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Original Article

Phytochemical Screening and Effects of Parquetina Lemongrass Herbal Tea on Haematological, Serum Biochemical and Histological Parameters in Wistar Rats

Victoria Joshua[1,2], Rowland Kayode[1]*, Mayowa Sanusi[3], Aderinola Awoniyi[4], Olufunmilola Abiodun[1], Bukola Kayode[1]

[1]*Department of Home Economics and Food Science, Faculty of Agriculture, University of Ilorin, Ilorin, Kwara State, Nigeria*

[2]*Department of Science Laboratory Technology, School of Applied Sciences, Kogi State Polytechnic, Lokoja, Kogi State, Nigeria*

[3]*Department of Food Engineering, Faculty of Engineering and Technology, University of Ilorin, Ilorin, Kwara State, Nigeria*

[4]*Department of Chemical Sciences, Faculty of Science, Crown-Hill University, Eiyenkorin, Kwara State, Nigeria*

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Corresponding Email. *rowland@unilorin.edu.ng*

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ABSTRACT

Background and objectives. *Herbal teas are beginning to gain more attraction globally due to their ability to promote health and well-being by virtue of the bioactive compounds in them. This attraction is fostered by consumers' interests in foods that go beyond basic nutrition to provide certain health benefits. This study investigated the effect of a composite herbal tea from Parquetina and Lemongrass on health.* ***Methods.*** *Infusions of five different formulations of Parquetina and Lemongrass at 100:0%, 87.5:12.5%, 75:25%, 62.5:37.5% and 50:50%, were analyzed for their impact on the health of Wistar rats using water as a control.* ***Results.*** *The Wistar rats fed on different formulations of the composite herbal tea showed significant ($P \leq 0.05$) decrease in body weight, blood urea nitrogen, creatinine, alanine transaminase, alanine aspartate, triglycerides, cholesterol, low-density lipoprotein and glucose when compared with control group fed with water. Packed cell volume, red blood cells and haemoglobin levels were significantly ($P \leq 0.05$) increased, while high-density lipoprotein, total protein and feed intake remained unaffected. Histological examinations of the liver and kidney showed no evidence of toxicity. More so, there was no mortality recorded during the period of the study.* ***Conclusion.*** *The findings of this study reveal that parquetina-lemongrass herbal tea has the potential of improving health evidenced by its erythropoietic, anti-diabetic and anti-cholesteremic properties, and its ability to maintain normal liver and kidney functions.*

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INTRODUCTION

Herbal tea is tea made from any other plant other than the tea plant *Camellia sinensis.* It may be prepared from a single plant or from a combination of many plants, whether fresh or dried, and these could include various parts of such plants e.g., leaves, flowers, barks, fruits, nuts, etc. [1]. Preparing the tea brew can be by any of the following methods – decoction, infusion or maceration. Decoction involves boiling the tea leaves in water and decanting the brew. An infusion is made when tea leaves are steeped in hot water and removed after some time. In maceration, tea leaves are soaked in water in air-tight containers and left to stand for a variable time, and then the brew is decanted. Some of the major herbs used singly or in combination for the manufacture of herbal tea include Chamomile (*Matricaria chamomilla*), Ginger (*Zingiber officinale*), Cardamom (*Elettaria cardamomum*), Sage (*Salvia officinalis*), Peppermint (*Mentha piperita*), Thyme (*Thymus vulgaris*), Rosemary (*Salvia rosmarinus*), Lemongrass (*Cymbopogon citratus*) etc. Currently, herbal teas are beginning to gain more attraction globally due to their ability to promote health and well-being. This ability is attributed to the presence of certain bioactive compounds which make these herbs functional in promoting health [2].

Parquetina (*Parquetina nigrescens*) is a member of the Asclepiadaceae family and it is locally known as *Kwankwanin* in Northern Nigeria, *Mgbidim gbe* in Eastern Nigeria and *Ewe ogbo* in Western Nigeria [3]. Parquetina is reported to contain alkaloids, flavonoids, saponins, tannins, cardiac glycosides and terpenoids which account for its medicinal properties. It is also reported to contain minerals like iron, copper, magnesium, manganese and zinc, and vitamins which include retinol, folic acid, cobalamin and ascorbic acid. Though highly underutilized, it is reported to be often employed in traditional medicine in the rural areas for the treatment of anaemia, constipation, diabetes, ulcers, etc. [4-6]. Lemongrass (*Cymbopogon citratus*) is a perennial tall grass belonging to the family Poaceae. It is distinct for its medicinal properties and strong lemon-like flavour. Lemongrass is reported to contain flavonoids, phenolics, terpenoids, alkaloids and tannins, which foster its use in medicine and the food industry. Lemongrass is rich in aromatic essential oils which have high levels of volatile compounds like citral and myrcene, vitamins - thiamine, pantothenic acid and pyridoxine and minerals - potassium, zinc, calcium, iron, magnesium, manganese and copper. Lemongrass is often used in the treatment of fevers, inflammations, nausea, constipation, etc. [7-9].
Parquetina and lemongrass have both been used traditionally to improve the health of consumers through their antioxidant, anticancer, antidiabetic, anti-inflammatory, antihypertensive, analgesic, weight reduction and calming properties. This led to the investigation of the effects of composite herbal tea from Parquetina and Lemongrass on health using Wistar rats as subjects to gather more data on efficacy and safety.

METHODS

Ethical review

Ethical review was obtained from the University of Ilorin Ethical Review Committee and the approval number UERC/ASN/2021/2041 was issued.

Plant materials and processing of composite herbal tea

The leaves of Parquetina and Lemongrass were harvested within Ilorin Metropolis, Kwara, Nigeria. They were identified and authenticated at the Plant Herbarium Unit of the Department of Plant Biology, University of Ilorin, Kwara, Nigeria and given voucher numbers UILH/002/2019/980 and UILH/003/2019/1284, respectively. They were sorted and cleaned before further processing.
The modified method adopted by [10] was used for the production of the composite herbal tea. Fresh leaves were washed and steam-blanched at 100 0C for five minutes and then dried in a cabinet dryer at 40 0C. The dried leaves were milled to a fine powder using an electric Binatone blender. The plant powders were homogenously mixed in a blender to give five formulations of the composite tea powder (Table 1) as obtained using Design Expert (Version 12, Stat-Ease Inc., Minneapolis, USA). The tea powder was packaged in 55 x 75 mm tea bags (1 g/teabag) and stored in opaque glass bottles.

