total blood volume (Rahman and Pramanik, 2025). They are mobile units of defence, circulating in the bloodstream and migrating into tissues to mount cellular and inflammatory responses against injury, infection, and foreign invaders. A typical concentration in healthy individuals ranges from 4,000 to 11,000 cells per microliter (µL) of blood (Tigner *et al*., 2022). Based on the presence of cytoplasmic granules visible under specific stains (e.g., Giemsa, Wright's stain), leukocytes are broadly classified into two categories: granulocytes and agranulocytes (Lisano *et al*., 2023).

2.7.3. MID cells percentage (MID%)

The term "MID cells" in automated hematology analyzers typically refers to a differential population that includes monocytes, immature granulocytes, eosinophils, basophils, and other atypical or rare cells, which are grouped together based on their cell size and complexity (also known as depolarization or granularity) (Seo *et al*., 2015). The percentage of MID cells is a parameter generated by automated complete blood count (CBC) instruments, which use technologies such as flow cytometry, impedance, and laser light scattering to classify white blood cells into three main populations: lymphocytes, granulocytes (neutrophils), and the MID group (Kim *et al*., 2012). An elevated MID cell percentage on an automated differential count serves as a flag for the laboratory professional to perform a manual microscopic review of a peripheral blood smear to identify the specific cell types present (Lima *et al*., 2017).

2.7.4. Lymphocytes

Lymphocytes are a specialized class of leukocytes that constitute the core of the adaptive immune system, responsible for the antigen-specific recognition, targeted effector functions, and immunological memory that provide long-lasting protection against pathogens (Nutt *et al*., 2015). They are broadly categorized into three distinct lineages: B lymphocytes (B cells), T lymphocytes (T cells), and natural killer (NK) cells, each derived from hematopoietic stem cells in the bone marrow but following different developmental and functional pathways (Jameson and masopust, 2018). While B cells complete their maturation within the bone marrow, T cell progenitors migrate to the thymus to undergo a rigorous selection process, and NK cells, often considered part of the innate immune system, develop in the bone marrow and secondary lymphoid tissues without the need for antigen-specific receptor gene rearrangement (Vivier *et al*., 2018).

2.7.5. Granulocytes

Granulocytes known as the first responders of innate immunity are characterized by the presence of prominent cytoplasmic granules that contain powerful enzymes and inflammatory mediators. They are primarily involved in the innate immune response and can be further differentiated into neutrophils, eosinophils, and basophils based on their staining affinities and nuclear morphology (Keohane *et al*., 2019). Representing 50-70% of all white blood cells, neutrophils are the most numerous and act as the primary responders to immune threats (Buchner *et al*., 2018). Eosinophils are chiefly responsible for fighting parasites and participate in allergic reactions

(Huang *et al*., 2019). Although they are the scarcest type, basophils contribute significantly to inflammation by secreting histamine and other signaling molecules (Wen *et al*., 2020). Granulocytes develop in the bone marrow from hematopoietic stem cells via granulopoiesis, a process carefully controlled by cytokines and growth factors like granulocyte colony-stimulating factor (G-CSF) (Dahlgren *et al*., 2016). Mature cells enter the bloodstream and are directed to areas of infection or inflammation by chemical signals (López *et al*., 2019).

2.7.6. Red Blood cells

Erythrocytes, or red blood cells (RBCs), are the most abundant cell type in the blood, accounting for 40–50% of its total volume.m, these cells, which are 6–8 µm in diameter and lack a nucleus, are responsible for transporting oxygen from the lungs to bodily tissues and facilitating the removal of carbon dioxide for excretion (Da Costa *et al.,* 2017). The production of RBCs, a process known as erythropoiesis, is primarily regulated by the hormone erythropoietin, which is synthesized in the kidneys (Kuhn *et al*., 2013; D'Alessandro *et al*., 2017). These cells develop in the bone marrow for approximately seven days before entering the bloodstream, where they circulate for about 120 days (Gordon-Smith, 2013). The oxygen-carrying capacity of RBCs is due to the presence of hemoglobin, a specialized protein that also gives blood its red color. Hemoglobin binds to oxygen in the lungs for delivery to the body and transports carbon dioxide back to the lungs to be exhaled (Corrons *et al*., 2021). Normal RBC counts are typically between 4.3-5.9 million/mm^3 for males and 3.5-5.5 million/mm^3 for females. Corresponding normal hemoglobin levels are 13.5–17.5 g/dL for men and 12.0–16.0 g/dL for women (Bain, 2017). An elevated RBC count, a condition known as polycythemia, can result from factors such as dehydration, smoking, lung disease, kidney tumors, high-altitude living, or certain genetic disorders. Conversely, anemia, or a low RBC count, can be caused by inherited conditions (e.g., sickle cell anemia, thalassemia), nutritional deficiencies (e.g., vitamin B12, folate), bone marrow disorders, chronic kidney disease, cancer, or certain medications like chemotherapy drugs (Diez-Silva *et al.*, 2010).

2.7.7. Hemoglobin

Hemoglobin (Hb) is a tetrameric metalloprotein found in red blood cells, responsible for the vital transport of oxygen from the lungs to peripheral tissues and the facilitation of carbon dioxide return. (Yuan *et al.,* 2015) Each hemoglobin molecule consists of four polypeptide subunits—two α-like and two β-like globin chains—each encircling a heme group, which contains a central iron atom (Fe^{2+}) essential for oxygen binding (Dybas *et al.,* 2020). The major physiological function of hemoglobin (Hb) is to bind oxygen in the lungs and deliver it to the tissues. This function is regulated and/or made efficient by endogenous heterotropic effectors. A number of synthetic molecules also bind to the protein to alter the allosteric activity of Hb. (Safo *et al.,* 2011; Jeong *et al.,* 2021). The binding of oxygen to hemoglobin is a cooperative process, whereby the binding of one oxygen molecule to a heme group increases the affinity of the remaining heme groups for oxygen, a characteristic described by the sigmoidal shape of the oxygen dissociation curve. (Kishimoto *et al.,* 2020). This allosteric regulation is profoundly influenced by heterotropic effectors, primarily 2,3-bisphosphoglycerate (2,3-BPG), which binds to the central cavity of deoxyhemoglobin, stabilizing its tense (T) state and decreasing its affinity for oxygen. (Mairbäurl and Weber, 2023)

