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BREWING HEALTH BENEFITS: A COMPARATIVE STUDY OF BLACK, HERBAL, AND GREEN TEA ON RAT PHYSIOLOGY

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Abstract

This study compared the physiological effects of black, herbal, and green tea in rats to determine prospective health advantages. Animals were divided into eight groups of six male rats each. In the morning and evening, the negative control group was intubated with 1ml of distilled water, with rat chow and water. The remaining six groups got each type of tea (black, herbal, and green)

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in the morning and evening for 14 days while physiological data were recorded. Green tea showed the most significant lipid profile and liver function improvement among the three tea varieties. The findings imply that all three tea varieties may have health advantages, particularly in enhancing liver health and lipid profiles. The highest impacts on lipid profile and body weight reduction were specifically shown with green tea.

Keywords: *Male rats, Liver function, lipid profile, Black tea, Green Tea, Herbal Tea.*

1.0 Introduction

Many people have embraced weight management teas due to the widespread search for efficient dietary supplements to help them lose weight (Liu et al., 2021). These teas, which contain natural ingredients such as green tea, oolong tea, ginger, and dandelion root, are thought to improve metabolism, energy levels, and appetite suppression. While these teas are not meant to replace healthy lifestyle choices, they may complement them (Kim et al., 2017).

Black tea is made from the Camellia sinensis leaf and is highly oxidized, giving it a dark color and distinct flavor. Catechins, theaflavins, thearubigins, flavonols, and caffeine are all found in black tea, with theaflavins and thearubigins formed during the oxidation process (Chacko et al., 2010). Because of the oxidation process, the amount of catechins in black tea is lower than in green tea, but black tea still contains significant amounts of these compounds (Yang et al., 2019). Although black tea's caffeine content is lower than coffee's, it still has a stimulating effect (Jówko et al., 2019).

Black tea has emerged as a popular option among the various teas available due to its potential for weight management. Although the underlying mechanisms of its action are unknown, research suggests that black tea's caffeine and catechin content may play an essential role in disease prevention (Henning et al., 2012; Davies et al., 2018). Furthermore, black tea may contain antioxidants and other bioactive compounds that may boost metabolism, increase fat burning, and reduce appetite, ultimately promoting weight loss (Janssens et al., 2016). As scientists continue to investigate the potential benefits of black

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tea, its role in weight management remains an intriguing area for further investigation.

Herbal teas contain no tea leaves and are made from various plants. Depending on the plant used, herbal teas contain many bioactive compounds. Chamomile tea contains apigenin, a flavonoid with anti-inflammatory properties (Fetrow & Avila, 2000), whereas peppermint tea contains menthol, a compound that can aid digestion (Fetrow & Avila, 2000). (McKay & Blumberg, 2006). Rooibos tea, derived from a South African plant, contains flavonoids and other antioxidant-rich compounds (Joubert et al., 2008).

Green tea is made from the same plant's leaves as black tea but is not oxidized, so it retains more natural bioactive compounds. Green tea is high in catechins, particularly EGCG, which have antioxidant and anti-inflammatory properties. It also contains flavonoids, amino acids, and caffeine (Grove et al., 2018). Green tea catechin content varies depending on growing conditions, processing methods, and storage (Chacko et al., 2010). The search for natural weight-loss remedies has led many people to investigate the potential benefits of green tea. Green tea, known for its high antioxidant and bioactive compound content, including catechins, has been linked to better weight management and weight loss (Westerterp-Plantenga et al., 2005). Catechins boost metabolism, burn fat, and suppress appetite, making green tea a promising weight loss aid (Hursel & Westerterp-Plantenga, 2010). Green tea may also reduce fat absorption from the diet, increasing its ability to promote weight loss (Hursel et al., 2011). Herbal teas—also referred to as diet teas—are commonly promoted as aids in weight loss. These drinks frequently include organic plant extracts, like green tea, which are highly antioxidative and may speed up metabolism and aid in fat burning (Wang et al., 2019).

However, the benefits of herbal/diet teas on weight loss must be kept in mind; drinking tea alone is unlikely to cause significant weight loss (Mansour et al., 2019). Tea's dry weight can be up to 30% polyphenols, which include flavonols, flavanols, flavonoids, and phenolic acids (Babu & Liu, 2008). Catechins, the most physiologically active class of tea polyphenols, including (+)-gallocatechin (GC), (+)-catechin (C), (+)-epigallocatechin 3-gallate (ECG), (+)-epicatechin 3-gallate (ECG), and (+)-epigallocatechin 3-gallate (ECG) (Chen et

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al., 2018). During fermentation, the polyphenol oxidase converts catechins into quinone, which condenses to produce high-molecular-weight substances, including bisflavanol, theaflavin, and thearubigen (Li et al., 2019). Based on variables like species, season, leaf age, climate, and horticulture practices, the content of tea can vary greatly (Zhang et al., 2019). Research shows that tea polyphenols may have various biological effects, including anti-fungal, anti-inflammatory, antimutagenic, antioxidative, and anti-carcinogenic.