Table 1: Formulations of parquetina-lemongrass herbal tea

Sample code	Parquetina (%)	Lemongrass (%)
$P_{100}L_0$ (control)	100	-
$P_{87.5}L_{12.5}$	87.5	12.5
$P_{75}L_{25}$	75	25
$P_{62.5}L_{37.5}$	62.5	37.5
$P_{50}L_{50}$	50	50

$P_{100}L_0$ (control) = Parquetina only; $P_{87.5}L_{12.5}$ = 87.5% Parquetina and 12.5% Lemongrass; $P_{75}L_{25}$ = 75% Parquetina and 25% Lemongrass; $P_{62.5}L_{37.5}$ = 62.5% Parquetina and 37.5% Lemongrass and $P_{50}L_{50}$ = 50% Parquetina and 50% Lemongrass.

Phytochemical screening

Sample preparation

Infusions were prepared by pouring 100 ml of boiling water over one teabag (i.e. 1 g) of each sample formulation and allowed to infuse for five minutes [11]. Then they were concentrated in a water bath at 50 0C to a quarter of their original volumes.

Test for phenols
The samples were screened for the presence or absence of phenols by the Lead acetate (Pb (C2H3O2)2) method as described by [12]. To 2 ml of samples, 1 ml of 10% Lead acetate solution was added and the mixtures were observed for the formation of white precipitate.

Test for tannins
Using the Ferric chloride ($FeCl_3$) test, 2 ml of the samples were each treated with 1 ml of 0.1% $FeCl_3$ and observed for the formation of a blue-black coloration [13].

Test for cardiac glycosides
Samples were screened for the presence of cardiac glycosides using the Keller-Killani test. 3 ml of samples were each treated with 2 ml of glacial acetic acid (CH3COOH; containing one drop of FeCl3 solution). 1 ml of concentrated Sulfuric acid (H2SO4) was added to the mixture. The formation of a brown ring at the interface indicated the presence of cardiac glycosides [14].

Test for terpenoids
The Salkowki's test was used to screen samples for the presence or absence of terpenoids. 2 ml of samples were each treated with 2 ml of chloroform (CHCl3) and 3 drops of concentrated HCl and they were observed for the development of a red-brown coloration at the interface [14].

Test for alkaloids
One milliliter of samples was each treated with 1 ml of Dragendoff's reagent (solution of Potassium Bismuth Iodide) and an orange precipitate was regarded to indicate the presence of alkaloids [15].

Test for saponins
Three milliliters of the samples were diluted with 2 ml of distilled water and shaken vigorously for two minutes. The formation of a persistent froth indicated the presence of saponins [15].

Test for flavonoids
Three milliliters of the samples were treated with 1 ml of 10% aqueous NaOH solution and they were observed for the formation of yellow colouration which was taken to indicate the presence of flavonoids [15].

Animal housing and treatment
A total of thirty-six adult male Wistar rats were obtained from the Department of Biochemistry, University of Ilorin. They were acclimatized for 7 days before the start of the experiment. The rats were housed in standard polycarbonate cages with wood shavings as beddings in groups of six rats per cage. A 12-hour light-dark cycle, ambient temperature and relative humidity of 50-60% were maintained in the animal laboratory and the rats were fed with standard rat chow and tap water *ad libitum*. The rats were cared for following the guide for the care and use of laboratory animals.

Experimental setup
The rats were randomly divided into six groups with six rats each and were fed the same diet throughout the experimental period of 14 days. Group 'water' (control group): rats fed with only diet and tap water; Group $P_{100}L_0$: rats fed with diet and herbal tea containing 100% Parquetina (control sample); Group $P_{87.5}L_{12.5}$: rats fed with diet and parquetina-lemongrass herbal tea containing 87.5% Parquetina and 12.5% Lemongrass; Group $P_{75}L_{25}$: rats fed with diet and parquetina-lemongrass herbal tea containing 75% Parquetina and 25% Lemongrass; Group $P_{62.5}L_{37.5}$: rats fed with diet and parquetina-lemongrass herbal tea containing 62.5% Parquetina and 37.5% Lemongrass, and Group $P_{50}L_{50}$: rats fed with diet and parquetina-lemongrass herbal tea containing 50% Parquetina and 50% Lemongrass. During the experimental period, cage side behavioral observations, body weight, feed intake and gross morphological changes were recorded as part of the regular check-up [16]. Weight change was calculated in percentage using the formula below.

$$Weight\ change\ (\%) = \frac{Final\ weight - Initial\ weight}{Initial\ weight} \times 100$$

Tea administration
Infusions were prepared daily by pouring 100 ml of boiling water over 1 teabag for five minutes, allowed to cool to ambient temperature and then given to the rats as their sole source of drinking water [17].

Laboratory investigations
At the end of the 21 days, the overnight fasted rats were sacrificed under anesthesia (Diethyl ether). Blood samples were collected by cardiac puncture into Ethylene Diamine Tetra-acetic Acid (EDTA) and sterile plain bottles for haematological and serum biochemical studies, respectively. The abdominal cavities of the rats were opened to excise the liver and kidney for histological examinations.

Haematological studies
The EDTA blood samples were used for haematological investigations using an automated haematological analyzer (Sysmex KX-21, Japan) for the measurement of haemoglobin (Hb) levels, total count of red blood cells (RBC) and white blood cells (WBC), and packed cell volume (PCV).

Serum biochemical studies
The blood samples in the sterile plain bottles were allowed to clot and serum was prepared by centrifugation at 3000 rpm for 15 minutes. Selected serum biochemical parameters measured include total glucose, total protein, low-density lipoprotein (LDL), high-density lipoprotein (HDL), alanine aminotransferase (ALT), aspartate aminotransferase (AST), creatinine, total cholesterol, blood urea nitrogen (BUN) and total triglycerides using a fully automated biochemical analyzer (Chemray 240, India).

