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Serum Biochemical Parameters Profile of Wistar Rats Following Daily Administration of Some Food Spices

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Abstract

Garlic, ginger, and turmeric are widely used together or individually as spices in food or for their different medicinal purposes all around Nigeria. This study was conducted to assess the effects of consuming either of the three samples on the livers of wistar rats. Standard methods of analyses were employed for the study. A set of fifteen male Wistar Rats divided equally into three groups of which group I served as control and groups II and III as test groups were used for each of the samples; a total of 45 wistar rats were used for this study. The rats in the test groups for each of the samples were placed on different concentrations (group II: 100 mg/kg Body Weight and group III: 200 mg/kg BW) of the sample extract for 21 days. Results obtained reveal that ethanol extracts (100 mg/kg BW and 200 mg/kg BW) of garlic significantly ($p<0.05$) reduced the liver enzymes Alanine Aminotransferase (ALT) and Alkaline Phosphatase (ALP), and the bilirubin levels but significantly ($p < 0.05$) reduced Aspartate Aminotransferase (AST) against the control. However, ginger extracts and turmeric extracts significantly ($p<0.05$) increased ALT and AST in the test groups against the control, and while ginger extracts significantly ($p<0.05$) increased the levels of bilirubins, turmeric extracts significantly ($p<0.05$) reduced the levels of bilirubins in the attest groups against the control. The significant decrease in the levels of ALT, ALP, total and conjugated bilirubin levels by garlic extracts shows garlic hepatoprotective potential while the significant increase in the levels of ALT and AST by ginger extracts and turmeric extracts shows their hepatotoxic potential to the body of the experimental animals employed.

Keywords: Alanine Aminotransferase, Aspartate Aminotransferase, Alkaline Aminotransferase, Hepatoprotective, Hepatotoxic

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INTRODUCTION

Garlic, ginger, and turmeric are widely used together or individually as spices in food or for different medicinal purposes all around Nigeria and powdered form of each of these spices is commonly added to cooked food to improve the flavor (Mann, 2011). The raw tubes of any of these herbs, particularly ginger, is also commonly boiled in water to make decoction which is used by the locals to treat different ailments like diabetes, obesity, high blood pressure and so on (Semwal *et al*., 2010).

The common garlic belongs to the same family of plants as the onion. The term is Anglo-Saxon in origin and refers to the way the plant's leaves are shaped (Blumenthal *et al.,* 2000). It is a member of the Liliaceae family and goes by the botanical name *Allium sativum*. For hundreds of years, people have utilized garlic for both culinary and medical purposes (Blumenthal *et al.,* 2000). Its satisfying flavor makes it the ideal accent to any cuisine. Garlic also has high antioxidant content, is low in calories, and offers a number of health advantages (Blumenthal *et al.,* 2000).

Turmeric is widely acknowledged as the top wound healer, antibacterial, colorant, hypoglycemic, and antioxidant. Indian curries' distinctive vivid yellow-orange color is a result of the spice (Timba *et al.,* 2019). The mucous membranes are soothed by turmeric, which has anti-inflammatory properties. Colitis, Crohn's disease, diarrhea, and salmonella-related diseases can all be treated by regular turmeric use (Timba *et al.,* 2019). The usage of turmeric can lessen itch and inflammation (Timba *et al.,* 2019). Turmeric is one of the most often utilized ingredients in cosmetics and medications due to its therapeutic benefits. As a powerful detoxifier, turmeric can also help skin disorders like eczema, psoriasis, and acne (Timba *et al.,* 2019).

The ginger spice is derived from the plant's roots, and the rhizome, or subterranean stem, is used both as a spice and a medicinal treatment (Timba *et al.,* 2019). Ginger is a herb and a plant with a leafy stem and a yellowish green blossom that can be consumed as juice or oil, dried and powdered, or fresh and is frequently used to treat a variety of "stomach problems," including nausea brought on by cancer therapy, motion sickness, morning sickness, unsettled stomach, gas, diarrhea, nausea and vomiting after surgery, as well as loss of appetite (Timba *et al.,* 2019). Menstrual discomfort, upper respiratory tract infections, coughing, and bronchitis are among its other uses, along with pain treatment from arthritis or muscle soreness. Additionally, stomach pain, low back pain, and chest pain are occasionally treated with ginger (Timba *et al.,* 2019).