2.7.8. Hematocrit

The term hematocrit is derived from the English prefix hemato- and the Greek word krites. Hematocrit measures the volume of packed red blood cells (RBCs) relative to whole blood cells

(WBCs) (Reinhart, 2017). Hematocrit (Hct), also known as packed cell volume (PCV), is a fundamental hematological parameter defined as the volume percentage of erythrocytes in whole blood (Harder and Boshkov, 2020). It is a crucial measure of the oxygen-carrying capacity of the blood, as erythrocytes contain hemoglobin, the protein responsible for binding and transporting oxygen from the lungs to peripheral tissues (Ramljak *et al.,* 2013). Consequently, hematocrit levels are directly proportional to the blood's oxygen content and are a key determinant of overall oxygen delivery, influencing metabolic homeostasis and physical performance (Pfützner *et al.,* 2013). The measurement of hematocrit is routinely performed as part of the complete blood count (CBC), one of the most frequently ordered clinical laboratory tests worldwide (Brun *et al.,* 2018). It serves as a primary screening tool for diagnosing and monitoring a wide spectrum of conditions, including anemia, polycythemia, dehydration, and other disorders affecting red blood cell production or survival (Kishimoto *et al*., 2020).

2.7.9. Mean corpuscular volume (MCV)

Mean Corpuscular Volume (MCV) is a critical erythrocyte index that quantifies the average volume of individual red blood cells (RBCs), expressed in femtoliters (fL) (Lee *et al*., 2022). It is a fundamental parameter reported in a standard complete blood count (CBC) and is calculated by dividing the hematocrit (Hct) by the red blood cell count (RBC) using automated hematology analyzers (Yavorkovsky, 2021). The MCV value is pivotal for the initial morphological classification of anemia into microcytic (low MCV), normocytic (normal MCV), or macrocytic(high MCV) categories, which subsequently guides the diagnostic evaluation (Brzeźniakiewicz *et al*., 2021).

2.7.10. Mean Corpuscular Hemoglobin (MCH)

Mean Corpuscular Hemoglobin (MCH) is a calculated parameter in the complete blood count (CBC) that represents the average mass of hemoglobin within a single red blood cell (RBC), expressed in picograms (pg) (Gupta *et al.*, 2021). It is derived by dividing the total mass of hemoglobin by the total number of erythrocytes in a given blood sample (Pathak *et al.*, 2022). The formula for its calculation is MCH (pg) = [Hemoglobin (g/dL) / RBC count ($x10^{12}$/L)] x 10, which integrates two directly measured laboratory values to provide an indirect assessment of red cell hemoglobin content (Lippi and Plebani, 2014).MCH must be interpreted in conjunction with other red cell indices, particularly Mean Corpuscular Volume (MCV) and Red Cell Distribution Width (RDW), for accurate differential diagnosis (Urrechaga *et al.,* 2018). It is important to note that MCH is a mean value and does not reflect the homogeneity of hemoglobin distribution among erythrocytes, a parameter provided by the Mean Corpuscular Hemoglobin Concentration (MCHC) (Egbono *et al.,* 2025).

2.7.11. Mean Corpuscular Hemoglobin Concentration

Mean Corpuscular Hemoglobin Concentration (MCHC) is a calculated value in a complete blood count (CBC) that indicates the average concentration of hemoglobin within individual red blood cells (RBCs). This measurement is typically expressed either as a percentage or in grams per deciliter (g/dL) (Egbono *et al.*, 2025). Mean corpuscular hemoglobin concentration is derived from the measured amounts of hemoglobin and hematocrit, using the equation: MCHC = (Hemoglobin / Hematocrit) × 100 (Gulati *et al*., 2022). In contrast to the related index, Mean corpuscular hemoglobin concentration evaluates the concentration of hemoglobin, providing valuable information regarding the hemoglobin content of erythrocytes (Urrechaga *et al*., 2018). The main clinical significance of Mean corpuscular hemoglobin concentration resides in its assistance in the morphological classification of anemia (Pathak*et al.*, 2022). A decreased Mean corpuscular hemoglobin concentration value, known as hypochromia, is a key characteristic of conditions associated with impaired hemoglobin production (Lee *et al.,* 2022; Kishimoto *et al.,* 2020).

CHAPTER THREE

MATERIALS AND METHOD

3.1. APPARATUS AND EQUIPMENT USED

The materials and equipment used in this study included an analytical weighing balance (Ohaus, Pine Brook, NJ, USA; China), beakers, a chopping board, methylated spirit, conical flasks, a dissecting set, a dehydrator (Model: SF-4006, China), ethylene diamine acetic acid (EDTA) bottles, a haematological automated analyser (Model PCE-2100, Japan), hand gloves, an industrial blender (KENWOOD KCB2239K), knives, masking tape, a measuring cylinder, an oral gastric tube, rat cages, a stirrer, a strainer, syringes and needles (1 ml, 2 ml, and 5 ml), coloured markers, a storage container, cotton wool, a mortar and pestle, and a water bath (HH-S6, China).

3.2. CHEMICAL/SOLVENTS USED

The following chemicals were employed in this study: cholic acid, arachis oil, coconut oil, distilled water, ketamine, fructose, and cholesterol.

3.3. PLANT COLLECTION

Anthocleista djalonensis and *Allium sativum* were obtained from the Ikpoba Okha Local Government Area in Edo State. *Zingiber officinale* was purchased from Igbanke, Orhionmwon Local Government Area, Edo State. *Thespesia garckeana* was purchased from Tula village in the

Kaltungo Local Government Area, Gombe State. Goat weed was purchased from the Kurmi market within the Kano Municipal Local Government Area, Kano State.

3.4. PREPARATION OF PLANT MATERIALS

The plant materials, including *Allium sativum*, *goatweed*, *Zingiber officinale*, and *Thespesia garckeana*, were thoroughly rinsed under running water and then cut into smaller pieces. *Anthocleista djalonensis* leaves were separated from their stalks and washed. All materials were dehydrated in a dehydrator (Model: SF-4006 China), and then each was separately milled to a fine powder using an industrial blender (KENWOOD KCB2239K).