Histological examinations
Harvested organs were trimmed of adherent tissues and cleaned using physiological saline solution. The organs were weighed and fixated in 10% neutral buffered formalin. The tissues were embedded in paraffin wax, sectioned to a thickness of 5 µm and stained using Hematoxylin and eosin dyes. Tissues were mounted on glass slides and examined under a light microscope for inflammations, scarring, fibrosis, haemorrhage, lymphocytic infiltration morphology [5].

Statistical analysis
Results are expressed as the mean of two replicates ± standard deviation (SD) and analyzed using One-way ANOVA. Significant differences between means were assessed by the Duncan Post Hoc test, and $P \leq 0.05$ was considered statistically significant. Statistical analysis was done using Statistical Package for the Social Sciences (SPSS) software, version 20 (SPSS Inc., Chicago, IL, USA).

RESULTS

Phytochemical composition
Phytochemical screening of parquetina-lemongrass herbal tea samples (Table 2) showed that phenols, flavonoids, alkaloids, saponins, terpenoids, tannins and cardiac glycosides were all present.

Table 2: Phytochemicals screening of parquetina-lemongrass herbal tea

Samples	Phenols	Saponins	Tannins	Alkaloids	Flavonoids	Terpenoids	Cardiac glycosides
$P_{100}L_0$ (control)	+	++	+	+	+	+	++
$P_{87.5}L_{12.5}$	+	++	+	+	++	+	++
$P_{75}L_{25}$	++	+	+	++	++	+	+
$P_{62.5}L_{37.5}$	++	+	++	++	++	++	+
$P_{50}L_{50}$	++	+	++	++	++	++	+

++ means moderately present, + means mildly present; $P_{100}L_0$ (control) = herbal tea containing only Parquetina; $P_{87.5}L_{12.5}$ = composite herbal tea containing 87.5% of Parquetina and 12.5% of Lemongrass; $P_{75}L_{25}$ = composite herbal tea containing 75% of Parquetina and 25% of Lemongrass; $P_{62.5}L_{37.5}$ = composite herbal tea containing 62.5% of Parquetina and 37.5% of Lemongrass; $P_{50}L_{50}$ = composite herbal tea containing 50% of Parquetina and 50% of Lemongrass.

Body weight and feed intake

The initial body weights of the rats ranged from 154.17 ± 3.49 to 156.67 ± 3.27 g with the control group 'water' and group $P_{100}L_0$ having the lowest and highest values, respectively (Table 3). Initial body weights of the groups were not significantly *($P \geq 0.05$)* different. After 14 days of feeding the rats with parquetina-lemongrass herbal tea, the final body weights ranged from 152.50 ± 3.73 to 183.50 ± 4.59 g, with groups $P_{87.5}L_{12.5}$ and control group 'water' having the lowest and highest values, respectively. All the treated groups ($P_{100}L_0 - P_{50}L_{50}$) were significantly (*$P \leq 0.05$*) different from the control group 'water'. Percentage weight change revealed that there was a weight loss in groups $P_{100}L_0$ and $P_{87.5}L_{12.5}$, while the other treated groups experienced weight gains. However, their weight gains were significantly (*$P \leq 0.05$*) lower than that of the control group 'water'.

The mean feed intake of the groups through the experimental period was not significantly (*$P \geq 0.05$*) different (Figure 1).

Table 3: Effect of administering parquetina - lemongrass herbal tea on the body weight of wistar rats

Body weight		**Groups**					
		'Water'	**$P_{100}L_0$**	**$P_{87.5}L_{12.5}$**	**$P_{75}L_{25}$**	**$P_{62.5}L_{37.5}$**	**$P_{50}L_{50}$**
IBW (g)		154.17 ± 3.49	156.67 ± 3.27	154.33 ± 4.13	154.83 ± 3.31	154.50 ± 3.83	154.80 ± 3.92
FBW (g)		183.50^{a} ± 4.59	151.02^{c} ± 2.58	152.50^{bc} ± 3.73	156.50^{bc} ± 4.46	158.33^{b} ± 8.50	158.67^{b} ± 4.46
WC (%)		19.02	-3.61	-1.19	1.08	2.48	2.50

Values are expressed as mean ± S.D (n = 3). Means with different superscripts are significantly (P≤0.05) different. IBW: initial body weight, FBW: final body weight, WC: weight change. Water: control group fed with only diet and tap water; $P_{100}L_0$: rats fed with diet and tea containing only Parquetina (control sample); $P_{87.5}L_{12.5}$: rats fed with diet and herbal tea containing 87.5% Parquetina and 12.5% Lemongrass; $P_{75}L_{25}$: rats fed with diet and herbal tea containing 75% Parquetina and 25% Lemongrass; $P_{62.5}L_{37.5}$: rats fed with diet and herbal tea containing 62.5% Parquetina and 37.5% Lemongrass; $P_{50}L_{50}$: rats fed with diet and herbal tea containing 50% Parquetina and 50% Lemongrass