This research aimed to compare the physiological effects of black, herbal, and green tea on rat physiology and identify potential health benefits associated with these tea varieties. The authors wanted to see if these three types of tea had different effects on physiological parameters like lipid profile and liver function. The authors also sought to identify potential mechanisms through which tea exerts its physiological effects, emphasizing the distinct phytochemical composition of each type of tea.

The study's rationale is based on the well-documented health benefits of tea consumption in humans. Most studies, however, have focused on green tea, and little is known about the potential health benefits of other tea varieties, such as black and herbal tea. This study aimed to provide a more comprehensive understanding of the potential health benefits of tea consumption and to identify the unique contributions of each type of tea by comparing the effects of these three types of tea. The study's findings could have significant implications for preventing and managing chronic diseases such as cardiovascular disease and non-alcoholic fatty liver disease, major public health concerns worldwide.

2.0 MATERIALS AND METHODS

2.1 Chemicals. Randox provided total cholesterol, triglyceride, LDL-C, HDL-C, urea, creatinine, AST, ALP, and ALT reagent kits (Randox Laboratories, Antrim, UK). Green tea, Sliming/German herbal tea, and black tea was produced by Qualitea Ceylon (Pvt) ltd (14 Station Road, Wattala 11300, Sri Lanka), German Herb (Thai) & Co. (Thailand), and Unilever Plc (Agbara Industrial Layout, Agbara, Ogun State Nigeria). All tea bags were crushed into

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powder and thoroughly mixed with the basal diet in the experiment.

2.2 Animals and Treatment. The National Research Council's Guide conducted the animal experiment for the Care and Use of Laboratory Animals. Ethical approval was obtained from the Babcock University Health Research Ethics Committee (BUHREC). Fifty-five adult male albino Wistar rats (200-350 grams) were purchased from the University of Ibadan's Pathology Department (UI). They were then housed in stainless steel wire-bottomed cages, acclimated for a week under laboratory conditions (19-23 °C, humidity 60%, 12-h light/dark cycle), and fed commercial rat chow (purchased from Animal Care Feeds, Nigeria Limited) and water ad libitum. Rats weighed between 200 and 350g at the start of the study. Every week, all rats were weighed. After one week of acclimation, the rats have randomly divided into eight (8) groups of at least six rats each.

2.2.1 Study Design: The study design included eight groups of male rats, each with six rats. The first group was a positive control, receiving only rat chow and water. The negative control group was intubated with 1ml of distilled water in the morning and evening, along with rat chow and water. The other six groups received tea extracts, with two groups receiving each type of tea (green, herbal, and black). For the tea groups, one group received 1ml of tea extract only in the morning, while the other received 1ml of tea extract both morning and evening. The rats were given tea extracts for 14 days, and their physiological parameters were measured at the start and end of the experiment. i.e.;

Group 1- Positive (-) control: Rats fed with rat chow and water.

Group 2- Negative (-) control: Rats intubated with 1ml distilled water in the morning and evening + rat chow and water.

Group 3- Rats intubated with 1ml green tea morning only + rat chow and water.

Group 4: Rats intubated with 1ml green tea morning and evening + rat chow and water.

Group 5- Rats intubated with 1ml slim herbal tea morning only + rat chow and water.

Group 6: Rats intubated with 1ml slim herbal tea morning and evening + rat chow and water.

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Group 7- Rats intubated with 1ml black tea morning only + rat chow and water.

Group 8: Rats intubated with 1ml black tea morning and evening + rat chow and water.

The experiment ended after two weeks. The rats were then chloroform-anaesthetized from the jugular vein. The serum was separated for total cholesterol, triglyceride, HDL-C, and LDL-C determination, and the liver, kidney, and brain organs were weighed and frozen at -70 °C. Assay for Triglycerides. The GPO-PAP method was used to accomplish this (Randox Laboratories, Antrim, U.K.). Special lipases hydrolyze triglycerides enzymatically to glycerol and free fatty acids. H2O2 is formed during the subsequent enzymatic oxidation by glycerol kinase and phosphatase. This is converted into a coloured quinonimine by a peroxidase-catalyzed reaction with 4-amino antipyrine and phenol, measured spectrophotometrically at 546 nm. The triglyceride content was expressed in milligrams per deciliter.

2.2.2 Control of confounding factors: The study considered confounding factors such as the rats' diet and physical activity levels, ensuring that the control groups were fed the same diet and exposed to the same physical activity levels as the treatment groups.

2.3 Cholesterol Assay. The CHOD-PAP method was used to calculate this (Randox Laboratories, Antrim, U.K.). Detergents release cholesterol and its esters from lipoproteins. The esters are hydrolyzed by cholesterol esterase. H2O2 is formed during the subsequent enzymatic oxidation by cholesterol oxidase. This is converted into a coloured quinonimine by a peroxidase-catalyzed reaction with 4-amino antipyrine and phenol, measured spectrophotometrically at 546 nm. The cholesterol content was expressed in milligrams per deciliter.

2.4 HDL-Cholesterol Assay. Phosphotungstic acid and magnesium ions specifically precipitate low-density lipoproteins (LDL and VLDL), which centrifugation can remove. HDL remains in the supernatant (Randox Laboratories, Antrim, U.K.). The clear supernatant is used to determine HDL-C levels. The CHOD-P4-amino antipyrineAP method estimates this. The content of HDL-C was measured in milligrams per deciliter.

