SUITABILITY OF ROUTINE SAMPLE CONTAINERS, SAMPLING CONDITIONS, AND DIET TYPES CONDURUM ON SOME LIVER FUNCTION PARAMETERS

Eni-Yimini Solomon Agoro[1], Jerry Akpoboloukemi Ombor[2], Samuel Okechukwu Richard[3]

[1]Department of Biochemistry, Faculty of Science, Federal University Otuoke, Bayelsa State, Nigeria.
[2]Department of Chemical Pathology, Federal Medical Centre Yenagoa, Bayelsa State, Nigeria.
[3]Department of Medical Laboratory, Battleford Union Hospital, North Battleford, Saskatchewan, Canada.

Corresponding Author: Eni-Yimini Solomon Agoro

How to cite this article:Solomon Agoro, E.-Y. ., Ombor, J. A. . ., & Richard, S. O. . (2025). SUITABILITY OF ROUTINE SAMPLE CONTAINERS, SAMPLING CONDITIONS, AND DIET TYPES CONDURUM ON SOME LIVER FUNCTION PARAMETERS. Journal of Advance Research in Pharmacy and Biological Science (ISSN 2208-2360) , 11(1), 38-46. https://doi.org/10.61841/cet6gz79

ABSTRACT

Liver function tests (LFTs) are a critical investigation used to evaluate the liver's status. The accuracy of the investigation could be affected by pre-analytical factors, including sample containers, sampling conditions, and dietary types. This study is therefore designed to address the many misconceptions and disagreements associated with the above itemized preanalytical factors. A total of 150 participants were recruited for this study, and were categorized into fasting, starvation, and random. The samples were collected into plain containers, lithium heparin, K_2EDTA, and fluoride oxalate containers simultaneously and separated into plasma and serum. Liver function parameters were analysed using Randox (UK) reagents on an automated chemistry analyzer, and the data on SPSS version 18, using One-Way Anova (Post Hoc-LSD). The study revealed a significant decrease ($p<0.05$) in the concentration of globulin in the starvation group, when compared to the control and random groups, using fluoride oxalate anticoagulant. Random samples tend to be significantly increased in the activities of the AST, ALT, and ALP when compared to the fasting and starvation groups in the plain container. Fasting, starvation, and random samples exhibited a significant decrease in concentration of globulin in K_2EDTA, whereas it increased in fluoride oxalate, when compared to plain and lithium heparin containers. Furthermore, the lipid group exhibited a significant increase in ALP and AST activities when compared to the carbohydrate and protein groups, respectively. The findings of the study have shown the suitability of plain and lithium heparin containers and the preference of random or fasting sampling in LFT estimation.

KEY WORDS: *Liver function tests, anticoagulants, fasting, random, starvation*

1. INTRODUCTION

The liver is composed of four lobes, each with thousands of lobules (small lobes) and eight sections. It is a critical organ in the human body, responsible for a range of functions that support metabolism, immunity, digestion, detoxification, blood filtration, and vitamin storage, among others.1 It comprises around 2% of an adult's body weight.

Liver disease, a prevalent condition, is the ninth-largest cause of death in Western countries and accounts for 4% of all deaths globally. It includes cirrhosis, viral hepatitis, and liver cancer, causing approximately two million fatalities annually and accounting for 4% of all deaths globally. The four main causes of liver disease associated with CLD are chronic hepatitis C virus (CHC), chronic hepatitis B virus (CHB), alcohol-related liver disease (ALD), and non-alcoholic fatty liver disease (NAFLD).2 Liver diseases are diagnosed using a panel of tests known as liver function tests (LFTs). Liver function tests are blood tests that measure different substances produced by your liver, including proteins, enzymes, and bilirubin. High or low levels of various substances can indicate several disease conditions. The liver function tests typically include, but are not limited to, alanine aminotransferase (ALT) and aspartate aminotransferase (AST), alkaline phosphatase (ALP), gamma-glutamyl transferase (GGT), serum bilirubin, prothrombin time (PT), the international normalized ratio (INR), total protein, and albumin. [3-4]

The precision and accuracy of LFT results are multifaceted, including preanalytical, analytical, and post-analytical phases.5 The most overlooked aspect of laboratory analysis is the preanalytical phase, which dictates the precision and accuracy of any laboratory result. This study focused on the choice of blood collection tubes, sampling conditions, and dietary effects.