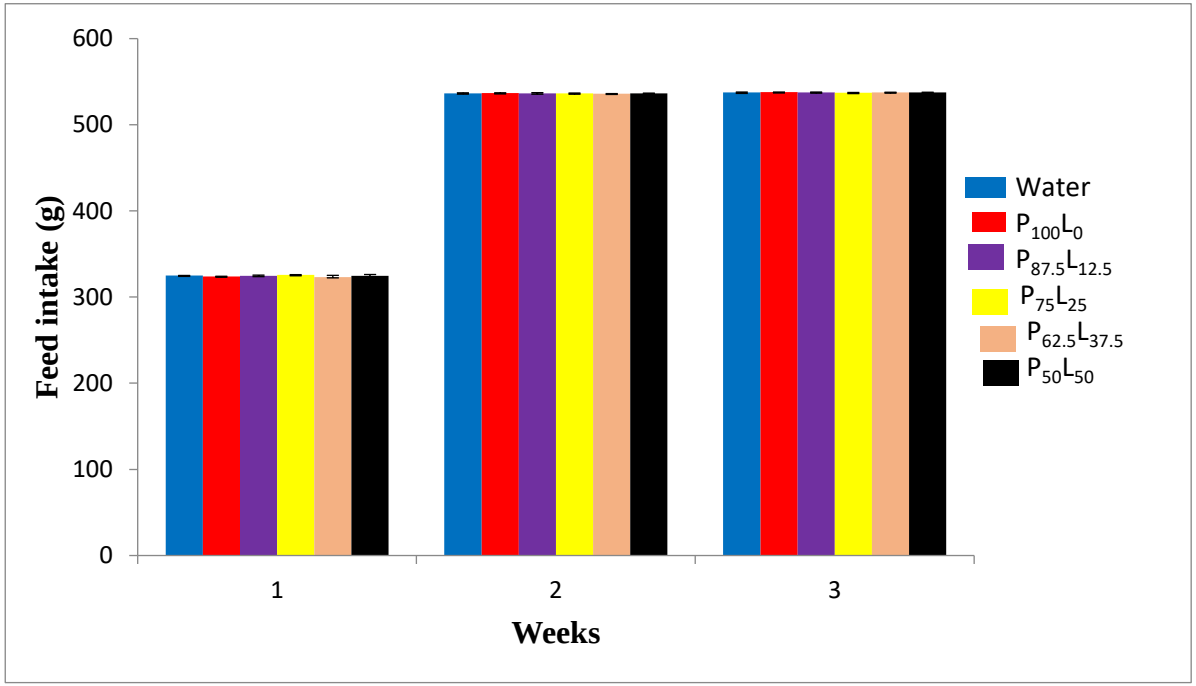

Figure 1: Effect of parquetina - lemongrass herbal tea on the feed intake of wistar rats

Values expressed as mean ± S.D (n = 3). Means with different superscripts are significantly (P≤0.05) different. Water: control group fed with only diet and tap water; $P_{100}L_0$: rats fed with diet and tea containing Parquetina only (control sample); $P_{87.5}L_{12.5}$: rats fed with diet and herbal tea containing 87.5% Parquetina and 12.5% Lemongrass; $P_{75}L_{25}$: rats fed with diet and herbal tea containing 75% Parquetina and 25% Lemongrass; $P_{62.5}L_{37.5}$: rats fed with diet and herbal tea containing 62.5% Parquetina and 37.5% Lemongrass; $P_{50}L_{50}$: rats fed with diet and herbal tea containing 50% Parquetina and 50% Lemongrass.

Behavioral and gross morphological changes

No behavioral changes were observed in any of the groups. Furs were well laid and no mortality was recorded in this study.

Haematological parameters

The haematological investigation of the effect of Parquetina-lemongrass herbal tea is represented in Table 4. This included parameters like packed cell volume (PCV), red blood cell (RBC) counts, white blood cell (WBC) counts and haemoglobin (Hb) levels. The results (Table 4) show that PCV ranged from 31.59 ± 0.09 to 40.25 ± 0.11%, with the control group 'water' and the treatment group $P_{100}L_0$ having the lowest and highest values, respectively. All groups are significantly (*P≤0.05*) different from the control group 'water'. WBC values ranged from 9.9 ± 0.14 to 11.3 ± 1.27× 10^9/L, with group $P_{50}L_{50}$ and 'water' having the lowest and highest values, respectively. No significant *(P≥0.05)* difference was observed. RBC values varied from 5.86 ± 0.04 to 10.94 ± 0.01 × 10^{12}/L, with groups 'water' and $P_{100}L_0$ having the lowest and highest values, respectively. The treated groups are significantly (*P≤0.05*) different from the control group 'water'. Haemoglobin levels ranged from 6.96 ± 0.02 to 11.12 ± 0.13g/dl, with groups 'water' and $P_{100}L_0$ having the lowest and highest values, respectively. The control group 'water' is significantly (*P≤0.05*) different from the treated groups.

Table 4: Effect of parquetina - lemongrass herbal tea on haematological parameters of wistar rats

Parameters	Groups					
	'Water'	**$P_{100}L_0$**	**$P_{87.5}L_{12.5}$**	**$P_{75}L_{25}$**	**$P_{62.5}L_{37.5}$**	**$P_{50}L_{50}$**
PCV (%)	31.59^e ± 0.09	40.25^a ± 0.11	37.47^b ± 0.32	36.42^c ± 0.19	35.40^d ± 0.18	34.97^d ± 0.05
WBC (× 10^6/L)	11.3 ± 1.27	10.85 ± 1.06	10.30 ± 0.71	10.5 ± 0.42	10.05 ± 0.49	9.9 ± 0.14
RBC (× 10^{12}/L)	5.86^e ± 0.04	10.94^a ± 0.01	10.19^b ± 0.05	9.55^c ± 0.23	7.17^d ± 0.04	6.97^d ± 0.01
Hb	6.96^e ± 0.02	11.12^a ± 0.13	10.87^b ± 0.06	9.56^c ± 0.01	9.33^d ± 0.04	9.23^d ± 0.06

Values expressed as mean ± S.D (n = 3). Means with different superscripts across a row are significantly (P≤0.05) different. PCV: packed cell volume, WBC: white blood cells, RBC: red blood cells, Hb: haemoglobin. 'Water': control group fed with only diet and tap water; $P_{100}L_0$: rats fed with diet and tea containing only Parquetina (control sample); $P_{87.5}L_{12.5}$: rats fed with diet and herbal tea containing 87.5% Parquetina and 12.5% Lemongrass; $P_{75}L_{25}$: rats fed with diet and herbal tea containing 75% Parquetina and 25% Lemongrass; $P_{62.5}L_{37.5}$: rats fed with diet and herbal tea containing 62.5% Parquetina and 37.5% Lemongrass; $P_{50}L_{50}$: rats fed with diet and herbal tea containing 50% Parquetina and 50% Lemongrass.