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2.5 LDL-Cholesterol Assay. Heparin precipitates LDL at its isoelectric point (pH 5.12). The HDL and VLDL remain in the supernatant after centrifugation and can be determined using enzymatic methods (Randox Laboratories, Antrim, UK). Total cholesterol (LDL-C) - cholesterol in the supernatant. The unit of LDL-C content was milligrams per deciliter—Superoxide Dismutase Activity in Serum Assay. In a glass test tube, 400 microliters of absolute ice-cold ethanol/chloroform 62.5:37.5 (v/v) were added to 250 L of serum and thoroughly mixed for at least 30 seconds before centrifugation at 3000g for 5 minutes at four °C. The resulting supernatant was kept at 2 to 8 °C until used in the assay. Randox's commercial kit determined serum SOD activity (Randox Laboratories).

2.6 Statistical Analysis of the Data. A statistical significance of $p>0.05$ was established. The obtained results were expressed as the mean, standard error (SE), and the significance of the difference (p-value) was statistically analyzed using the two-tailed unpaired Student's t-tests to identify the difference between variables were made using GraphPad Prism Version 5.01 for home windows (GraphPad Software application, La Jolla CA). They were, furthermore, calculated as p-values 0.05 (*), 0.01 (**), and 0.001 (***).

3.0 Result

3.1 The Effect of Tea Leaves on Rat Body Weight and Dietary Intake (Figures 1ai & ii); shows the weights of rats in each group after two weeks. The initial weight of the rats was found to be similar across all groups. Despite their chemical differences, black tea (BT), herbal tea (HT), and green tea (BT) all reduced body weight in male rats when compared to the positive control group. The BTG1 and BTG2 groups had a moderate weight gain, while the HTG1 and HTG2 groups showed a decrease in weight, which may be due to the type of tea used in their diets. The GTG1 and GTG2 groups also decreased weight, possibly due to the low nutrient content in green tea. Also, PC gained the most weight, while NC lost weight.

The weight gain/loss and percentage of weight gain/loss in the tea groups ranged from 2.22±0.48 g to 6.87±0.89 g, indicating that tea consumption improved growth performance compared to the NC group. However, the weight gain in the tea groups was less than that of the PC group, which gained 9.57±0.01 g.

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Furthermore, the current study found that intubating rats once and twice daily with black and green tea resulted in a significant ($p<0.05$) reduction in body weight compared to the positive control on day 5. Body weight fluctuated in rats intubated once and twice with herbal tea on days 5, 9, and 14 when compared to rats in the positive control group. On days 9 and 14, animals intubated with green tea had a significantly lower body weight ($p>0.05$) than the positive control group.

Another essential factor to consider when evaluating the effects of different diets on animal physiology is the organ/body weight ratio. The heart organ/body weight ratio was relatively consistent across all groups, ranging from 0.27% to 0.40%, with no statistically significant differences observed. On the other hand, the liver organ/body weight ratio showed a significant difference between groups, with the highest value observed in the rats fed diet tea, followed by the rats fed green tea, and the lowest value observed in the rats fed black tea. The kidney organ/body weight ratio ranged from 0.61% to 0.70% across all groups, with no statistically significant differences observed.

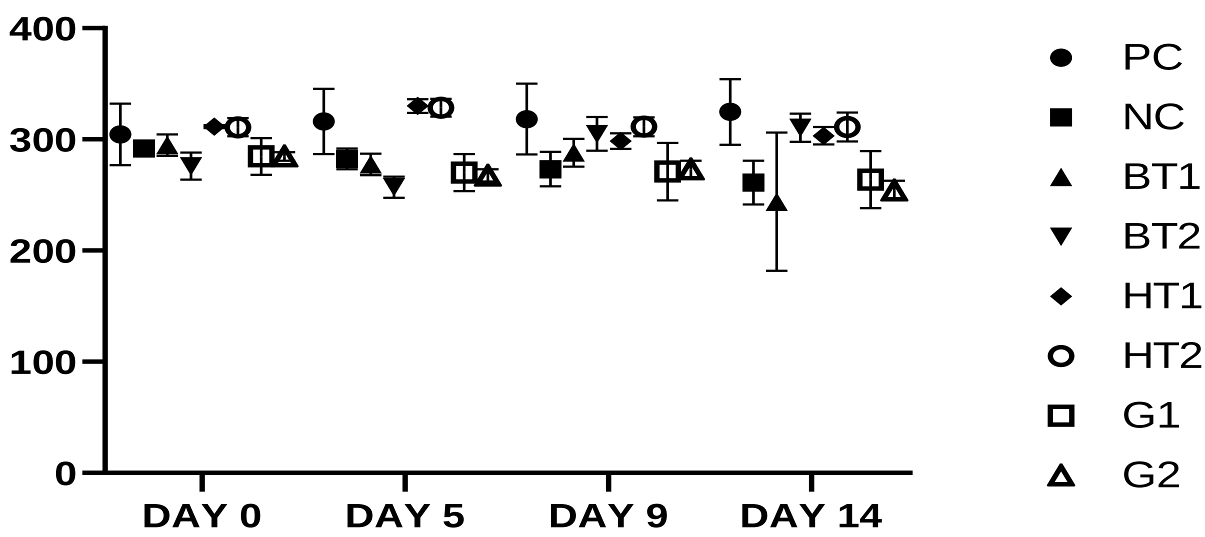

Figure 1ai: Effects of black, herbal, and green tea on Wister Rat Growth*.

