

## Original Research Article

# Effect of coffee consumption on liver enzymes (alanine transaminase, aspartate transaminase and alkaline phosphatase), total and conjugated bilirubin levels among students in Nnewi

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## ABSTRACT

**Background:** Coffee has a number of bioactive compounds that have beneficial effects on human health in general and more importantly is the fact that coffee consumption has positive impact on the liver function. The present study investigated the effect of coffee consumption on liver enzymes: alanine transaminase (ALT), aspartate transaminase (AST) and alkaline phosphatase (ALP), total bilirubin (TB) and conjugated bilirubin (CB) levels among student in Nnewi.

**Methods:** A total of twenty-five (25) apparently healthy participants aged between 18 and 30 years which were randomly recruited from College of Health Sciences' students to serve as both test and control group. Each participant was advised to abstain from coffee and similar beverages for a period of three weeks prior to the commencement of the study. Subsequently, in addition to their normal diet, each of the subjects was given 2 gm of coffee dissolved in 150 ml of hot water in which 50 mg of non-dairy creamer was added before breakfast daily for 28 consecutive days. 6 ml each of baseline and test samples (after an overnight fast) were collected at day 0 and 29 respectively from each participant. Liver enzymes such as ALT, AST, and ALP activity as well as TB and CB levels was determined using standard laboratory methods.

**Results:** This showed significant reductions in the mean serum AST and ALT activity, TB and unconjugated bilirubin (UB) levels with no significant alterations in the mean ALP activity and CB level in participants studied after short-term coffee consumption.

**Conclusions:** This study revealed the hepatoprotective effect of coffee intake at short term basis.

**Keywords:** Coffee, Liver enzymes, Total bilirubin, Conjugated bilirubin

## INTRODUCTION

The liver is an important organ in the regulation of metabolic balance in the body and detoxification of harmful chemicals and drugs.<sup>1</sup> Liver disease remains a significant global health problem that may result from

variety of causes inducing oxidative stress, inflammation, and necrosis of liver cells.<sup>2</sup> The liver produces a number of enzymes which are diagnostic in function serving as markers of hepatic damage. These enzymes majorly include aspartate aminotransferase (AST), alanine aminotransferase (ALT), alkaline phosphatase (ALP) and

gamma-glutamyltransferase with ALT and AST been the most sensitive indicators of hepatic damage while ALP is an important marker of biliary cholestasis. These enzymes are usually found in low concentrations in healthy state but with cellular injury or changes in cell membrane permeability, these enzymes leak into circulation. Of the two, ALT is the more sensitive and specific test for hepatocyte injury as AST can be also elevated in the state of cardiac arrest or muscle injury.<sup>3</sup> Bilirubin is substance made when the body breaks down old red blood cells.<sup>4</sup> It is also part of bile, which the liver makes to help digest the food we eat. Bilirubin that is bound to certain protein is called unconjugated or indirect while conjugated or direct bilirubin travels freely through the bloodstream to the liver.<sup>5</sup>

Life style moderation and dietary management has been implicated in the management of a lot of disorders, of which the liver is not left out. Coffee is a functional food which is gaining attention worldwide due to its acclaimed general medicinal value and specifically for its hepatoprotective potential. Coffee is one of the most commonly consumed beverages worldwide.<sup>6</sup> Coffee is a complex mixture of more than a thousand different chemicals, many of which are reported to be biologically active and important for human health.<sup>7</sup> It has been shown to contribute a large proportion of daily intake of dietary antioxidant, greater than tea, fruit, and vegetables.<sup>8</sup> Two species are of significant economic importance, *Coffea arabica*, commonly known as arabica coffee, which accounts for 60% of world production, and *Coffea canephora* variety robusta (40%), which is used to produce robusta coffee.<sup>9</sup> These two species differ in physical aspects, chemical composition, and characteristics of the beverage. Arabica coffee brew is appreciated for its superior cup quality and aroma, whereas robusta brew possesses a more aggressive flavor and contains higher amounts of soluble solids, antioxidants, and caffeine.<sup>10</sup> Coffee contains large amounts of bioactive compounds including caffeine, phenolic compounds, trigonelline, diterpenes and soluble fiber.<sup>10</sup> Chlorogenic acid is the most abundant antioxidant in coffee; though it is degraded by roasting, alternative antioxidant organic compounds are formed.<sup>11,12</sup> Caffeine also has significant antioxidant effects. The diterpenes, cafestol and kahweol, induce enzymes involved in carcinogen detoxification and stimulation of intracellular antioxidant defence, contributing towards an anti-carcinogenic effect.<sup>13</sup> These antioxidant and anti-inflammatory effects are also likely to be responsible for the mechanism behind the beneficial associations between coffee consumption and varying degrees of liver disorders.<sup>14</sup> Furthermore, several authorities have in time pasted documented different beneficial effects of coffee on various aspect of human health, although some of the author reported conflicting findings.<sup>15,16</sup> Importantly, consumption of coffee has been shown in literature to possess beneficial potentials for the liver.