Serum biochemical parameters

The effect of parquetina-lemongrass tea samples on the serum biochemical parameters of the rats is represented in Table 5. Blood urea nitrogen (BUN) ranged from 5.70 ± 0.57 to 11.00 ± 0.99 mmol/L while creatinine ranged from 80.00 ± 12.70 to 136.50 ± 16.30 mmol/L. The treated groups were significantly (*P≤0.05*) different from the control group 'water' in both parameters. Alanine transaminase (ALT) ranged between 27.00 ± 0 and 46.00 ± 1.41 mmol/L and aspartate transaminase (AST) ranged from 46.50 ± 2.12 to 62.50 ± 2.12 mmol/L. A significant (*P≤0.05*) difference was observed between the treated groups and the control group 'water'. Total protein ranged from

68.0 ± 11.31 to 84.0 ± 14.14 mmol/L. Values for all groups were quantitatively different but not significantly (*P≤0.05*) different. Total triglycerides (0.90 ± 0.00 – 1.50 ± 0.28 mmol/L), total cholesterol (2.30 ± 0.28 – 5.90 ± 0.28 mmol/L) and LDL (1.05 ± 0.21 – 3.85 ± 0.64 mmol/L) were observed to significantly (*P≤0.05*) decrease in the treated groups ($P_{100}L_0$ – $P_{50}L_{50}$) in comparison with the control group 'water'. HDL (0.75 ± 0.07 – 1.00 ± 0 mmol/L) quantitatively increased but no significant (*P≤0.05*) difference was observed in all groups. Blood glucose varied from 0.90 ± 0.14 to 4.95 ± 0.35 mmol/L with a significant (*P≤0.05*) decrease in the treated groups as compared to the control group.

Table 5: Effect of parquetina - lemongrass herbal tea on serum biochemical parameters of wistar rats

Parameters	**Groups**					
(mmol/L)	**Water**	**$P_{100}L_0$**	**$P_{87.5}L_{12.5}$**	**$P_{75}L_{25}$**	**$P_{62.5}L_{37.5}$**	**$P_{50}L_{50}$**
BUN	$11.0^{a} \pm 0.99$	$8.35^{b} \pm 0.35$	$7.0^{bc} \pm 0.28$	$6.45^{bc} \pm 0.92$	$6.2^{bc} \pm 1.70$	$5.7^{c} \pm 0.57$
Creatinine	$136.5^{a} \pm 16.3$	$109.0^{b} \pm 4.25$	$113.0^{b} \pm 0.00$	$103.0^{bc} \pm 4.25$	$80^{c} \pm 12.7$	$90.5^{bc} \pm 13.43$
ALT	$46.0^{a} \pm 1.41$	$40.0^{b} \pm 1.41$	$39.5^{bc} \pm 10.60$	$29.5^{bc} \pm 4.95$	$28.5^{bc} \pm 0.71$	$27.0^{c} \pm 0.00$
AST	$62.5^{a} \pm 2.12$	$55.5^{b} \pm 4.95$	$55.5^{b} \pm 7.07$	$54.5^{b} \pm 0.71$	$49.5^{b} \pm 7.78$	$46.5^{b} \pm 2.12$
Triglycerides	$1.5^{a} \pm 0.28$	$1.1^{b} \pm 0.00$	$1.05^{b} \pm 0.21$	$1.0^{b} \pm 0.14$	$0.9^{b} \pm 0.00$	$0.9^{b} \pm 0.14$

Values expressed as mean ± S.D (n = 3). Values with different superscripts across a row are significantly (P≤0.05) different. BUN: blood urea nitrogen; ALT: alanine transaminase; AST: aspartate transaminase. Water: control group fed with only diet and tap water; $P_{100}L_0$: rats fed with diet and tea containing only Parquetina (control sample); $P_{87.5}L_{12.5}$: rats fed with diet and herbal tea containing 87.5% Parquetina and 12.5% Lemongrass; $P_{75}L_{25}$: rats fed with diet and herbal tea containing 75% Parquetina and 25% Lemongrass; $P_{62.5}L_{37.5}$: rats fed with diet and herbal tea containing 62.5% Parquetina and 37.5% Lemongrass; $P_{50}L_{50}$: rats fed with diet and herbal tea containing 50% Parquetina and 50% Lemongrass.

Table 5 cont'd: Effect of parquetina - lemongrass herbal tea on serum biochemical parameters of wistar rats

Parameters		**Groups**					
(mmol/L)		**Water**	**$P_{100}L_0$**	**$P_{87.5}L_{12.5}$**	**$P_{75}L_{25}$**	**$P_{62.5}L_{37.5}$**	**$P_{50}L_{50}$**
Cholesterol		$5.9^{a} \pm 0.28$	$3.8^{b} \pm 0.42$	$4.0^{b} \pm 0.14$	$2.9^{c} \pm 0.28$	$2.3^{c} \pm 0.28$	$2.4^{c} \pm 0.57$
LDL		$3.85^{a} \pm 0.64$	$2.7^{b} \pm 0.28$	$2.6^{b} \pm 0.42$	$1.5^{c} \pm 0.00$	$1.4^{c} \pm 0.28$	$1.05^{c} \pm 0.21$
HDL		$0.75^{a} \pm 0.07$	0.95 ± 0.07	0.90 ± 0.14	0.95 ± 0.07	0.95 ± 0.21	1.0 ± 0.00
Glucose		$4.95^{a} \pm 0.35$	$1.92^{b} \pm 0.26$	$1.15^{bc} \pm 0.07$	$1.05^{c} \pm 0.49$	$1.0^{c} \pm 0.42$	$0.90^{c} \pm 0.14$
Protein		68.0 ± 11.31	83.0 ± 0.00	84.0 ± 14.14	78.5 ± 6.37	71.5 ± 2.12	82.5 ± 4.95

Values expressed as mean ± S.D (n = 3). Values with different superscripts across a row are significantly (P≤0.05) different. LDL: low density lipoprotein; HDL: high density lipoprotein. Water: Control group fed with only diet and tap water; $P_{100}L_0$: rats fed with diet and tea containing only Parquetina (control sample); $P_{87.5}L_{12.5}$: rats fed with diet and herbal tea containing 87.5% Parquetina and 12.5% Lemongrass; $P_{75}L_{25}$: rats fed with diet and herbal tea containing 75% Parquetina and 25% Lemongrass; $P_{62.5}L_{37.5}$: rats fed with diet and herbal tea containing 62.5% Parquetina and 37.5% Lemongrass; $P_{50}L_{50}$: rats fed with diet and herbal tea containing 50% Parquetina and 50% Lemongrass.