*The data is presented as the mean ± s.e of 6 rats per group. Different from the control group statistically: (a) $p < 0.05$; (b) $p < 0.01$; (c) $p < 0.001$.

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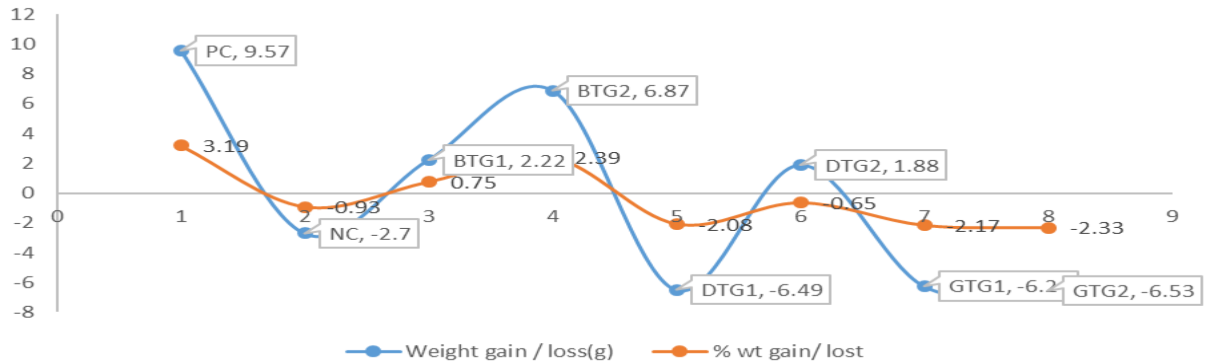

Figure 1aii: Effects of black, herbal, and green tea on Wister Rat Growth*

*The data is presented as the mean ± SE of 6 rats per group. Different from the control group statistically: (a) $p < 0.05$; (b) $p < 0.01$; (c) $p < 0.001$.

3.2 Effect of select tea on Liver transaminase, Serum Total Cholesterol and Serum Triglycerides (Figures 2a-e). Figure 2a shows the result of the activities of the Transaminase Enzyme (AST), Cholesterol, and Triglycerides in the Organs of rats placed on black, herbal and green tea for 14 days. The data shows that the rats fed on Black tea (BTG1, BTG2), Herbal tea (HTG1, HTG2), and green tea (GTG1, GTG2) have varying AST activities (Figure 2a). In the heart, the AST activity was lower in the rats on Herbal and Green tea (1.31±0.30, 1.22±0.22, 1.31±0.25, 1.22±0.21) compared to those fed on Black tea (1.46±0.30, 2.10±0.24). In the liver, the AST activity was highest in the rats fed herbal tea (3.80±0.03a) and lowest in those given black and green tea (1.75±0.00). In the kidney, the AST activity was highest ($p<0.001$) in the rats fed Black tea (2.10±0.94) and lowest in the rats fed herbal tea (0.71±0.43).

In Figure 2b, the ALT activity of rats treated with herbal tea had the highest ALT activity in the heart (2.99±0.23) and liver (2.57±0.14) compared to other groups. The rats given black tea have the lowest ALT activity in the heart (1.45±0.84) and liver (1.75±0.00). In the