Biochemical parameters are mostly liver non-plasma enzymes that get released into the blood when the liver is damaged and some biomolecules that are acted upon by the liver and these enzymes are often assayed in the blood to evaluate the health status of the liver or the effect of a particular drug or chemical substance on the liver (Wolf, 1999). These parameters include alanine aminotransferase (ALT), aspartate aminotransferase (AST), alkaline phosphatase (ALP), bilirubins and so on (Halevy *et al.,* 1994).

Substances that increase these non-plasma parameters in the blood are said to be hepatotoxic as they are believed to have increased the volumes of the parameters by injuring the liver and on the other hand, substances that decrease these parameters in the blood are described as hepatoprotective as they are believed to exact positive effects on the liver (Ferreira *et al.,* 2010). Numerous natural therapeutic advantages were supplied by the bioactive components of ginger, garlic, and turmeric, including polyphenolic chemicals, organosulfur compounds, vitamins, carotenes, curcumin, and lycopene (Ajanaku *et al.,* 2022).

A study carried out by Madkor *et al*. (2011) showed that garlic, ginger, turmeric and their mixture (GGT) significantly alleviated (80–97 %, $p<0·05$–$0·001$) most signs of the metabolic syndrome of diabetes including hyperglycaemia and dyslipidaemia, the elevation in atherogenic indices, and cellular toxicity in STZ–nicotinamide diabetic rats by increasing the production of insulin (26–37 %), reactivating the antioxidant defence system (31–52 %, especially GSH) and decreasing lipid peroxidation (60–97 %). In addition, the three spices as well as their mixture reduced serum levels of ALAT, aspartate aminotransferase and alkaline phosphatase activities as well as liver TBARS and increase liver GSH level suggest that the chemical components of these spices prevented hepatocellular damage by stabilising the integrity of the cell membrane, keeping the membrane intact and the enzymes enclosed, through scavenging free radicals (Madkor *et al.,* 2011).

The present study unraveled the possible effects of daily consumption of any of the three spices on the liver of healthy animals.

MATERIALS AND METHODS

Procurement and Preparation of Sample Extracts

Fresh samples of garlic, ginger, and turmeric were bought from the Lokoja International Market, Lokoja, Kogi State, Nigeria. The method described by Trono *et al*. (2016) was adopted for preparation of the samples. Each sample was cleaned, air dried at room temperature for three (3) weeks and was pulverized using blender (Super Master Co., Ltd, Osaka, Japan). The resulting powdered product was stored in a sterilized container before the period of analysis. Ethanol was used as the solvent of extraction. The ethanol extract of each sample was prepared by soaking weighed powdered form of the sample in 500 ml of ethanol. The combined extract was filtered through a vacuum filter using Whatman No. 1 filter paper. The resulting solution was subjected to heat using water bath heater at 55 °C to obtain the extract.

Experimental Animals and Research Design

Fifteen (15) male albino rats weighing between 150 to 200 g were used in the experiment for each of the samples. The Albino rats were purchased from a Commercial Breeding Center in Ilorin, Kwara State, Nigeria. The rats were kept in standard wooden cage at the animal house under a strict compliance with the guide for animal research, as detailed in Guidelines for the Care and Use of Laboratory Animals in Biomedical Research as reported by Jones-Bolin (2012). The rats were fed *ad libitum* with commercially formulated pelletized rat feed (T.J Top Feed Ltd, Port Harcourt, Nigeria) and water under a natural light/dark cycle. The rats were allowed to acclimatize in the standard wooden cage for 2 weeks before the commencement of the study as to allow for adaptation of life in the cage.

After acclimatization period, the rats for each of the samples were allocated to three groups of five rats each designated as control group (Group I) and test groups (Groups II, and III). The weights of the rats were equalized as nearly as possible. The rats' treatments lasted for twenty-one (21) days. The treatments given to the rats are stated as follows:

Group I: normal saline + feed + water
Group II: 100 mg/kg BW of ethanol sample extract + feed + water
Group III: 200 mg/kg BW of ethanol sample extract + feed + water

Blood Sample Collection

At the end of administration period (21 days), rats from various groups were reweighed, anaesthetized with chloroform vapor, and dissected. Blood was collected by cardiac puncture

into clean anticoagulant tubes for the selected biochemical indices. The tubes were properly labeled and used for analysis.

Serum Assay

Serum assays for liver function testing were conducted. The method of Write *et al*. (1972) was used to measure the alkaline phosphatase (ALP) level. According to Reitman & Frankel's (1957) instructions, the enzymes alanine aminotransferase (ALT) and aspartate aminotransferase (AST) were measured. The method developed by Jendrassik and Groff (1938) was used to conduct the assay of bilirubin, both total and conjugated. The Urease-Berthlot method was used to estimate the amount of urea.