3.5. POLYHERBAL TEA FORMULATION

The polyherbal tea was prepared following the procedure of Uwaya and Effiong (2024) with minor modifications. The formulation consisted of a 1:1:1:1:0.5 ratio of garlic (*Allium sativum*), ginger (*Zingiber officinale*), *Anthocleista djalonensis, goat weed* (Barron wort), and *Thespesia garckeana* (Goron tula) powder.

3.6. POLYHERBAL TEA EXTRACTION

A 255 g portion of the polyherbal blend was placed in an extraction jar and combined with 3L of distilled water. The mixture was stirred and allowed to macerate for 72 hours before being strained into a storage container. The filtrate was then concentrated using a water bath (MODEL HH-S6, China), and the resulting extract was stored at 4°C in the refrigerator prior to use.

3.7. EXPERIMENTAL ANIMALS

Healthy adult Wistar rats, both male and female, were obtained from a commercial breeder in Ibadan, Oyo State. Animals were housed within the animal facility of the Department of Plant Biology and Biotechnology, University of Benin, and allowed to acclimatise under normal laboratory conditions for two weeks under a 12-hour light/dark cycle, with free access to feed pellets and water. All procedures adhered to the National Institutes of Health (NIH) guidelines for the care and use of laboratory animals. This study was approved by the Faculty of Science Laboratory Technology Research Ethical Committee with reference number UNIBEN/FSLT/00016.

3.8. EXPERIMENTAL DESIGN

This research was carried out using an atherogenic diet-induced hyperlipidaemia model in Wistar rats, following the methods described by Aziza *et al*. (2015), Shalini *et al*. (2014–2015), and Vetrivadivelan *et al*. (2012) with a slight modification.

The 25 healthy Wistar rats were randomly divided into five groups, with five animals per group.

Group 1: Received 2 mL/kg of distilled water without cholesterol.

Group 2: Received cholesterol only, without any treatment.

Group 3: Received 20 mg/kg of the aqueous extract of the polyherbal formulated tea.

Group 4: Received 40 mg/kg of the aqueous extract of the polyherbal formulated tea.

Group 5: Received 5 mg/kg of atorvastatin as the standard drug.

Hyperlipidaemia and atherosclerosis were induced by administering 10 mg/kg of 1% cholesterol and 0.5% cholic acid for five consecutive days before initiating treatment. Thereafter, the extracts and standard drug were administered orally for 28 days, alongside concurrent administration of oil throughout the study period.

At the end of 28 days, the animals were anaesthetised with ketamine (100 mg/kg) and sacrificed. A midline abdominal incision was made to access the abdominal aorta, from which blood was collected using a 5 mL syringe. The blood was placed in an EDTA tube for haematological analysis.

3.9. HAEMATOLOGICAL ASSAY

The blood in the EDTA container was analysed using a haematological automated analyser (Model PCE-2100, JAPAN).

3.10. STATISTICAL ANALYSIS

The data are shown as the mean ± standard error of the mean (SEM), and "n" stands for the number of rats in each experimental group. A one-way analysis of variance (ANOVA) was performed, followed by the Tukey test for post-hoc analysis. All data analyses were conducted using GraphPad Prism software version 9, obtained from the UK. A significance level of $p < 0.05$ was established to indicate statistically significant differences between the compared groups.

CHAPTER FOUR

RESULT

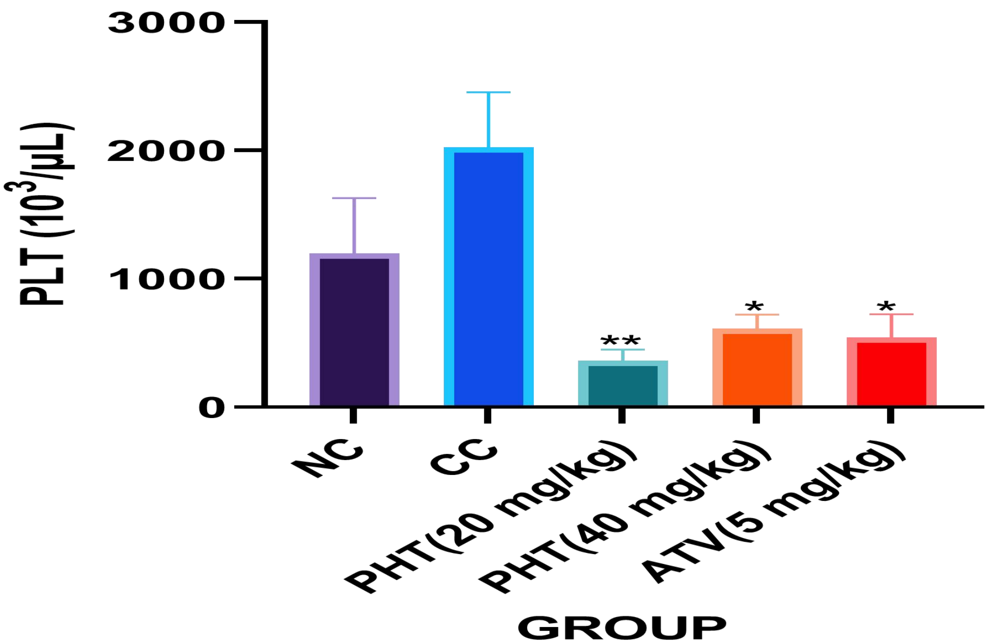

Figure 1: The effect of polyherbal formulated tea on Platelet value on hyperlipidaemia induced rat. The polyherbal formulated tea at 20mg/kg, 40mg/kg and atorvastatin reduces cholesterol level when compared with normal control and cholesterol induced control ($P < 0.01$: 0.001). NC: Normal control or distilled water control. CC: Cholesterol control. PHT: Polyherbal formulated tea. ATV: Atorvastatin. The data are represented as mean ± standard error of mean. n=5.