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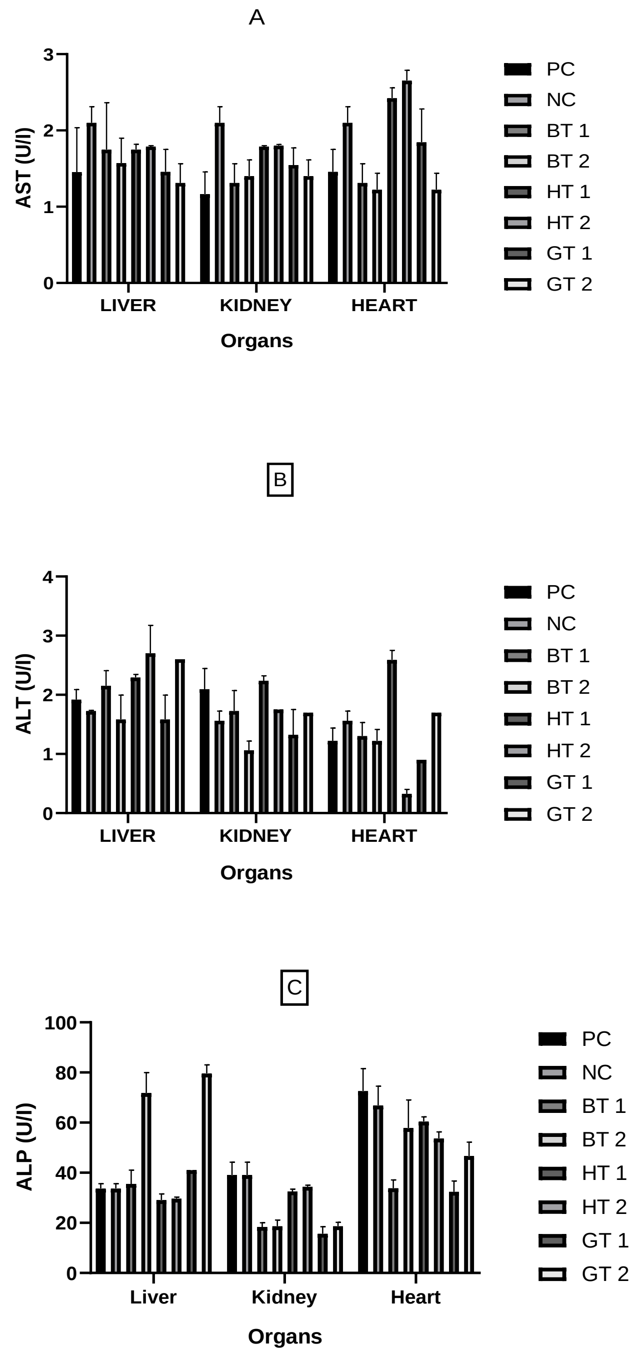
kidney, the rats fed on green tea have the lowest ALT activity (1.06±0.16). Figure 2c shows the LP activity of rats treated with brewed teas. The heart of rats given black tea had the highest ALP activity (78.00±14.53), while in the liver, the rats fed on herbal tea had the highest ALP activity (205±15.09). In the kidney, the given green tea has the highest ALP activity (104.00±12.06).

3.3 Cholesterol levels (Figure 2d). The rats fed on herbal tea have the highest cholesterol levels in the liver (66.67±1.01). The rats given black and green tea had the lowest cholesterol levels in the liver (11.20±1.66, 17.53±0.24). In the heart, the rats fed on green tea had the lowest cholesterol levels (8.41±1.24), and those given herbal tea had the highest (17.50±2.89). In the kidney, the rats fed on Black tea and green tea have the lowest cholesterol levels (10.75±0.32, 13.64±0.32), and the rats fed on herbal tea have the highest (50.00±0.89, 53.33±8.66).

3.4 Triglycerides level (Figure 2e). In the heart, the rats fed on herbal tea had the highest triglyceride levels (254.32±61.20), while the rats given black and green tea had significantly lower (p>0.05) triglyceride levels (134.13±28.95 and 110.22±19.09, respectively).



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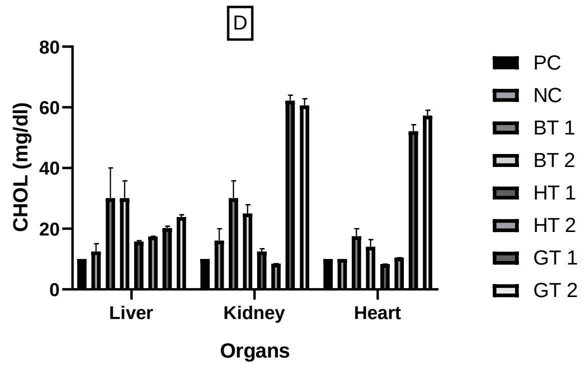

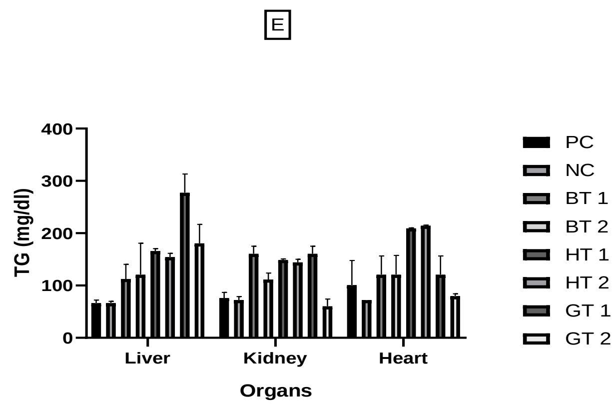

Figure 2(A-E): Effects of black, herbal, and green tea on Transaminase Enzyme, CHOL & Triglycerides*.

*(A), AST (U/L), (B), ALT (U/L) (C), ALP (U/L) (D), CHOL (mg/dl) (E), TG (mg/dl) levels in Wister Rat Organ were estimated by the method described in the Materials and Methods. Data are presented as the mean ± s.e from 6 rats per group. Statistically different from the control group: (a) $p < 0.05$; (b) $p < 0.01$; (c) $p < 0.001$.