Histological parameters

Histological examinations (Figures 2 - 13) showed that the examined organs (liver and kidney) for all groups had well-preserved cytoarchitecture. Liver tissues (Figures 2 - 7) had well preserved lobular architecture with cords of hepatocytes connecting the portal tracts in the periphery to the central veins. There are no evidence of inflammations and no degenerative changes in the hepatocytes. Kidney tissues (Figures 8 - 13) contained numerous normal glomeruli and proximal and distal convoluted tubules. There are no changes in the glomeruli and no tubular necrosis or inflammation in the interstitium.

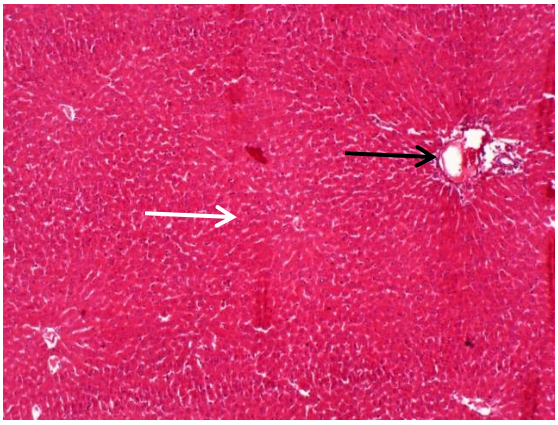

Figure 2: Photomicrograph of liver from rats in the control group administered water (H and E, ×40)

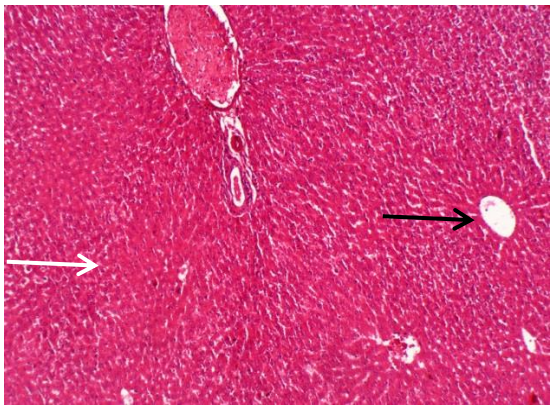

Figure 3: Photomicrograph of liver from rats administered $P_{100}L_0$ – 100% parquetina herbal tea (H and E, ×40)

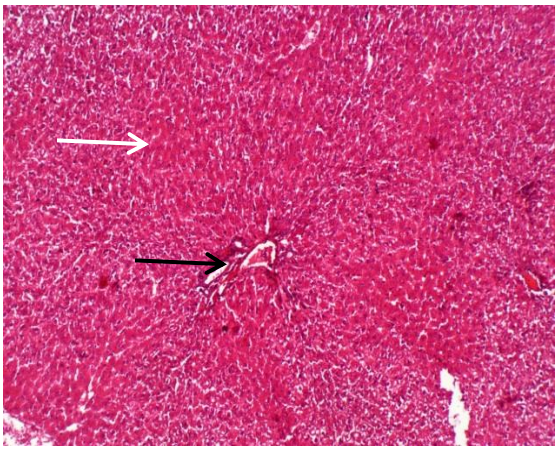

Figure 4: Photomicrograph of liver from rats administered $P_{87.5}L_{12.5}$ – 87.5% parquetina and 12.5% lemongrass herbal tea (H and E, ×40)

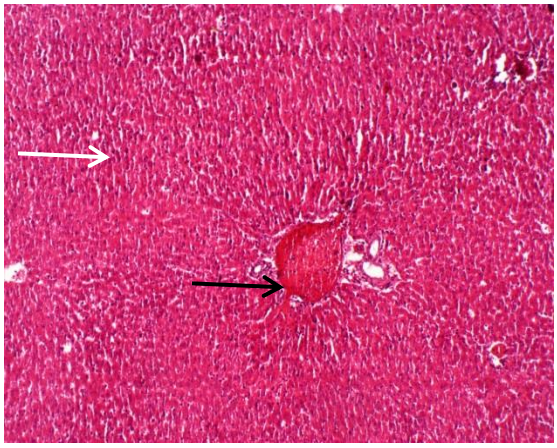

Figure 5: Photomicrograph of liver from rats administered $p_{75}l_{25}$ – 75% parquetina and 25% lemongrass herbal tea (H and E, ×40)

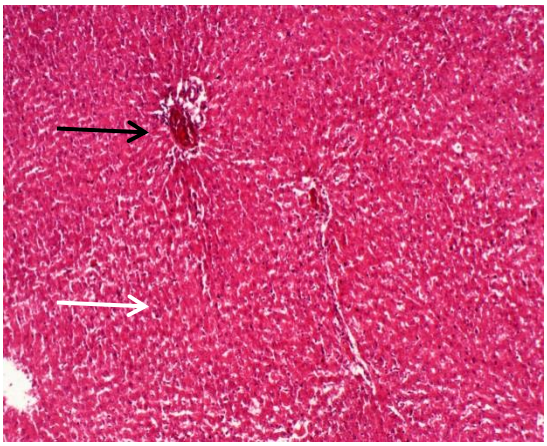

Figure 6: Photomicrograph of liver from rats administered $p_{62.5}l_{37.5}$ – 62.5% parquetina and 37.5% lemongrass herbal tea (H and E, ×40)

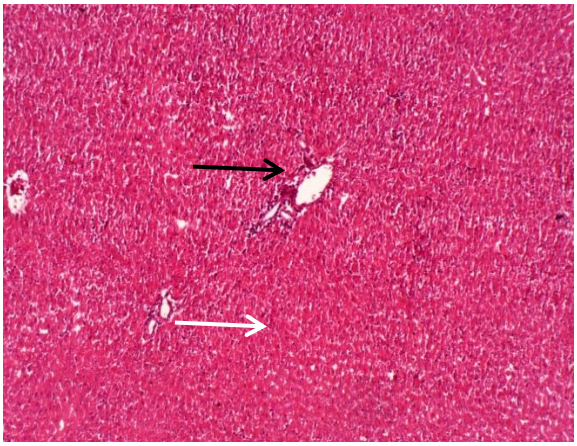

Figure 7: Photomicrograph of liver from rats administered $p_{50}l_{50}$ – 50% parquetina and 50% lemongrass herbal tea (H and E, ×40)

Black arrow = central vein; white arrow = hepatocytes. H and E = Hematoxylin-eosin. ×40 = magnification.