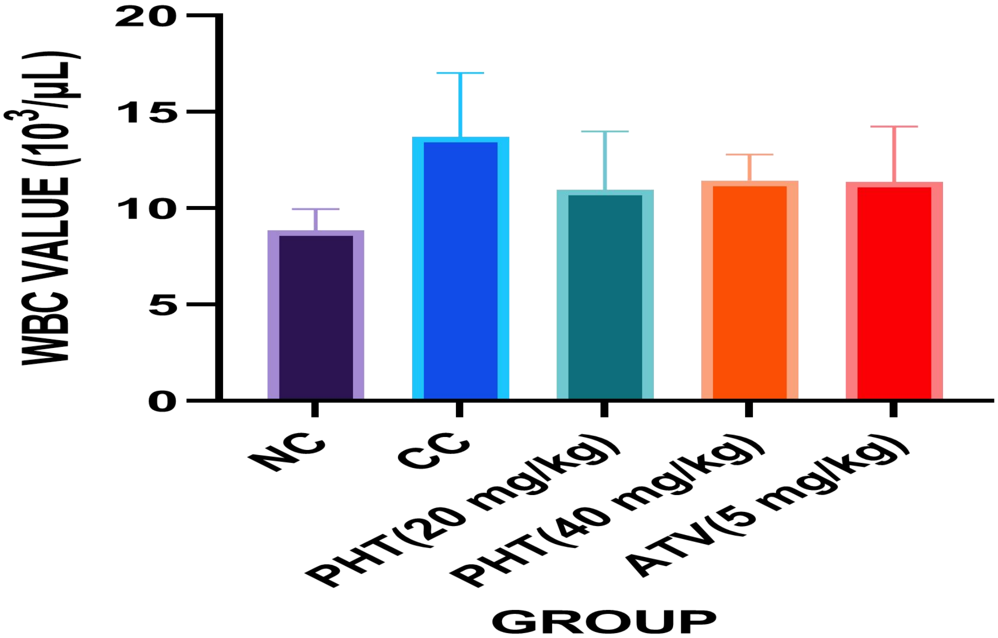

Figure 2: The effect of polyherbal formulated tea on White Blood Cell value on hyperlipidaemia induced rat. The polyherbal formulated tea at 20mg/kg and 40mg/kg had no effect on White Blood Cell level when compared with normal control and cholesterol induced control (P> 0.05). NC: Normal control or distilled water control. CC: Cholesterol control. PHT: Polyherbal formulated tea. ATV: Atorvastatin. The data are represented as mean ± standard error of mean. n=5.

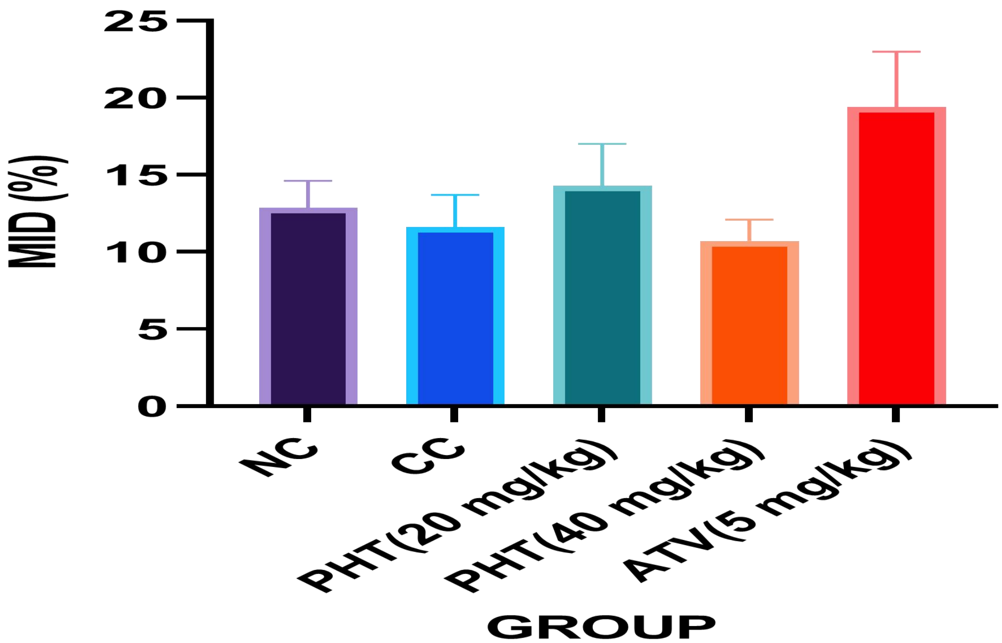

Figure 3: The effect of polyherbal formulated tea on Mid sized value on hyperlipidaemia induced rat. The polyherbal formulated tea at 20mg/kg and 40mg/kg had no effect on Mid size level when compared with normal control and cholesterol induced control (P> 0.05). NC: Normal control or distilled water control. CC: Cholesterol control. PHT: Polyherbal formulated tea. ATV: Atorvastatin. The data are represented as mean ± standard error of mean. n=5.

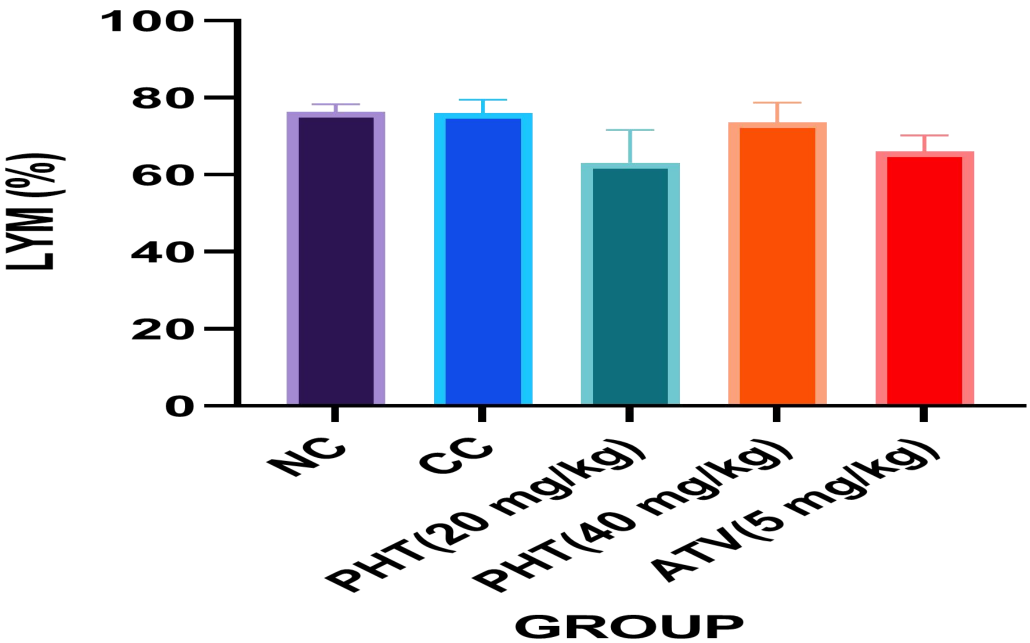

Figure 4: The effect of polyherbal formulated tea on Lymphocyte value on hyperlipidaemia induced rat. The polyherbal formulated tea at 20mg/kg and 40mg/kg had no effect on Lymphocyte level when compared with normal control and cholesterol induced control ($P > 0.05$). NC: Normal control or distilled water control. CC: Cholesterol control. PHT: Polyherbal formulated tea. ATV: Atorvastatin. The data are represented as mean ± standard error of mean. n=5.