The tube commonly used in the laboratory could be without an anticoagulant (plain containers) or with an anticoagulant (anticoagulated containers). Routine sample containers mostly used in sample collection in Nigeria are plain containers, K2EDTA, lithium heparin, and fluoride oxalate tubes. Their choices are due to unverifiable data with diverse opinions in the literature.6-8 These containers could be inappropriately selected, resulting in wrong results and consequently invalid therapeutic intervention or treatment.

Additionally, sampling conditions or dietary types are another preanalytical factor commonly considered in medical laboratory investigations. There are some investigations, such as lipid profile or sugar tests, that require 12 hours of fasting (fasting samples). Whereas others, such as renal function tests (RFT), hormonal profile, or cardiac markers assessment, don't require diet restrictions (random samples). The effect of dieting on LFT is also disputed, with different perspectives by researchers.9-12 This has been attributed to the central roles played by the liver in food digestion and assimilation, coupled with the detoxification mechanisms.

Therefore, this study was designed to investigate the effect of routine sample containers, sampling conditions, and dietary types on the accuracy and precision of LFT results. This study will in on measure address many misconceptions and beliefs associated with the itemized preanalytical factors.

2. MATERIALS AND METHODS

LOCATION AREA

The study was conducted at Otuoke in Ogbia Local Government Area of Bayelsa State. Otuoke hosts the Federal University Otuoke, the institution the subjects of the study were drawn.13-18 The subjects were students of the Department of Biochemistry undergoing their final year projects. The blood samples were collected and separated at the Federal Medical Centre, Yenagoa, Otuoke Outreach. The analysis was carried out at Eni-Yimini Laboratory (eL) Limited at Yenezue Gene Epie, Yenegoa, Bayelsa State. the study spanned six months, beginning in December 2024 and terminating in June 2025.

RESEARCH DESIGN/POPULATION SIZE

The research design employed a quantitative experimental design, which is a scientific method to establish the cause-and-effect relationship among the study groups. The sample size was pegged at one hundred and fifty (150) as validated by Araoye.18

3. SELECTION CRITERIA

Subjects who were healthy, free of chronic disease conditions, and not on any form of medication or hard drugs, as observed by the university clinician, were recruited into the study. The acceptable age bracket of the study was pegged between 18-40.

4. ETHICAL APPROVAL

The ethical approval was granted by the Directorate of Research and Quality Assurance (DR&QA) of the Federal University Otuoke, following the laid-down requirements and processes, with a registry number of DR&QA/190/2024.

5. SAMPLE COLLECTION

Blood samples were collected using a simple phlebotomy method by an expert Medical Laboratory Scientist. The samples were collected into plain containers, K2EDTA, lithium heparin, and fluoride oxalate tubes aseptically. The samples were then spun at 3000 rpm for the extraction of serum for the plain containers, and plasma for the anticoagulated containers. Furthermore, the subjects were exposed to diets rich in carbohydrates, proteins, and lipids for three days, and samples were collected in a fasting state, starvation state, and random state into the above-stated blood collection tubes.

6. LABORATORY METHODS

The liver function tests (LFTS) parameters analysed included aspartate aminotransferase (AST), alanine aminotransferase (ALT), alkaline phosphatase (ALP), total protein (TP), albumin (ALB), total bilirubin (TB), and conjugated bilirubin (CB). The parameters were all analysed on a semi-automated analyser (Contec-China) using Randox reagents (UK). The enzymes were analyzed based on the principle of transferase mechanisms, whereas TP, ALB, TB, and CB were analyzed by the spectrophotometric principle.

7. STATISTICAL ANALYSIS

Data were analyzed with the Statistical Package for Social Sciences (SPSS) program (SPSS Inc., Chicago, IL, USA; Version 18–21) and Microsoft Excel. A one-way ANOVA (Post Hoc) was used to compare the means of the various biochemical parameters of the various groups.

