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Effect of Oral Administration of "Gadagi" Tea on Liver Function in Rats

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Abstract**—**Effect of oral administration of "Gadagi" tea on liver function was assessed on 50 healthy male albino rats which were grouped and administered with different doses(mg/kg) i.e low dose (380mg/kg, 415mg/kg, 365mg/kg, 315mg/kg for "sak", "sada" and "magani" respectively), standard dose (760mg/kg, 830mg/kg, 730mg/kg for "sak', "sada" and "magani" respectively) and high dose (1500mg/kg, 1700mg/kg and 1460mg/kg for "sak'',"sada" and "magani" groups respectively) for a period of four weeks. Animals that were not administered with the tea constituted the control group. At the end of fourth week, the animals were sacrificed and their serum alanine aminotransferase (ALT), aspartate aminotransferase (AST), alkaline phosphatase (ALP), total protein (TP), albumin (ALB), and globulins (GLO) were determined. Mean serum ALT and ALP activities were significantly higher ($P<0.05$) in rats orally administered with high dose of "sak" and those administered with standard dose of "sada" than those of the control group, suggesting a probable impairment of liver function due to liver cytolysis.Mean serum AST, ALT and ALP activities were significantly lower ($P<0.05$) in rats that were orally administered with high dose of "magani" than that of the control group, suggesting a probable improvement in liver function (due to decrease in liver cytolysis). Mean serum TP, ALB and GLO levels were significantly higher ($P<0.05$) in rats that were orally administered with the various doses of"sak", "sada" and "magani" than those of the control group. This also suggests a probable improvement in the synthetic function of the liver.Thus, some dosages of "sak" and "sada could be hepatotoxic, whereas "magani" especially at the high dose administered could have pharmacologically positive effect on the liver of the rats.

Keywords**—** "Gadagi" tea, Liver function, Oral, Rats.

I. Introduction

LIVER is the largest internal organ of the body. It plays a central role in transforming and clearing chemicals and is susceptible to toxicity from these agents. Certain medicinal agents when taken in overdoses and sometimes even when introduced within the therapeutic ranges may injure the organ. Other chemical agents such as those used in laboratories and industries, natural chemicals (e.g. microcystins) and herbal remedies can also induce hepatoxicity [1].

"Gadagi" tea is a special type of tea prepared and sold to various people engaged in strenuous jobs to achieve different purposes such as stimulation, medication, agitation and total ability to endure any hardship involved in goal attainments. It is a concoction of several herbs and shrubs, which is believed to posses so many medicinal value by the users. All herbs contain substances that may cause undesirable side effects or interact with medication [2]. There are three major types of "Gadagi" tea, viz:

1."Sak"/baki: This is a mixture of sugar (76g), highland tea (5.69g) and mint plant (0.3g) boiled together in water (1 liter).

2. "Sada": This is a mixture of sugar (114g), highland tea (5.69g), ginger (4.40g), lemon grass (0.30g), mint plant (0.30g) and negropepper (0.34g) boiled together in water (1 liter).

3. "Magani": This is a mixture of sugar (76g), highland tea (5.69g), leaves of *Citrus aurantiifollia* (3.50g), garlic (1.00g), chips of African mahogany (3.80g), mango leaves (2.50g), *Thonningi sanginue* (0.80g) and leaves of river red gum (2.50g) boiled together in water (1 liter).

Other types include, garlic/herbal, ginger, "gahwa", and "shayi da magani". The component of each varies from one individual producer to another.

In addition, there are some special types called 'cockroach' and even 'bastard'. The 'cockroach' type is "Gadagi" tea with high concentration of Nescafe. The bastard type has high concentration of Alabukun. Also, there is another type of "Gadagi" tea which is boiled with a plant called *Wiltheria indica* ("Hankufa" in Hausa) which makes its consumers feel much stronger. Therefore, this research work is aimed at finding out the the effect of oral administration of the 3 common types of "Gadagi" tea on liver function.

II. Materials and Methods

A. Dose Selection

Samples of "sak", "sada" and "magani" types of Gadagi" tea were obtained from Kofar Wambai Market, Kano, Nigeria (one of the oldest and the most popular "Gadagi" tea market). They were subjected to direct heating process. Residues were obtained and weighed using a weighing balance.

The procedure was repeated five times. Average weight was determined and used in the following formular for determination of amounts of tea in cm^3 to be administered.