3.4 Figure 3a shows the effects of black, herbal, and green tea Serum electrolytes.

3.4.1 Aspartate aminotransferase (AST): When compared to rats fed PC (45.3±33.01), rats given BTG2 (102.50±33.82), HTG1 (206.60±5.94), and HTG2 (207.00±44.55) had considerably higher blood levels of AST enzyme. AST levels significantly decreased in rats administered GTG2 compared to those in the positive control group. ALT (Alanine Aminotransferase) (Figure 2a): When compared to rats given PC (25.66±4.98), rats fed with HTG1 (169. 4±2.57) and DTG2 (160.6 3±1.048) had significantly higher blood levels of the ALT enzyme. Rats who were given BTG1 and BTG2 treatments exhibited lower (p>0.05) ALP levels than the control group. Alkaline phosphatase (ALP): Rats fed on HTG1 (304.40 ± 90.21), HTG2 (247.20 ± 10.7b), GTG1 (137.50± 30.35), and NC (123.20 ± 27.90) had considerably higher blood levels of ALP enzyme than rats fed on PC (119.33±56.88), respectively. Compared to rats treated on PC, animals placed on HTG1, HTG2, and GTG1 had considerably higher blood levels of TC (total cholesterol). Rats

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given BTG1 & GTG2 demonstrated a negligible reduction in TC levels.

3.4.2 Triglycerides (TG) (Figure 3a): When compared to rats given PC, animals treated with BTG2, HTG1, and HTG2 had considerably higher blood levels of TG. Rats given TG1 and GTG1 exhibited a negligible rise in TG levels.

3.4.3 HDL (High-density Lipoprotein) (Figure 3a): Rats fed GTG1 had considerably higher blood levels of HDL than rats fed PC, NC, BTG1, BTG2, GTG2, HTG1, and HTG2 diets. HDL levels significantly dropped in rats given HTG1. Low-density lipoprotein (LDL): Compared to normal rats (PC), rats fed on HTG1 had considerably higher blood levels of LDL. LDL levels increased non-significantly in rats given BTG1 and HTG2; the same was significantly low in NC, BTG1, BTG2, GTG1, GT2, and HTG2 compared to rats in the PC group.

3.4.4 Urea (Figure 3a): Compared to rats placed on PC, rats given HTG1 had considerably $p < 0.05$ higher blood urea levels. Urea levels increased non-significantly in rats placed on HTG2 diets.

3.4.5 Creatinine (Figure 3b): Compared to rats placed on the PC, rats given HTG1, HTG2, and NC had significantly ($p < 0.05$) higher blood creatinine levels.

3.4.6 White blood cells (Figure 3c): When compared to rats placed on PC, rats fed on HTG1 had considerably higher blood levels of WBC. WBC counts increased insignificantly in rats given HTG2. PCV (Packed Cell Volume): The levels of PCV in the blood were significantly increased ($p < 0.05$) in rats placed (GTG1) and (GTG2). Total cholesterol (TC) (mg/dl): Regarding the rats in (HTG1) had the highest levels, followed by the rats in BTG2.TC levels were higher in the rats in the GTG1 than in the Negative Control (NC) group. On the other hand, rats placed on the Negative Control (NC) and Diet Tea Group 2 (HTG2) exhibited decreased ($p < 0.05$) TC levels. Triglycerides (TG) (mg/dl): The rats in the BTG2 group had the highest levels, followed by those in the GTG1 group compared with the rats in the PC group. Rats placed on BTG1 had intermediate TG levels, while rats fed Negative Control (NC) had the lowest TG levels compared to those in the PC. HDL (mg/dl): High-density lipoprotein (HDL), also known as "good cholesterol," was present in the highest concentrations in the rats

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placed on GTG1, while those in the BTG2 group had the lowest HDL levels (p<0.01) whereas those placed in the Negative Control (NC) had the second-highest compared with the normal levels rats (PC). n