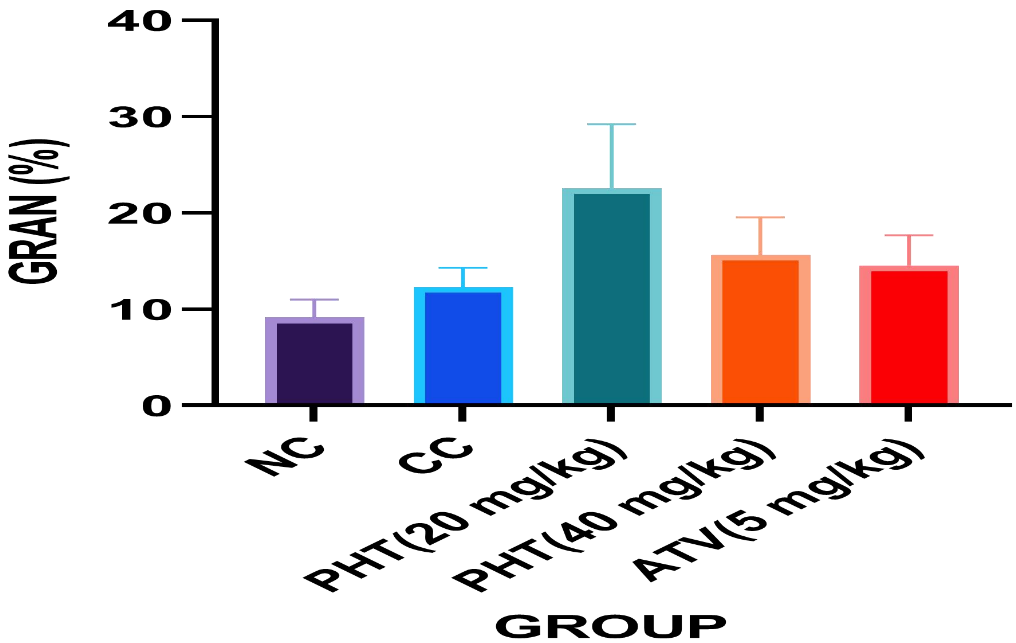

Figure 5: The effect of polyherbal formulated tea on Granulocyte value on hyperlipidaemia induced rat. The polyherbal formulated tea at 20mg/kg and 40mg/kg had no effect on Granulocyte level when compared with normal control and cholesterol induced control (P> 0.05). NC: Normal control or distilled water control. CC: Cholesterol control. PHT: Polyherbal formulated tea. ATV: Atorvastatin. The data are represented as mean ± standard error of mean. n=5.

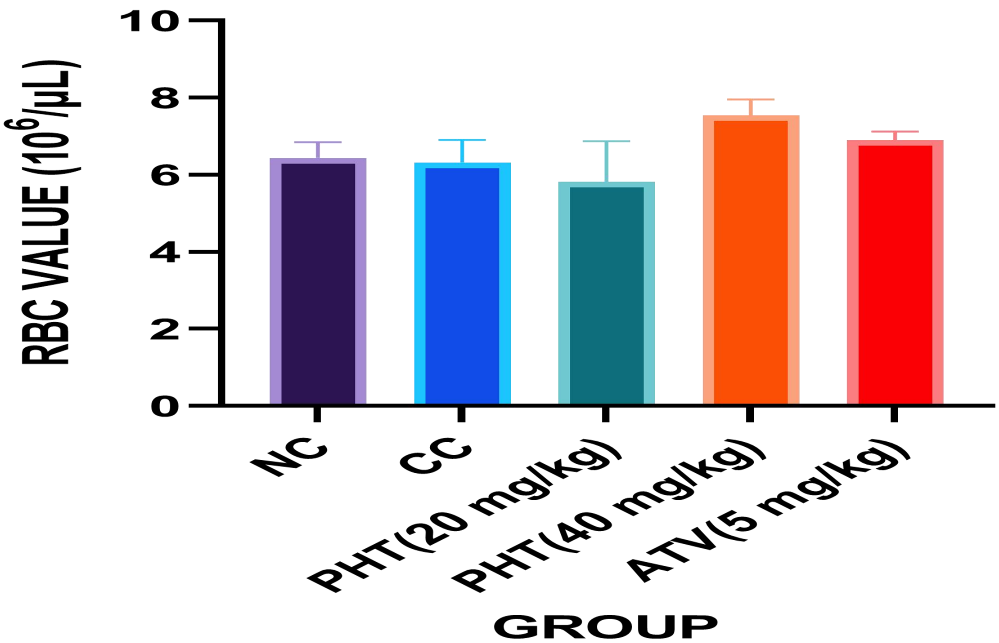

Figure 6: The effect of polyherbal formulated tea on Red Blood Cell value on hyperlipidaemia induced rat. The polyherbal formulated tea at 20mg/kg and 40mg/kg had no effect on Red Blood Cell level when compared with normal control and cholesterol induced control (P> 0.05). NC: Normal control or distilled water control. CC: Cholesterol control. PHT: Polyherbal formulated tea. ATV: Atorvastatin. The data are represented as mean ± standard error of mean. n=5.