A recent study of Liu and colleagues demonstrated significantly reduced incidence of cirrhosis amongst coffee drinkers when compared to those who did not drink the beverage.<sup>17</sup> Several other similar studies recorded beneficial effects of coffee intake in both humans and animals alike.<sup>18</sup> In Nigeria, coffee consumption is gaining attention in recent times. However, little is known about its effect on the liver as there are only a few scholarly works documented in the present study area on the effects of coffee consumption on the liver function.<sup>19</sup> In view of the above, the evaluation of the effect of coffee consumption on the liver enzymes and bilirubin levels in male and female adult Nigerians is needed at such time there is marked increase in the level of coffee consumption in this community especially among students as this will present crucial information on the beneficial or deleterious effect of coffee intake on the liver function.

## METHODS

### Subjects

Apparently healthy male and female students of College of Health Sciences and Technology, Nnamdi Azikiwe University, Nnewi campus, aged between 18 and 30 years was recruited for the study. They were given 4 of coffee daily for 28 days.

### Study site

This research was carried out in College of Health Sciences, Nnamdi Azikiwe University, Okofia, Nnewi Campus, Anambra.

### Study design

This is an experimental study which was designed to evaluate the effect of coffee intake on the liver enzymes and bilirubin levels in apparently healthy students. A total of twenty-five (25) apparently healthy students within the age range of 18-30 years were randomly recruited from the College of Health Sciences, Nnamdi Azikiwe University, Nnewi Campus, Nigeria. Participants were properly informed about the study and only those who give their consent were recruited for the study. Participants were asked to abstain from drinking of coffee and other similar beverages for a period of three weeks. Afterwards, 5 ml each of baseline samples was collected from each participant into plain container at day 0 as control samples, and levels of these liver enzymes (ALT, AST and ALP) and bilirubin evaluated. Subsequently, in addition to their normal diet, each of the subjects was given 2 gm of coffee powder daily for 28 days. After an overnight fast, 5 ml of post research sample (post-test sample) was collected on day 29 and the levels of liver enzymes and bilirubin was re-evaluated. Liver enzymes (ALT, AST and ALP) and bilirubin levels estimation was determined using standard laboratory methods.

Also, a structured questionnaire was used to obtain relevant information such as age, sex, demographic factors, and dietary patterns.

#### Preparation of coffee

The coffee used for this study was commercially prepared and marketed by Tesco. Each of the participants was given the same quantity of coffee comprising of a mixture of 150 ml of water and 2 gm of coffee powder. 150 ml of hot water was measured using a measuring cup and 2 gm of coffee measured using a weighing scale was added to it. Afterwards, 50 mg of non-dairy creamer was added.

#### Inclusion criteria

Apparent healthy subjects (male and female) aged between 18 and 30 years was recruited for this study.

#### Exclusion criteria

Subjects that are sick, on drugs, alcohol addicts, smokers or those outside the age bracket of 18-30 years was excluded from the study.

#### Ethical consideration

The ethical approval for this study was sought and obtained from the Ethics Committee of Faculty of Health Sciences and Technology, Nnamdi Azikiwe University, Nnewi, Anambra State, Nigeria.

#### Determination of serum AST activity

AST activity was determined using the colorimetric method of Rietman and Frankel.<sup>20</sup>

#### Determination of serum ALT activity

ALT was estimated according to the method of Rietman and Frankel.<sup>20</sup>

#### Determination of serum ALP activity

ALP was assayed according to the method as described by Bessey et al.<sup>21</sup>

#### Determination of serum conjugated (direct bilirubin) and total bilirubin levels

Estimation of bilirubin level was done using the colorimetric method described by Jendrassik and Grof.<sup>22</sup>

#### Statistical analysis

The data obtained was presented as mean±standard deviation (SD) and the mean values of the baseline and test samples were compared by students t-test and Pearson r-correlation using Statistical package for social sciences (SPSS) (version 23) software. Statistical significance was tested at  $p < 0.05$ .