Statistical Analysis

Results were presented as means and standard deviations of triplicate determinations. Group comparisons were done using the least significant difference (LSD). Significant difference was established at 5% level by one- way ANOVA followed by Duncan *post – hoc* test for multiple comparisons.

RESULTS AND DISCUSSION

The primary organ in the body responsible for maintaining homeostasis, where metabolism and detoxification occur, is the liver (Hashem *et al.,* 2019). The majority of the metabolic pathways associated to growth, immunity, nutrition delivery, and energy production pass via this organ (Hashem *et al.,* 2019). The health status of the liver is often evaluated by measuring the plasma levels of some biochemical parameters (Wolf, 1999), which are released by the liver into the plasma when injured as a result of the liver being exposed to toxic substances or drugs (Au *et al.,* 2011). In addition, reduction of these parameters in the serum is an indication that consumption or administration of a particular substance or drug exerts positive effects on the liver (Salomone *et al.,* 2016). The biochemical parameters often considered for this course and as well studied in this research are aspartate aminotransferase (AST), alanine aminotransferase (ALT), alkaline phosphatase (ALP), total bilirubin (Tbil) and conjugated bilirubin (Cbil) (Wolf, 1999).

Results of the effects of garlic, ginger, and turmeric extracts on these biochemical parameters are shown in Tables 1, 2, and 3 respectively.

Table 1: Effects of Garlic Extracts on Selected Biochemical Parameters in Wistar Albino Rats

Group	Biochemical Parameters				
	ALT	AST	ALP	**TBIL**	**CBIL**
Group 1	26.24 ±0.24^{c}	33.42 ±0.52^{a}	30.08 ±0.03^{b}	1.14 ±0.01^{b}	0.67 ±0.01^{c}
Group 2	20.19 ±0.06^{a}	35.83 ±0.15^{b}	12.34 ±0.05^{c}	1.12 ±0.02^{b}	0.34 ±0.01^{a}
Group 3	23.90 ±0.09^{b}	45.83 ±0.03^{c}	26.25 ±0.02^{a}	1.03 ±0.06^{a}	0.60 ±0.01^{b}

Data represented as mean ± standard deviation of the concentration of serum biochemical parameters of TBIL and CBIL (mg/dl), and AST, ALT, and ALP (U/L). Mean values having different lowercase letters as superscripts are considered significant ($p<0.05$) down the column.

In Table 1 above, garlic extracts (100 and 200 mg/kg bw) significantly ($p<0.05$) reduced the liver enzymes; alanine aminotransferase (ALT) and alkaline phosphates (ALP) when the test groups are compared to the control group but significantly ($p<0.05$) increased aspartate

aminotransferase in the test groups compared to the control. The significant reduction of serum levels of ALT and ALP could be attributed to the daily administration of garlic extracts in the experimented rats. This observation is in line with the previous works of Ajayi *et al*. (2009) who observed a significant ($p < 0.05$) decrease in ALT and ALP levels in Lead induced rats treated with garlic. Apart from the total bilirubin level of group 1 (100 mg/kg bw), bilirubin levels for other test groups (both total and conjugated) were significantly ($p < 0.05$) reduced when compared to the control group. This observation of reduction of bilirubin levels in the test animals further signifies effectiveness of garlic administration in promoting liver function and cannot be linked with cholestatic disease as the bilirubin levels were still within the acceptable range of 0.2-1.2 mg/dl (Onuegbu *et al*., 2011). However, the observed increase in serum AST in both test groups (100 and 200 mg/kg bw) could be attributed to injury of other organs like the heart, kidney or muscles that make small amounts of the enzyme (Levick, 2017) and in addition ALT being more specific liver enzyme for diagnostic use (Moss & Henderson, 1996). The observed increase in AST levels in the test groups of this study is as well in line with the earlier work of (Ajayi *et al*., 2009).