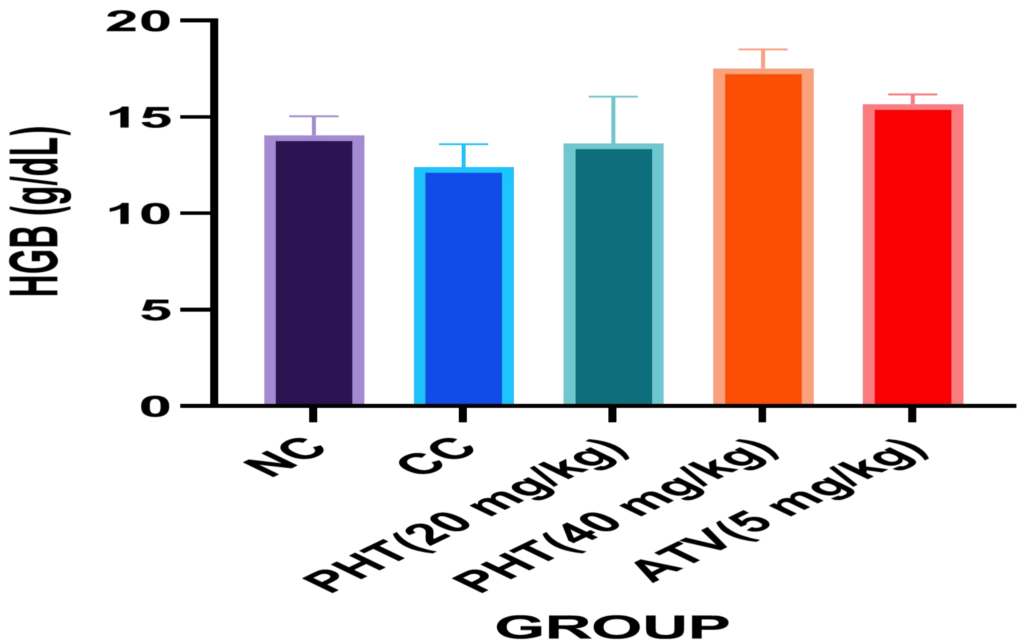

Figure 7: The effect of polyherbal formulated tea on Hemoglobin value on hyperlipidaemia induced rat. The polyherbal formulated tea at 20mg/kg and 40mg/kg had no effect on Haemoglobin level when compared with normal control and cholesterol induced control (P> 0.05). NC: Normal control or distilled water control. CC: Cholesterol control. PHT: Polyherbal formulated tea. ATV: Atorvastatin. The data are represented as mean ± standard error of mean. n=5.

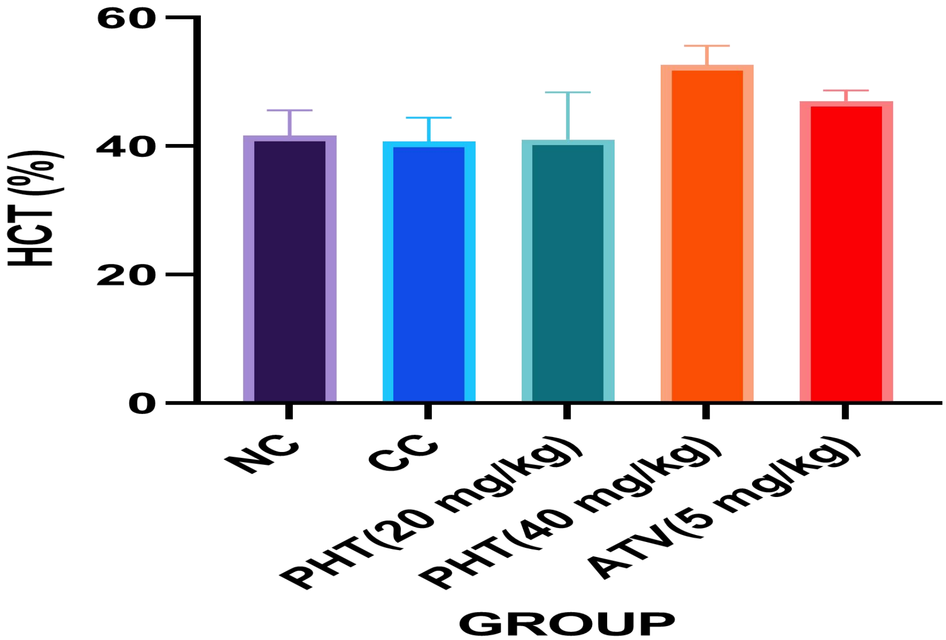

Figure 8: The effect of polyherbal formulated tea on Hematocrit value on hyperlipidaemia induced rat. The polyherbal formulated tea at 20mg/kg and 40mg/kg had no effect on Hematocrit level when compared with normal control and cholesterol induced control (P> 0.05). NC: Normal control or distilled water control. CC: Cholesterol control. PHT: Polyherbal formulated tea. ATV: Atorvastatin. The data are represented as mean ± standard error of mean. n=5.

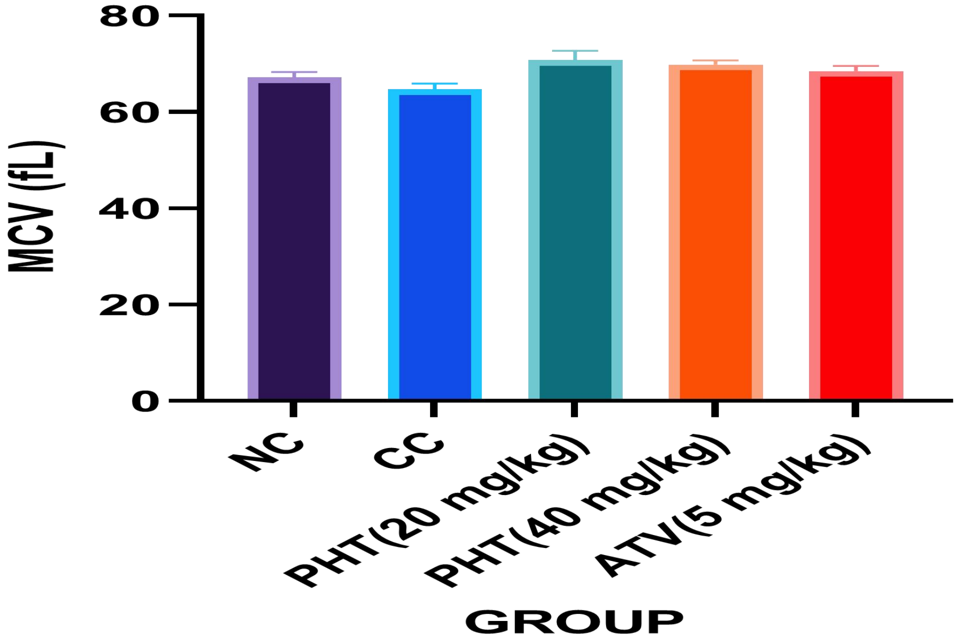

Figure 9: The effect of polyherbal formulated tea on Mean Corpuscular Volume on hyperlipidaemia induced rat. The polyherbal formulated tea at 20mg/kg and 40mg/kg had no effect on Mean Corpuscular Volume level when compared with normal control and cholesterol induced control ($P > 0.05$). NC: Normal control or distilled water control. CC: Cholesterol control. PHT: Polyherbal formulated tea. ATV: Atorvastatin. The data are represented as mean ± standard error of mean. n=5.