Where:

- Amount consumed by 70kg man = $700cm^3$
- Average amount of tea residue = 53.42g, 60.57g, and 51.35g, for "sak", "sada" and "magani" respectively.
- Average weight of rats = 120g for "sak" and "magani" groups, and 100g for "sada" group.
- Dose (mg/kg) = 760mg/kg, 870mg/kg, and 730mg/kg, for "sak", "sada" and "magani" respectively.

Therefore, amount of tea in cm^3 = $1.0cm^3$, $1.02cm^3$ and $0.995cm^3$ for "sak", "Sada" and "Magani" respectively.

Hence,

Standard dose = $1cm^3$

Low dose =Standard dose/2

High dose =Standard dose × 2

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Formula:

$$\text{Amount of tea} = \frac{Amount\ consumed\ by\ 70kg\ man\ in\ cm^3 \text{x Average of rats(g)xdose(mg/kg)}}{1000xAverage\ Amount\ of\ tea\ residue\ (g)}$$

B. Experimental Design

Fifty (50) experimental male albino rats were divided into four groups based on the type of "Gadagi" tea i.e. one control group and three experimental groups (for the three types of "Gadagi" tea). The control group consisted of five rats while the other three groups were further divided into three equal sub – groups each consisting of five rats. The three sub groups were for Standard dose (760mg/kg, 830mg/kg, 730mg/kg for "sak', "sada" and "magani" respectively); Low dose (380mg/kg, 415mg/kg, 365mg/kg, 315mg/kg for "sak","sada" and "magani" respectively) and high dose (1500mg/kg, 1700mg/kg and 1460mg/kg for "sak'', "sada" and "magani" groups respectively).They were administered with the tea orally using syringe once daily for a period of four weeks (the dose and type of the tea administered were considered). At fourth week, all the rats were sacrificed. Blood samples were taken for analysis of liver function parameters. The rats' liver samples were taken for histopathological analysis.

C. Methods of Analysis

Activities of serum aminotransferases (ALT and AST) were estimated according to the method of [3]. Serum alkaline phosphatase activity was measured using the method of [4]. Serum total protein level was measured using the method of [5], serum bilirubin level was determined using the method of [6] and serum albumin level was determined as outlined by [7].

III. Results and Discussion

AST, ALT and ALP are useful in assessing liver cytolysis [8]. Increased serum activities of these enzymes are associated with acute liver damage, while decreased serum activities could indicate an improvement in liver function. Serum albumin levels are decreased in chronic liver disease such as cirrhosis and nephrotic syndrome. Liver is responsible for the production of most of the plasma protein in the body. Decrease in serum total protein level could be associated with decrease in liver function [1].

From the result of the study, mean serum ALT and ALP activities were significantly higher ($P<0.05$) in rats orally administered with high dose of "sak" (Table I) and those administered with standard dose of "sada" (Table II) than those of the control group, suggesting a probable impairment of liver function due to liver cytolysis. Mean serum AST, ALT and ALP activities were observed to be significantly lower ($P<0.05$) in rats that were orally administered with high dose of "magani" (Table III) than that of the control group, suggesting a probable improvement in liver function (due to decrease in liver cytolysis).

Serum mean TBil level increased significantly ($P<0.05$) at low dose of "sak"and at low and high dose of "magani". High level of TBil (unconjugated bilirubin) indicates that too much heamoglobin is being destroyed the liver is not actively treating the heamoglobin it is receiving [1]. Serum mean DBil level increased significantly ($P<0.05$) at an over-dose of "sak"and decreased significantly ($P<0.05$) at low dose level of "magani". High level of DBil (conjugated bilirubin) indicates that bile is not properly excreted therefore an obstraction may be present in the bile duct or gall bladder, while the low level of DBIL indicates that, bile is properly excreted [1].