## RESULTS

The mean age of the subjects studied were  $22.60 \pm 2.36$  years as shown in Table 1. There was a significant reduction in the mean serum concentration of AST ( $8.36 \pm 1.14$  versus  $11.04 \pm 2.03$  IU/l;  $p = 0.000$ ) and ALT ( $7.92 \pm 2.47$  versus  $11.32 \pm 2.10$  IU/l;  $p = 0.000$ ) activities after consumption of coffee when compared with baseline values respectively. Also, the mean serum levels of total bilirubin (TB) ( $10.32 \pm 2.43$  versus  $11.93 \pm 2.97$   $\mu\text{mol/l}$ ;  $p = 0.001$ ) and unconjugated bilirubin (UB) ( $7.182 \pm 2.6$  versus  $8.34 \pm 2.85$ ;  $p = 0.003$ ) were significantly reduced after the consumption of coffee when compared with baseline values respectively. However, there was no significant difference in the mean serum ALP activity ( $p = 0.954$ ), as well as conjugated bilirubin (CB) level in participants after the consumption of coffee when compared baseline ( $p > 0.05$ ) (Table 1).

There were significant positive correlations observed in parameters studied before coffee consumption between TB versus UB ( $r = 0.882$ ;  $p = 0.001$ ), while other remaining parameters did not show significant correlations ( $p > 0.05$ ) as shown in Table 2.

Also, there were significant positive correlations observed in parameter studied after coffee consumption between TB versus UB ( $r = 0.890$ ;  $p = 0.001$ ) and negative correlation between AST versus CB ( $r = -0.532$ ;  $p = 0.007$ ) respectively, while other remaining parameters did not show significant correlations ( $p > 0.05$ ) (Table 3).

**Table 1: Mean age, levels of liver enzymes activity and bilirubin levels in participants studied at baseline and after consumption of coffee (mean±SD).**

Parameters	Baseline values, n=25	Post consumption values, n=25	t-test	P value
Age (years)	$22.60 \pm 2.36$			
AST(IU/l)	$11.04 \pm 2.03$	$8.36 \pm 1.411$	-6.393	0.001*
ALT (IU/l)	$11.32 \pm 2.10$	$7.92 \pm 2.47$	-5.775	0.001*
ALP (IU/l)	$45.27 \pm 12.136$	$45.17 \pm 13.971$	-0.058	0.954
CB ( $\mu\text{mol/l}$ )	$3.592 \pm 1.42$	$3.14 \pm 1.19$	-1.458	0.158
TB ( $\mu\text{mol/l}$ )	$11.93 \pm 2.97$	$10.32 \pm 2.43$	-3.756	0.001*
UB ( $\mu\text{mol/l}$ )	$8.34 \pm 2.85$	$7.182 \pm 2.6$	-2.671	0.013*

\*Statistically significant at  $p < 0.05$

**Table 2: Levels of association between parameters studied at baseline (day 0).**

Parameters	R value	P value
AST (IU/l) versus ALT (IU/L)	0.261	0.207
AST (IU/l) versus ALP (IU/L)	0.091	0.666
AST (IU/l) versus CB (IU/l)	-0.084	0.690
AST (IU/l) versus TB (IU/l)	0.095	0.650
AST (IU/l) versus UB (IU/l)	0.141	0.500
ALT (IU/l) versus ALP (IU/l)	0.126	0.550
ALT (IU/l) versus CB (IU/l)	0.045	0.829
ALT (IU/l) versus TB (IU/l)	0.205	0.326
ALT (IU/l) versus UB (IU/l)	0.191	0.360
ALP (IU/l) versus CB (IU/l)	-0.065	0.757
ALP (IU/l) versus TB (IU/l)	0.163	0.436
ALP (IU/l) versus UB (IU/l)	0.203	0.331
CB (IU/l) versus TB (IU/l)	0.327	0.111
CB (IU/l) versus UB (IU/l)	-0.158	0.452
TB (IU/l) versus UB (IU/l)	0.882**	0.001**