8. RESULTS

Table 1: Demographics presentation of the age difference of the subjects

Age range	Frequency	Percentage (%)
18-25	68	68%
26-35	32	32%
Total	100	100%

Table 2: Demographic presentation of gender differences of the subjects

Gender	Frequency	Percentage (%)
Male	47	47
Female	53	53
Total	**100**	**100**

Table 3: Multiple comparison of the effect of fluoride oxalate anticoagulants on the various liver biochemical parameters based on sampling conditions.

Parameters	Control	Fasting	Starvation	Random	F-Value	P- Value
TP (g/L)	64.36 ± 0.94	68.23 ± 4.42[a]	68.70 ± 5.82[a]	71.88 ± 2.90[a]	6.08	0.02
ALB (g/L)	32.58 ± 0.50	42.15 ± 4.40[a]	51.15 ± 6.18[a]	44.84 ± 4.08[a]	32.00	0.00
GLO (g/L)	32.06 ± 0.44	26.08 ± 0.10	17.55 ± 1.72[a]	35.04 ±2.08[b,c]	22.00	0.04
ALP (U/L)	188.15 ± 0.99	38.40±24.90[a]	34.97±24.01[a]	28.41±14.96[a]	167.77	0.00
AST (U/L)	52.10 ± 0.88	20.30 ± 6.41[a]	27.60 ±10.36[a]	21.30 ± 6.04[a]	47.64	0.00
ALT (U/L)	26.90 ± 0.88	10.30 ± 6.77[a]	11.60 ± 4.14 [a]	9.30 ±3.80 [a]	35.28	0.00

Legend: TP- Total Protein; ALB- Albumin ; GLO-Globulin; ALP- Alkaline Phosphatase; AST- Aspartate aminotransferase; ALT- Alanine aminotransferase

Table 4: Multiple comparison of the effect of ethylenediaminetetraacetic acid (EDTA) anticoagulants on the various liver biochemical and glucose parameters based on sampling conditions

Parameters	Control	Fasting	Starvation	Random	F-VALUE	P- VALUE
TP (g/L)	71.33 ± 2.00	57.83 ± 6.95[a]	55.00 ± 3.92[a]	59.45 ± 8.37 [a]	14.66	0.00
ALB (g/L)	30.34 ± 1.79	50.19 ± 4.56[a]	50.21 ± 3.38[a]	45.03 ± 4.83 [a]	57.03	0.00
GLO (g/L)	40.01 ± 0.11	07.64 ± 2.39[a]	05.21 ± 0.18[a]	14.42 ± 3.13 [a,b,c]	13.22	0.00
ALP (U/L)	75.20 ± 1.75	14.80 ± 7.10 [a]	18.10 ± 4.10[a]	15.90 ±6.72 [a]	281.46	0.00
AST (U/L)	29.20 ±1.75	6.20 ± 3.39 [a]	5.40 ± 2.37[a]	5.50 ± 2.17 [a]	221.99	0.00
ALT (U/L)	22.44 ± 1.69	12.49 ± 2.40 [a]	18.55 ± 1 29	23.63 ± 1.66[b]	414.17	0.04

Table 5: Multiple comparison of the effect of plain containers on the various liver biochemical parameters based on sampling conditions

Parameters	Control	Fasting	Starvation	Random	F-value	P-value
TP (g/L)	51.90 ± 0.83	66.28 ±7.25[a]	61.90 ± 4.03[a]	77.55±18.48 [a,b,c]	11.00	0.00
ALB (g/L)	45.10 ± 0.88	49.18 ±3.13	48.26 ± 4.23	47.04 ± 3.02	3.31	0.09
GLO (g/L)	6.8± 0.85	17.10± 4.08[a]	13.64± 0.58[a]	30.51± 1.33[a,b,c]	7.69	0.04
ALP (U/L)	199.00±8.76	94.81±43.38[a]	125.05±47.12[a,b]	167.87±55.13[b,c]	11.72	0.00
AST (U/L)	86.70 ± 2.63	19.90 ±6.89[a]	23.40 ± 8.45 [a]	35.90±22.77[a,b,c]	59.39	0.00
ALT (U/L)	26.70 ± 2.63	5.00 ± 4.52[a]	6.70 ± 2.98[a]	7.80 ± 1.40[a, b]	108.21	0.00

Legend: P ≤ 0.05 Significant, P > 0.05 non-significant.
Groups: A – control, Group B – fasting, Group C – starvation, Group D – random.