Serum mean TP, ALB and GLO levels increased significantly ($P<0.05$) in rats that were orally administered with the various doses of "sak", "sada" and "magani" (Tables IV, V and VI respectively) than those of the control group. This also suggests a probable improvement in the synthetic function of the liver. This could be due to flavanoids, which have been reported to be present in all the "Gadagi" tea preparations studied [9]. Flavanoids are antioxidants and could improve the integrity of cells of the body including liver cells [10]. Histopathology test results showed no any remarkable difference between the experimental rats' liver and that of the control group.This could be due to mild obvious symptoms of most liver diseases at an initial stage. The result of this study is similar to a research finding which suggests significant toxicity of all the "Gadagi" tea preparations studied [11]. The few contradictions observed in the results of this study include; lack of remarkable sign of hepatotoxicity in the histopathology results of the experimental rats, decrease in the mean serum AST, ALT and ALP activities at certain dose levels in rats administered with "magani" at an high dose level, and, an increase in mean serum TP, ALB and GLO levels of the experimental groups. These contradictions could be due to the following reasons; variation of the dose administered to the experimental animals (the dose administered as high dose in the present study is equivalent to low dose of the related research) and modification/ variation of the method of preparation of the tea.

Thus, from the results of this study, "magani", could have pharmacologically positive effect or toxic depending on the amount/dose administered. It was reported that, at much higher dosages of the tea, it could cause hepatotoxicity [11]. However, results of this study show that, high dose of "magani" could improve the synthetic function of the liver and probably reduce liver cytolysis in the experimental rats, while at low and standard doses, no such effect was observed.

TABLE I
SERUM ASPARTATE AMINOTRANSFERASE (AST), ALANINE AMINOTRANSFERASE (ALT), ALKALINE PHOSPHATASE (ALP), TOTAL BILIRUBIN (TBIL), AND DIRECT BILIRUBIN (DBIL) OF ALBINO RATS ORALLY ADMINISTERED WITH "SAK" TYPE OF "GADAGI" TEA FOR FOUR (4) WEEKS

Group	Dose (mg/kg)	AST (U/L)	ALT (U/L)	ALP (U/L)	TBL (µmol/L)	DBIL (µmol/L)
Control n = 5	-	50.20^{a} ±6.69	$10.60^{b,c}$ ±3.21	$54.60^{d,e,f}$ ±5.73	10.20^{g} ±1.30	3.40^{h} ±1.14
Low Dose n = 5	380	55.60 ±20.37	12.20^{b} ±3.03	49.60^{d} ±3.21	15.40^{g} ±1.14	3.60 ±1.14
Standard Dose	760	38.20^{a} ±6.06	11.20 ±2.49	62.00^{e} ±9.97	8.40 ±0.89	3.40 ±1.14
High Dose n = 5	1520	51.40 ±4.93	16.40^{c} ±0.57	61.00^{f} ±4.42	10.60 ±1.14	4.00^{h} ±0.71

Results are presented as mean ± standard deviation. Values bearing similar superscript in the same column are significantly different (P<0.05).

TABLE II
SERUM ASPARTATE AMINOTRANSFERASE (AST), ALANINE AMINOTRANSFERASE (ALT), ALKALINE PHOSPHATASE (ALP), TOTAL BILIRUBIN (TBIL), AND DIRECT BILIRUBIN (DBIL) OF ALBINO RATS ORALLY ADMINISTERED WITH "SADA" TYPE OF "GADAGI" TEA FOR FOUR (4) WEEKS

Group	Dose (mg/kg)	AST (U/L)	ALT (U/L)	ALP (U/L)	TBIL (µmol/L)	DBIL (µmol/L)
Control n = 5	-	$50.20^{i,j}$ ±6.69	$10.60^{k,l}$ ±3.21	$54.60^{m,n}$ ±5.73	$10.20^{o,p,q}$ ±1.30	3.40 ±1.14
Low Dose n = 5	435	43.40^{i} ±6.19	6.40^{k} ±1.34	55.40 ±7.57	14.60^{0} ±0.89	3.40 ±0.55
Standard Dose n = 5	870	50.80 ±21.71	17.20^{l} ±0.84	70.80^{m} ±7.56	7.60^{p} ±0.55	3.20 ±1.30
High Dose n = 5	1740	54.80^{j} ±12.11	11.40 ±3.29	52.00^{n} ±2.55	13.20^{q} ±0.84	3.40 ±0.55

Results are presented as mean ± standard deviation. Values bearing similar superscript in the same column are significantly different (P<0.05)

TABLE III
SERUM ASPARTATE AMINOTRANSFERASE (AST), ALANINE AMINOTRANSFERASE (ALT), ALKALINE PHOSPHATASE (ALP), TOTAL BILIRUBIN (TBIL), AND DIRECT BILIRUBIN (DBIL) IN ALBINO RATS ORALLY ADMINISTERED WITH "MAGANI" TYPE OF "GADAGI" TEA FOR FOUR (4) WEEKS