\*\*Statistically significant at  $p < 0.05$

**Table 3: Levels of association between parameters studied after coffee consumption.**

Parameters	R value	P value
AST (IU/l) versus ALT (IU/l)	0.296	0.151
AST (IU/l) versus ALP (IU/l)	-0.002	0.991
AST (IU/l) versus CB (IU/l)	-0.523	0.007**
AST (IU/l) versus TB (IU/l)	0.092	0.661
AST (IU/l) versus UB (IU/l)	0.325	0.113
ALT (IU/l) versus ALP (IU/l)	0.006	0.976
ALT (IU/l) versus CB (IU/l)	-0.106	0.613
ALT (IU/l) versus TB (IU/l)	-0.152	0.469
ALT (IU/l) versus UB (IU/l)	-0.093	0.658
ALP (IU/l) versus CB (IU/l)	0.197	0.346
ALP (IU/l) versus TB (IU/l)	0.008	0.968
ALP (IU/l) versus UB (IU/l)	-0.082	0.697
CB (IU/l) versus TB (IU/l)	0.091	0.664
CB (IU/l) versus UB (IU/l)	-0.372	0.067
TB (IU/l) versus UB (IU/l)	0.890	0.001**

\*\*Statistically significant at  $p < 0.05$

## DISCUSSION

Coffee has been said to contain a number of bioactive principles that have enormous importance to human health and consumption of coffee have since been implicated in the management of several conditions including diabetes, hypertension, hyperlipidemia, liver disorders among others. This study investigated the effect of coffee consumption on liver enzymes (ALT, AST and ALP), total and conjugated bilirubin levels among student in Nnewi.

In this study, there was a significant reduction in the mean serum concentration of AST, and ALT activities in the participants studied after consumption of coffee when compared with baseline values respectively. Elevated levels of ALT and AST are markers of hepatic damage.

This reduction in the mean AST and ALT activity after a short-term consumption of coffee is an indication that coffee consumption has positive effects on liver enzymes. This is in line with previously documented reports of similar studies. Amer et al in their study "caffeine intake decreases oxidative stress and inflammatory biomarkers in experimental liver diseases induced by thioacetamide: biochemical and histological study" showed a significant decrease in the means AST and ALT activity following the administration of coffee in rats treated with thioacetamide.<sup>18</sup> Also, Chen et al in their study observed an inverse association between coffee drinking and serum AST levels as well as predicting indices of liver fibrosis after adjusting for potential confounders in subjects with hepatitis B virus (HBV) infection.<sup>23</sup> The mechanism behind the present finding may be as a result of the antioxidant effect of coffee on the liver which stems from its principal bioactive components such as caffeine, chlorogenic acid, and cafestol. The liver is known to produce a lot of free radicals as a result of the elevated metabolism in the mitochondria. Also, some other mechanisms responsible for the beneficial effects of coffee intake on the liver have been hypothesized including immunomodulatory, anti-inflammatory, and antifibrotic mechanisms.<sup>24</sup>

Furthermore, the present study showed a significant reduction in the mean serum levels of TB and unconjugated bilirubin in the participants studied after the consumption of coffee when compared with baseline values respectively. However, there was no significant difference in the mean serum ALP activity ( $p=0.954$ ), as well as conjugated bilirubin level in participants after the consumption of coffee when compared baseline ( $p>0.05$ ). Both bilirubin level and ALP activity when elevated are markers of biliary cholestasis. This is inconsonance with the report of Ikeda et al and Amer et al but in contrast with the report of Onuegbu et al that documented raised mean levels of ALT, AST, ALP and total bilirubin after coffee consumption relative to the baseline values.<sup>18,19,25</sup>

There were significant positive correlations observed in parameters studied before coffee consumption between TB versus UB ( $r=0.882$ ;  $p=0.001$ ), while other remaining parameters did not show significant correlations ( $p>0.05$ ). Also, there were significant positive correlations observed in parameter studied after coffee consumption between TB versus UB ( $r=0.890$ ;  $p=0.001$ ) and negative correlation between AST versus CB ( $r=-0.532$ ;  $p=0.007$ ), while other remaining parameters did not show significant correlations ( $p>0.05$ ).

## CONCLUSION

This study showed significant reductions in the mean serum AST and ALT activity, total bilirubin and unconjugated bilirubin levels with no significant alterations in the mean ALP activity and conjugated bilirubin level in participants studied after short-term

coffee consumption. Thus this study revealed the hepatoprotective effect of coffee intake at short term basis.

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