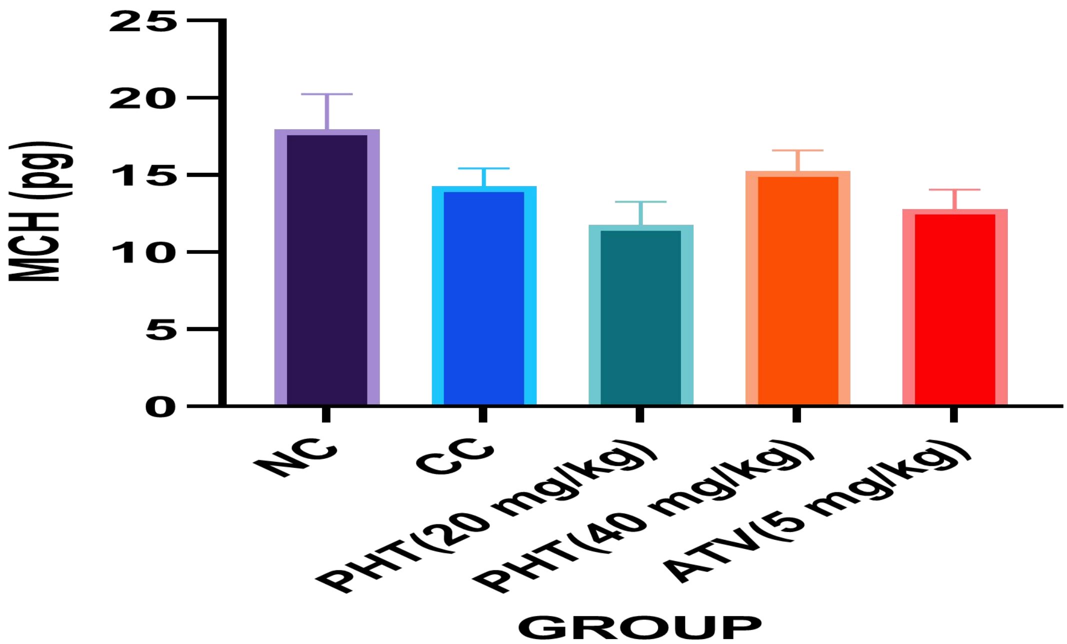

Figure 10: The effect of polyherbal formulated tea on Mean Corpuscular Hemoglobin value on hyperlipidaemia induced rat. The polyherbal formulated tea at 20mg/kg and 40mg/kg had no effect on Mean Corpuscular Haemoglobin level when compared with normal control and cholesterol induced control (P> 0.05). NC: Normal control or distilled water control. CC: Cholesterol control. PHT: Polyherbal formulated tea. ATV: Atorvastatin. The data are represented as mean ± standard error of mean. n=5.

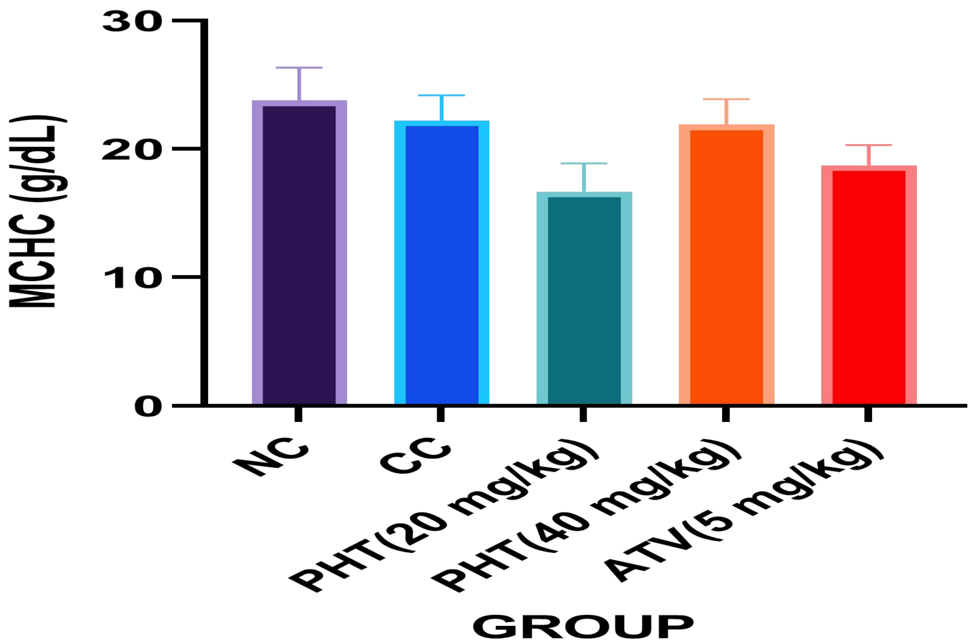

Figure 11: The effect of polyherbal formulated tea on Mean Corpuscular Hemoglobin Concentration on hyperlipidaemia induced rat. The polyherbal formulated tea at 20mg/kg and 40mg/kg had no effect on Mean Corpuscular Haemoglobin Concentration level when compared with normal control and cholesterol induced control (P> 0.05). NC: Normal control or distilled water control. CC: Cholesterol control. PHT: Polyherbal formulated tea. ATV: Atorvastatin. The data are represented as mean ± standard error of mean. n=5.

Table 1: The effect of polyhedral formulated tea on haematological indices in cholesterol induced hyperlipidemia and atherosclerosis in water rats.