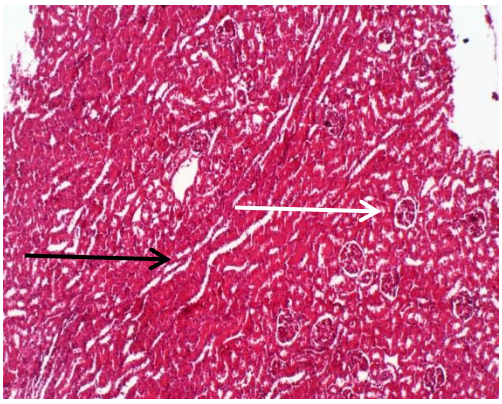

Figure 8: Photomicrograph of kidney from rats in the control group administered water (H and E, ×40)

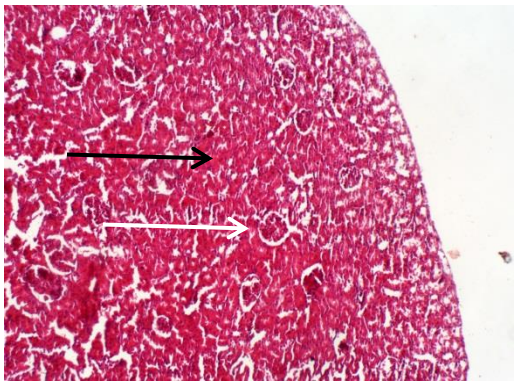

Figure 9: Photomicrograph of kidney from rats administered $p_{100}l_0$ – 100% parquetina herbal tea (H and E, ×40)

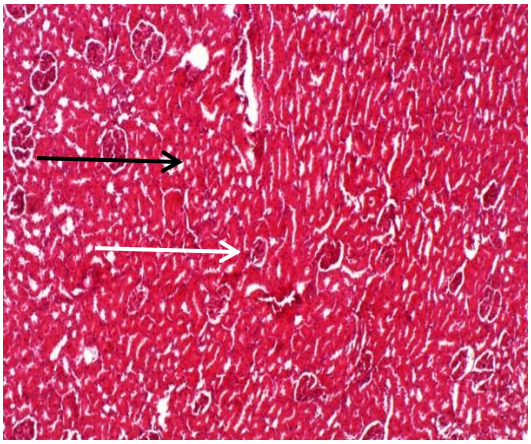

Figure 10: Photomicrograph of kidney from rats administered $p_{87.5}l_{12.5}$ – 87.5% parquetina and 12.5% lemongrass herbal tea (H and E, ×40)

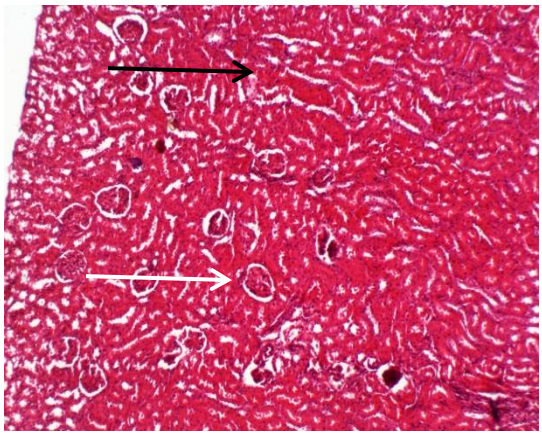

Figure 11: Photomicrograph of kidney from rats administered $p_{75}l_{25}$ – 75% parquetina and 25% lemongrass herbal tea (H and E, ×40)

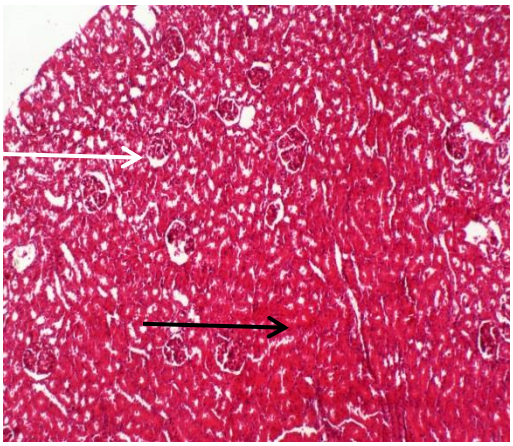

Figure 12: Photomicrograph of kidney from rats administered $p_{62.5}l_{37.5}$ – 62.5 % parquetina and 37.5% lemongrass herbal tea (H and E, ×40)

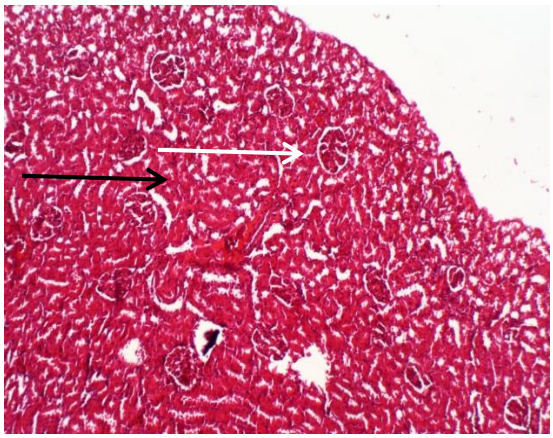

Figure 13: Photomicrograph of kidney from rats administered $p_{50}l_{50}$ – 50% parquetina and 50% lemongrass herbal tea (H and E, ×40)

Black arrow = tubules; white arrow = corpuscle. H and E = Hematoxylin-eosin. ×40 = magnification.