Table 2: Effects of Ginger Extracts on Selected Biochemical Parameters in Wistar Albino Rats

Group	Haematological Parameters				
	ALT	AST	ALP	TBIL	**CBIL**
Group 1	26.24 ±0.24^{a}	33.42 ±0.52^{a}	30.08 ±0.03^{c}	1.14 ±0.01^{b}	0.67 ±0.01^{a}
Group 2	35.35 ±0.05^{b}	48.65 ±0.02^{c}	11.85 ±0.05^{a}	1.18 ±0.01^{c}	0.92 ±0.02^{c}
Group 3	26.40 ±0.01^{a}	38.55 ±0.05^{b}	25.63 ±0.06^{b}	0.88 ±0.06^{a}	0.83 ±0.03^{b}

Data represented as mean ± standard deviation of the concentration of serum biochemical parameters of TBIL and CBIL (mg/dl), and AST, ALT, and ALP (U/L). Mean values having different lowercase letters as superscripts are considered significant ($p<0.05$) down the column.

In Table 2 of the current study, apart from the alanine aminotransferase level of group 2 (200 mg/kg bw), the levels of alanine aminotransferase and aspartate aminotransferase were significantly ($p<0.05$) increased in the test groups when compared to the control group. The two ginger extracts (100 and 200 mg/kg bw) also significantly ($p<0.05$) increased the bilirubin levels in all the test groups when compared to the control. These findings are contrary to the effects of garlic extracts on the four parameters as shown in Table 1. However, the ginger extracts (100 and 200 mg/kg bw) significantly ($p<0.05$) reduced the alkaline phosphatase enzymes of the test groups when compared to the control group. The significant ($p<0.05$) reduction of the alkaline phosphatase enzyme in the test groups when compared to the control is in line with the previous work of Ahmed & Sharma (1997). The significant ($p<0.05$) increase in the levels of alanine aminotransferase, aspartate aminotransferase, total bilirubin and conjugated bilirubin in the test groups compared to the control could be attributed to the daily administration of garlic extracts in the test groups and signifies hepatotoxic potential of ginger consumption; ALT and AST being excellent markers of liver damage caused by exposure of liver to a toxic substance (Ranjna, 1999). The significant ($p<0.05$) increase in the levels of alanine aminotransferase and aspartate aminotransferase and significant ($p < 0.05$) decrease in the levels of alkaline aminotransferase are similar to the observed effects of caffeine on the liver (Emmanuel *et al*., 2017).

Table 3: Effects of Turmeric Extracts on Selected Biochemical Parameters in Wistar Albino Rats

Group	Haematological Parameters				
	ALT	AST	ALP	TBIL	**CBIL**
Group 1	26.24 ±0.24[a]	33.42 ±0.52[a]	30.08 ±0.03[e]	1.14 ±0.01[e]	0.67 ±0.01[b]
Group 2	29.60 ±0.04[b]	38.10 ±1.64[b]	18.59 ±0.03[c]	0.90 ±0.01[b]	0.27 ±0.02[c]
Group 3	30.44 ±0.05[c]	44.47 ±0.48[c]	13.75 ±0.06[b]	0.93 ±0.01[c]	0.28 ±0.03[d]

Data represented as mean ± standard deviation of the concentration of serum biochemical parameters of TBIL and CBIL (mg/dl), and AST, ALT, and ALP (U/L). Mean values having different lowercase letters as superscripts are considered significant ($p<0.05$) down the column.

In Table 3, the turmeric extracts (100 and 200 mg/kg bw) significantly ($p<0.05$) increased the serum levels of alanine aminotransferase and aspartate aminotransferase and significantly ($p<0.05$) decreased the levels of alkaline phosphatase, total bilirubin and conjugated bilirubin. The significant increased levels of ALT and AST as observed in the current study is in line with earlier works of Essa *et al*. (2019) in which doses of turmeric increased the two parameters. The observed decrease in ALP, Tbil, and Cbil are in line with a previous work of Emmanuel *et al*. (2017) who observed that the parameters significantly ($p < 0.05$) decreased in rats administered with different doses of caffeine. ALT and AST being excellent markers of liver damage caused by exposure of liver to a toxic substance (Ranjna, 1999), their observed increase in the current study can be attributed to the daily administration of turmeric extracts to the rats and this also corresponds with the effect of caffeine administration in rats (Emmanuel *et al*., 2017).

CONCLUSION

Results recorded from this study have shown that daily administration of garlic extracts exerted hepatoprotective effects on the body of the experimental rats as it reduced the studied serum biochemical parameters. However, both ginger and turmeric extracts had possible hepatotoxic effects as they increased ALT and AST which are the two excellent biochemical markers of liver damage. These negative effects of ginger and turmeric on the liver are similar to the effect of caffeine consumption on the liver. There is need for those that consume ginger and/or turmeric for their medicinal benefits to take note of these findings.

COMPETING INTEREST

The authors declare that there is no conflict of interest regarding the publication of this paper.

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