PARAMETERS	NC	CC	PHT(20mg/kg)	PHT(40mg/kg)	ATV(5mg/kg)
PLT (10^3/uL)	1200±430.0	2026±427.9	362.8±85.74**	613.1±107.7*	544.4±180.0*
WBC(10^3/uL)	8.86±1.10	13.70±3.32	10.96±3.03	11.44±1.35	11.38±2.86

MID (%)	12.86±1.76	11.62±2.09	14.30±2.71	10.72±1.38	19.40±3.59
LYM (%)	76.40±1.93	76.06±3.39	63.12±8.52	73.62±5.08	66.06±4.12
GRAN (%)	9.14±1.87	12.32±1.99	22.58±6.63	15.66±3.88	14.54±3.15
RBC (10^6/uL)	6.44±0.40	6.32±0.59	5.82±1.05	7.54±0.41	6.90±0.22
HGB (g/dL)	14.06±0.98	12.40±1.20	13.62±2.44	17.52±0.99	15.68±0.50
HCT (%)	41.68±3.89	40.74±3.68	41.00±7.39	52.66±2.99	47.00±1.65
MCV (fL)	67.18±1.09	64.70±1.19	70.76±1.93	69.86±0.85	68.48±1.10
MCH (pg)	17.96±2.27	14.28±1.15	11.76±1.49	15.26±1.34	12.80±1.26
MCHC (g/dL)	23.78±2.55	22.24±1.94	16.70±2.18	21.92±1.96	18.74±1.58

The PHT significantly reduced the platelet level when compared to cholesterol control (CC) and distilled water control (NC) ($p<0.01$). All other hematology indices such as WBC, LYM, MID, GRAN, RBC, HGB, HCT, MCV, MCH, and MCHC were not affected when compared to control. PHT: Polyhedral Formulated Tea, CC: Cholesterol control, NC: Normal control, WBC: White Blood Cell, LYM: Lymphocyte, MID: MID cells percentage:GRAN: Granulocyte, RBC: Red Blood Cell, HGB: Hemoglobin, HCT: Hematocrit value, MCV:Mean Corpuscular Volume, MCH: Mean Corpuscular Hemoglobin, MCHC: Mean Corpuscular Hemoglobin Concentration. The data were represented as mean ± standard error of mean. n=5

CHAPTER FIVE

DISCUSSION AND CONCLUSION

5.1. DISCUSSION

Haematological parameters are essential diagnostic tools in clinical practice, used to identify a range of health disorders from nutritional deficiencies to systemic diseases (Kim *etal*., 2022). Among these, platelet count is a critical measure, vital for maintaining blood homeostasis and haemostasis; abnormalities may indicate bleeding risks or thrombotic tendencies (Koupenova *etal*., 2022). A reduced platelet count can suggest the presence of substances with anti-platelet properties, which may be therapeutically valuable in conditions such as thrombocytosis (Alkattan *etal*., 2022). Stability in haematological parameters, in the absence of pathogens, suggests that a substance does not induce adverse immunostimulatory effects, an important consideration in drug safety evaluation (Huseynov *et al*., 2023).

In this study, the polyherbal tea containing *Anthocleista djalonensis*, *Zingiber officinale*, *Allium sativum*, *Ageratum conyzoides*, and *Thespesia garckeana* significantly reduced platelet levels across all doses (**Figure 1**), while other parameters remained unaffected (**Figures2–11**). The observed platelet reduction in hyperlipidaemic rats (**Figure 1**) indicates a notable therapeutic potential. At a dose of 20 and 40 mg/kg, the polyherbal tea demonstrated significant anti-platelet activity, which could be beneficial in managing thrombocytosis, given the key role of platelets in blood homeostasis (Radaelli *et al*., 2016; Gotoh *et al*., 2015). This effect aligns with findings from a related hyperlipidaemia study, where doses of 500 mg/kg of *Allium sativium* effectively lowered cholesterol levels, comparable to atorvastatin (Kishimoto *et al*., 2025).

The lack of significant changes in other haematological parameters suggests an absence of a general immunostimulatory response, which would typically elevate immune cell counts involved in antibody production against infectious agents (Juliet *et al*., 2023). This pharmacological profile can be understood within the framework of contemporary cardiovascular and haematological science (Tanczos, 2021).

The decrease in platelet count strongly suggests that the polyherbal tea has strong anti-platelet effects. Platelets are crucial in haemostasis, but their hyperactivation contributes to arterial thrombosis, leading to myocardial infarction and ischaemic stroke (Mackman *et al*., 2020). By lowering circulating platelet numbers, the formulation limits the substrate for clot formation, serving as a primary preventive measure against thrombotic events. This aspect is especially important in hyperlipidaemia, which promotes a pro-thrombotic state characterised by increased platelet reactivity and adhesion (Stevens *et al*., 2020).

Furthermore, this anti-platelet effect offers a plausible mechanism for the cardioprotective potential of the polyherbal tea. While previous guidelines linked cardioprotection to haemoglobin changes, platelet reduction provides a more direct and established pathway (Stewart *et al*., 2020). Elevated platelet counts and activity are independent risk factors for atherosclerosis progression and acute coronary syndromes (Roweth and Battinelli, 2021). The tea's ability to lower platelet counts suggests it can modulate this risk, protecting the cardiovascular system from hyperlipidaemia-related complications (Sikora *et al*., 2013). This effect parallels that of atorvastatin, which is known for stabilising atherosclerotic plaques and reducing pro-thrombotic mediators (Koupenova *et al*., 2022).

By reducing platelet counts, the polyherbal tea may help prevent harmful blood clots, thereby lowering the risk of thrombotic events such as heart attacks and strokes (Valero *et al*., 2016; Mackman *etal*., 2020). This aligns with the suggested cardioprotective effects, supported by a significant decrease in haemoglobin without changes in haematocrit (Kishimoto *et al*., 2020).

Nonetheless, further research is necessary to fully elucidate the mechanisms and therapeutic potential of this platelet reduction (Wolberg and Sang, 2022).

5.2. CONCLUSION

The polyherbal formulated tea which comprises of *Anthocleista djalonensis*, *Zingiber officinale*, *Allium sativum*, *Ageratum conyzoides*, and *Thespesia garckeana*, exhibits anti-platelet properties. This suggests a potential cardioprotective effect through the reduction of a major cardiovascular disease risk factor. Further research should be carried out to fully understand its mechanism of action and explore other biological activities.

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