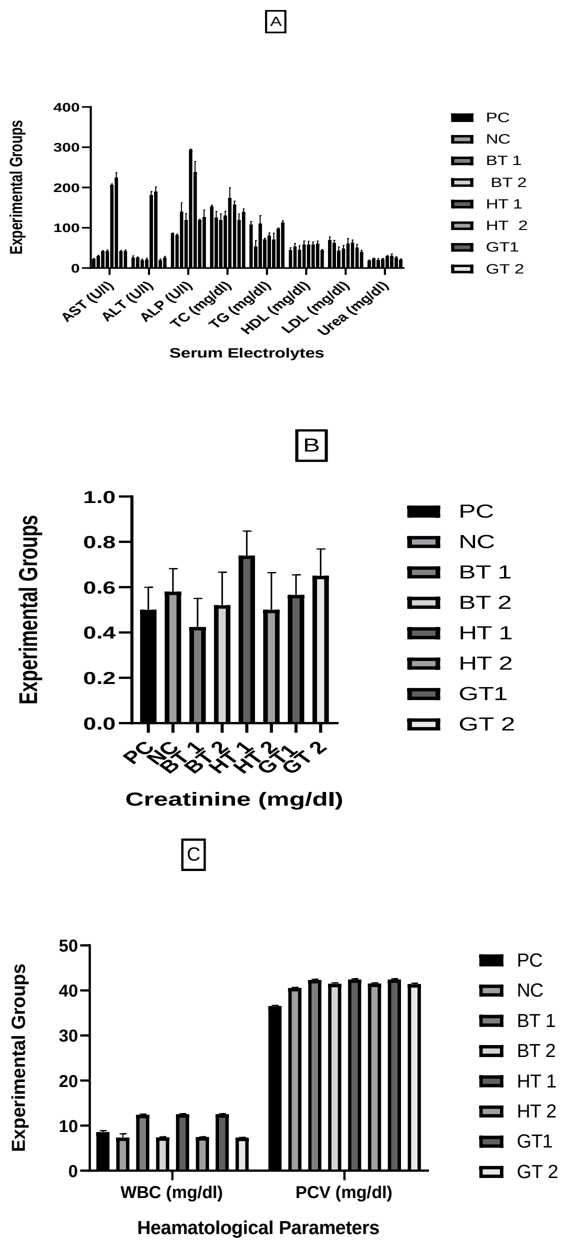

Figure 3(A-C): Effects of black, herbal, and green tea on clinical chemistry and haematological parameter*.

(A), Serum electrolytes (B), creatinine, and (C), and Hematology (mg/dl) levels in Wister Rat Organ were estimated by the method described in the Materials and Methods. Data are presented as the mean ± s.e from 6 rats per group. Statistically different from the control group: (a) $p < 0.05$; (b) $p < 0.01$; (cp < 0.001.

3.5 DISCUSSION

Regarding growth performance (Figure 1), the initial weight of the rats was similar across all groups, while the final weight and weight gain varied among the groups. Rats fed on black tea and green tea showed an increase in weight gain compared to rats in the negative control group, while rats fed on herbal tea did not show a significant difference in weight gain compared to the negative control group. The organ-to-body weight ratio of the rats' hearts, livers, and kidneys was also recorded. The liver had the highest ratio of any organ in this study, indicating it was the most affected organ. The results indicate that rats fed on herbal tea had a significantly higher liver-to-body weight ratio than all other groups.

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The BTG1 and BTG2 groups had a lower liver/body weight ratio than the NC group but a higher ratio than the PC group, indicating that black tea moderately ($p<0.05$) affects liver size. The HTG1 and HTG2 groups had the lowest liver/body weight ratio, which could be attributed to green tea's high antioxidant content, which helps to protect the liver from damage. The GTG1 and GTG2 groups had a lower liver/body weight ratio than the NC group but a higher ratio than the PC group, indicating that green tea may have a moderate effect on liver size. This suggests that herbal tea may impact this more than black or green tea. However, the heart and kidney organ-to-body weight ratio showed no significant differences between the groups.

These findings (Figure 1ai-aii) corroborate previous research on the effects of tea consumption on weight and organ-to-body weight ratio in animal models. According to Zhang et al. (2017), green tea extract supplementation reduced body weight and liver weight in high-fat rats' diets while improving the liver-to-body weight ratio. Tsai et al. (2014) discovered that using black tea extract reduced weight gain and liver fat accumulation in high-fat mice. The table suggests that black and green tea may positively affect weight gain in rats, while herbal tea may have a more significant ($p<0.01$) impact on liver weight than other tea types.

According to the findings (Figure 2a-e), different types of tea have different effects on the activities of transaminase enzymes, cholesterol, and triglycerides in different tissue types. The enzyme AST is found in the liver, heart, and other tissues. Another enzyme found in the liver, bones, and other tissues is ALP activity. Triglycerides are fats found in the blood. In particular, ALT and AST activities were significantly lower in the liver and heart of rats fed black and diet tea than in rats placed on green tea. Furthermore, rats fed black and diet tea had significantly higher cholesterol levels in their livers than those fed green tea.

This finding is consistent with previous research indicating the potential health benefits of tea consumption, such as managing cardiovascular diseases and lipid metabolism. Chen et al. (2015) found that rats fed oolong tea had lower total cholesterol and triglyceride levels. In contrast, Bahram Pourghassem

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Gargari et al. (2015) found that rats fed black tea extract had lower LDL-cholesterol and total cholesterol levels. Li et al. (2015) also discovered decreased AST, ALT, and total cholesterol levels in rats fed green tea extract. These findings suggest that different types of tea may have varying effects on lipid metabolism and liver hydrolysis. Compared to green tea, black and diet tea had lower ALT and AST activities in the liver and heart but higher levels of cholesterol in the liver.

Black tea-fed rats had significantly lower liver and kidney cholesterol levels than the control group. Green tea-fed rats, on the other hand, had significantly lower cholesterol levels in their hearts and livers. Compared to the control group, rats fed green tea had significantly lower levels of triglycerides in their hearts; in contrast, rats fed black tea had significantly higher levels of triglycerides in their hearts and liver. These findings indicate that black and green tea may have health benefits, but their effects on different organs and biomarkers differ. These findings may have significant implications for developing dietary interventions to improve cardiovascular health. On the other hand, high levels of triglycerides in the blood can cause hypertriglyceridemia, a risk factor for heart disease, stroke, and other health problems. According to the findings of this study, drinking green and black tea may help to lower triglyceride levels in the blood, potentially lowering the risk of developing heart disease and other health problems associated with high triglycerides. These findings are consistent with previous research that has suggested that tea consumption may improve lipid metabolism and lower cholesterol levels.