Group	Dose (mg/kg)	AST (U/L)	ALT (U/L)	ALP (U/L)	TBIL (µmol/L)	DBIL (µmol/L)
Control N = 5	-	$0.20^{r,s,}$ ±6.69	$10.60^{u,v,w}$ ±3.21	$54.60^{x,y}$ ±5.73	$10.20^{z,a}$ ±1.30	3.40^{b} ±1.14
Low Dose N = 5	365	55.40^{r} ±7.77	13.20^{u} ±1.79	49.80^{x} ±3.19	12.00^{z} ±0.71	2.40^{b} ±0.55
Standard Dose N = 5	730	43.60^{s} ±8.05	13.80^{v} ±1.79	52.80 ±4.97	10.20 ±0.84	2.80 ±0.84
High Dose N = 5	1460	39.20^{t} ±13.79	7.80^{w} ±2.28	47.00^{y} ±4.12	12.60^{a} ±1.14	3.20 ±0.84

Results are presented as mean ± standard deviation. Values bearing similar superscript in the same column are significantly different (P<0.05).

TABLE IV
SERUM TOTAL PROTEIN (TP), ALBUMIN (ALB), AND GLOBULIN (GLO) IN ALBINO RATS ORALLY ADMINISTERED WITH "SAK" TYPE OF "GADAGI" TEA FOR FOUR (4) WEEKS

Group	Dose (mg/kg)	TP (g/L)	ALB (g/L)	GLO (g/L)
Control n = 5	-	66.80^{abc} ±2.28	$31.60^{d,e,f}$ ±3.91	$37.20^{g,h,i}$ ±4.09
Low Dose n = 5	380	85.60^{a} ±4.34	34.20^{d} ±1.92	51.40^{g} ±5.32
Standard Dose n = 5	760	70.00^{b} ±4.00	27.00^{e} ±1.22	43.00^{h} ±2.92
High Dose n = 5	1520	90.00^{c} ±5.10	37.80^{f} ±3.11	52.20^{i} ±7.05

Results are presented as mean ± standard deviation. Values bearing similar superscript in the same column are significantly different (P<0.05).

TABLE V
SERUM TOTAL PROTEIN (TP), ALBUMIN (ALB), AND GLOBULIN (GLO) IN ALBINO RATS ORALLY ADMINISTERED WITH "SADA" TYPE OF "GADAGI" TEA FOR FOUR (4) WEEKS

Group	Dose (mg/kg)	TP (g/L)	ALB (g/L)	GLO (g/L)
Control n = 5	-	66.80^{abc} ±2.28	$31.60^{d,e,f}$ ±3.91	$37.20^{g,h,i}$ ±4.09
Low Dose n = 5	435	86.00^{a} ±3.74	36.80^{d} ±4.49	49.20^{g} ±5.31
Standard Dose n = 5	870	70.80^{b} ±3.90	25.80^{e} ±2.28	45.00^{h} ±4.69
High Dose n = 5	1740	82.00^{c} ±5.83	36.20^{f} ±5.67	45.80^{i} ±9.39

Results are presented as mean ± standard deviation. Values bearing similar superscript in the same column are significantly different (P<0.05).

TABLE VI
SERUM TOTAL PROTEIN (TP), ALBUMIN (ALB), AND GLOBULIN (GLO) IN ALBINO RATS ORALLY ADMINISTERED WITH "MAGANI" TYPE OF "GADAGI" TEA FOR FOUR (4) WEEKS

Group	Dose (mg/kg)	TP (g/L)	ALB (g/L)	GLO (g/L)
Control n = 5	-	$66.80^{a,b,c}$ ±2.28	$31.60^{d,e,f}$ ±3.91	$37.20^{g,h,i}$ ±4.09
Low Dose n = 5	365	72.60^{a} ±9.84	35.00^{d} ±1.87	37.60^{g} ±8.08
Standard Dose n = 5	730	79.20^{b} ±1.20	34.40^{e} ±4.62	44.80^{h} ±4.32
High Dose n = 5	1460	88.00^{c} ±1.41	42.80^{f} ±3.83	45.20^{i} ±4.76

Results are presented as mean ± standard deviation. Values bearing similar superscript in the same column are significantly different (P<0.05).

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