DISCUSSION

Phytochemicals are secondary plant metabolites which have been reported to play certain functions in the body, including acting as anti-inflammatory, anti-carcinogenic, anti-mutagenic, anti-diabetic, analgesic, anti-ulcer, anti-hypertensive agents. In this study, the phytochemical screening showed the presence of phenols, flavonoids, alkaloids, terpenoids, saponins, tannins and cardiac glycosides in the parquetina-lemongrass herbal tea samples. This is in agreement with the works of several reporters like [4] and [5] who reported that the leaves of Parquetina contained

the above listed phytochemicals. Also, [7], [8] and [18], have mentioned that Lemongrass contained the above listed phytochemicals with the exception of cardiac glycosides.

The weight loss observed in the treated groups as against the control group is evidence that parquetina-lemongrass herbal tea is capable of limiting weight gain and this outcome is expected as Parquetina extract has been reported to cause a decrease in body weight. This may probably be by lowering lipogenesis as mentioned by.[19] The effect of parquetina-lemongrass herbal tea samples on body weight is seen to reduce with decreasing amounts of Parquetina in the sample formulations. This can be attributed to the increasing amounts of Lemongrass in the sample formulations as Lemongrass has been reported to improve weight gain,[20] and this is probably why sample P100L0 had the most effect on body weight.

Parquetina-lemongrass herbal tea did not affect the feed intake of the rats treated with the samples in comparison to the control group which did not receive any of the tea samples. This was expected as Parquetina has been reported to have no significant effect on feed intake.[5] There is no information on the effect of Lemongrass on the feed intake of rats, but [21] documented that Lemongrass had no significant effect on the feed intake of Broilers.

The assessment of haematological parameters is often used in the diagnosis of the adverse effects of compounds on blood constituents. RBC is the fraction of whole blood that is packed with the Oxygen-carrying protein – haemoglobin, a decrease in RBC is often associated with the development of anaemia. PCV is the percentage of RBC in relation to the volume of the whole blood. Low PCV is often used as a cue to suspect cases of anaemia. Haemoglobin is an intracellular protein in the RBC, necessary for the transport of Oxygen to tissues and the transport of Carbon (iv) oxide from tissues to the lungs. A decrease in Hb levels may be due to haemorrhage, or accelerated blood cell destruction, leading to anaemia.[22] In this present study, parquetina-lemongrass herbal tea samples significantly ($P \leq 0.05$) increased PCV, RBC and Hb levels of the treated groups as compared to the control group. This is an indication that the samples have hematopoietic properties which may be attributed to the presence of hematopoietic stimulating compounds in the samples. On the contrary, there was a non-significant $(P \geq 0.05)$ decrease in the white blood cell (WBC) levels of the treated groups as compared to the control group. However, the mechanism for this action is not clear. This is similar to the findings of [23] and [24] whose findings show the same trends for Parquetina, and [25] who reported the same trend for Lemongrass.

BUN and creatinine are important kidney markers used to judge kidney health. The kidney is responsible for the excretion of metabolic wastes like urea and creatinine, thus, maintaining the optimum chemical composition of body fluids. When the kidney is damaged or impaired, the concentrations of these wastes increase in the blood.[26] The liver is responsible for the metabolism of protein, fat and carbohydrate, synthesis and secretion of bile and the detoxification of metabolic wastes. ALT, AST and total proteins are used as markers to analyse liver health. Normally, ALT and AST are found in the hepatocytes and their concentration in the blood is low. Elevated levels of ALT, AST and total protein is indicative of liver damage or impairment.[27] The lipid profile of the serum assesses four major parameters – triglycerides, cholesterol, low-density lipoprotein (LDL) and high-density lipoprotein (HDL). These are used as markers for lipid metabolism dysfunction, risks of cardiovascular diseases and cancers.[28] Triglycerides are fatty substances in the bloodstream usually obtained from ingested foods and used for the storage of excess energy. Cholesterol is a fat-like substance produced by the body. It plays a major role in the synthesis of vitamin D, bile and steroid hormones e.g. oestrogen and testosterone. Cholesterol is usually transported in lipoproteins. LDL ('bad cholesterol') transports cholesterol to tissues, leading to the accumulation of fat molecules in blood vessels. HDL ('good cholesterol') transport cholesterol away from blood and tissues to the liver for detoxification and removal. High concentrations of triglycerides, cholesterols and LDL are indicative of the risks of cardiovascular diseases, lipid metabolism dysfunction and cancers.[29] Glucose is the chief source of energy in living organisms. However, elevated levels in the bloodstream are often indicative of hyperglycaemia.[30] The findings reported in this study indicate that parquetina-lemongrass herbal tea samples significantly ($P \leq 0.05$) decreased BUN, creatinine, ALT, AST, triglycerides, cholesterol, LDL and glucose levels in the treated groups (P100L0 – P50L50) as compared to the control group ('water'). HDL and total Protein remained unaffected. This, however, is contrary to earlier research which reported that Parquetina extract caused no significant changes to the creatinine, ALT and AST levels of Wistar rats [31] and that Lemongrass had no significant effect on ALT, AST, total protein and BUN of Wistar rats [25], but similar to the reports of [32] and [20], whose findings are in agreement with the findings reported in this study for Parquetina and Lemongrass, respectively.

Histopathological examinations showed that the examined organs (liver and kidney) had well preserved cytoarchitecture in all the groups. By inference, the parquetina-lemongrass herbal tea samples had no detrimental effects on liver and kidney functions. This is in accordance with the report of [33] who conducted similar research on Lemongrass, and [32] who did the same with Parquetina.

CONCLUSION

This study investigated the effects of Parquetina-Lemongrass herbal tea on the health of Wistar rats. The findings of this study show that a composite herbal tea from Parquetina and Lemongrass has the potential of improving health evidenced by its erythropoietic, anti-diabetic and anti-cholesteremic properties, and its ability to maintain normal liver and kidney functions. The sample with the most impact on health was sample $P_{50}L_{50.}$ This can be attributed to the synergism between the two plants. Therefore, composite herbal tea from Parquetina and Lemongrass is an option for consumers looking for foods with health-promoting properties.

Disclaimer

The article has not been previously presented or published, and is not part of a thesis project.

Conflict of Interest

There are no financial, personal, or professional conflicts of interest to declare.

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