Figure 3a-c depicts the results of a 14-day evaluation of clinical chemistry and haematological parameters in rats fed different types of tea. In the HTG1 and HTG2 groups, AST and ALT values were considerably higher than in the PC and other groups, suggesting potential liver injury. This might be because green tea contains a lot of caffeine and catechins. The GTG1 and HTG1 groups had much greater ALP levels, which may have caused injury to the bones or the liver. Green tea consumption, according to Chen et al. (2018), reduced the levels of the liver enzymes AST and ALT in mice with high-fat diet-induced liver damage. Rats placed on black tea had the most significant ($p<0.55$) level of total

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cholesterol (TC), followed by those fed HTG1 and GTG2, while rats fed NC had the lowest level of TG compared to the rats in the PC group. Compared to the PC & NC groups, TC levels were considerably more significant in the BTG1, GTG1, and HTG1 groups, suggesting a potential rise in the risk of cardiovascular disease. The current study's findings on tea consumption's effects on serum lipid metabolism are consistent with previous research in this area.

Triglycerides, often known as TG, are a form of fat that can be present in the blood. Triglycerides are essential because they are the body's primary source of energy. Figure 3a demonstrates that rats given black tea had the highest ($p<0.001$) level of TG, followed by those given ($p<0.01$) HTG1 and GTG2, whereas rats given NC had the lowest level of TG compared to the rats in the PC group; raising the possibility of cardiovascular illness. Similarly, Kim et al. (2013) discovered that drinking black tea reduced human LDL cholesterol levels. High-density lipoprotein, or "good" cholesterol, has a concentration of mg/dl of HDL. According to the table, rats placed on GTG2 had the second-highest ($p<0.01$) amount of HDL, while rats fed BTG1 had the lowest ($p<0.01$) level of HDL when compared to rats fed PC. Rats in the NC group had the lowest level of HDL when compared to rats fed PC. This suggests that drinking black and green tea may raise HDL cholesterol levels in rats. Previous research supports the current study's conclusion that certain types of tea can benefit liver and lipid metabolism. Furthermore, the current study's findings on kidney function are consistent with previous research suggesting that tea consumption may be nephrotoxic.

Urea (mg/dl): The liver produces urea, which is then eliminated from the body through urine. Figure 3a demonstrates that compared to normal (PC) rats, rats fed BTG1 had the lowest level of urea, followed by those fed HTG1 and HTG2. Rats fed NC had the most significant level of urea. The HTG1 and HTG2 groups had much greater urea levels than the rats in the PC & other groups, which may have been caused by renal injury. Green tea extract caused renal toxicity in rats, according to Abdel-Rahman et al. (2009), which supports the current study's observation of elevated urea and creatinine levels in certain groups. Research suggests drinking black tea might cause rats to have lower urea levels.

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A waste product produced by the muscles and eliminated by the urine is creatinine (mg/dl). According to Figure 3b, rats fed HTG2 had the highest ($p<0.001$) amount of creatinine, followed by that placed on GTG2 than those in the PC group. In contrast, rats BTG1 had the lowest creatinine level compared to those in the PC group, suggesting potential muscle injury. Research implies that drinking black tea may help reduce rats' creatinine levels.

Finally, the current study's haematological parameters are consistent with previous research showing the effects of tea on blood cells. White blood cell count, or WBC (mg/dl), measures the immune system's capacity to combat infection. According to table 3c, rats given GTG1 had the greatest WBC level, followed by those given BTG1. Rats given HTG1 had the lowest ($p>0.001$) level of WBC compared to those given in the positive control group, suggesting a potential immunological response to inflammation or infection. Research implies that drinking green and black tea may help rats have more white blood cells.

Packed cell volume, or PCV (mg/dl), measures the blood's percentage of red blood cells. The table demonstrates that rats fed BTG1 had the lowest level of PCV compared to rats in the positive control group, whereas rats fed HTG1 had the most significant level of PCV. Rats placed in the NC group had the highest level of PCV. This implies that drinking black tea may cause rats' packed cell volume to shrink. The NC group's PCV levels were much more significant ($p < 0.05$) than those of the PC and other groups, suggesting that the blood's capacity to carry oxygen may have improved. Green tea catechins increased red blood cell count and haemoglobin levels in rats, according to Tian et al. (2016), which is consistent with the current study's finding of elevated WBC and PCV levels in certain groups. These findings support the possibility that tea consumption can influence haematological parameters. Overall, the findings imply that the various teas had distinct impacts on the rats' clinical chemical and h values.

Conclusion: Overall, the current study sheds light on the potential effects of various types of tea on various physiological parameters. The findings indicate that black tea consumption has positive and negative effects on various biomarkers, whereas green tea consumption has more consistent positive

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effects. Nonetheless, the current study's findings are consistent with previous research in this area, strengthening the scientific evidence for the health benefits of tea consumption. However, the mechanisms of action and long-term effects of tea consumption on these parameters require further investigation. More research is needed to understand the mechanisms involved fully in these potential health ramifications.

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