Table 6: Multiple comparison of the effect of lithium heparin containers on the various liver biochemical parameters based on sampling conditions

Parameters	Control	Fasting	Starvation	Random	F-value	P-value
TP (g/L)	55.20 ± 0.73	69.44 ±8.55[a]	65.22 ± 4.03[a]	75.33±19.66 [a,b,c]	16.20	0.02
ALB (g/L)	49.10 ± 0.66	51.31 ±4.22	52.01 ± 4.23	50.11 ± 11.01	6.21	0.10
GLO (g/L)	6.4± 0.13	18.13± 4.33[a]	13.21± 0.58[a]	25.22± 60[a,b,c]	8.33	0.05
ALP (U/L)	201.01±9.11	98.88±33.11[a]	129.01±40.13[a,b]	170.32±44.13[b,c]	15.02	0.04
AST (U/L)	90.71 ± 3.33	23.91 ±5.19[a]	27.10 ± 9.22 [a]	40.10±32.56[a,b,c]	45.33	0.03
ALT (U/L)	30.51 ± 3.43	9.01 ± 3.22[a]	9.10 ± 3.18[a]	11.20 ± 5.67[a]	134.11	0.04

Table 7: Effect of routine containers on mean concentrations of LFT Concentrations of the Fasting Group

Parameters mmol/L	Plain	Lithium	EDTA	Fluoride Oxalate	F-value	P-value
TP (g/L)	66.28 ±7.25	69.44 ±8.55	57.83 ± 6.95	68.23 ± 4.42	1.11	0.46
ALB (g/L)	49.18 ±3.13	51.31 ±4.22	50.19 ± 4.56	42.15 ± 4.40	0.45	0.45
GLO (g/L)	17.10± 4.08	18.13± 4.33	07.64± 2.39[a,b]	26.08±0.10[a,b,c]	0.33	0.04
ALP (U/L)	94.81±43.38	98.88±33.11	14.80±7.10[a,b]	38.40±24.90[a,b,c]	34.00	0.02
AST (U/L)	19.90 ±6.89	23.91 ±5.19	6.20 ± 3.39 [a,b]	20.30 ± 6.41[c]	0.11	0.04
ALT (U/L)	5.00 ± 4.52	9.01 ± 3.22[a]	12.49± 2.40[a]	10.30 ± 6.77[a]	0.67	0.04

Table 8: Effect of routine containers on mean concentrations of LFT Concentrations of the Starvation group

Parameters mmol/L	Plain	Lithium	EDTA	Fluoride Oxalate	F-value	P-value
TP (g/L)	61.90 ± 4.03	65.22 ± 4.03	55.00± 3.92	68.70 ± 5.82	0.89	0.07
ALB (g/L)	48.26 ± 4.23	52.01 ± 4.23	50.21±3.38	51.15 ± 6.18	0.33	0.34
GLO (g/L)	13.64± 0.58	13.21± 0.58	05.21±0.18[a]	17.55 ± 1.72[c]	0.55	0.05
ALP (U/L)	125.05±47.12	129.01±40.13	18.10±4.10[a,b]	34.97±24.01[a,b,c]	1.39	0.04
AST (U/L)	23.40 ± 8.45	27.10 ± 9.22	5.40 ± 2.37[a,b]	27.60 ±10.36	0.18	0.05
ALT (U/L)	6.70 ± 2.98	9.10 ± 3.18	18.55±1.29[a,b]	11.60 ± 4.14[a,b]	0.99	0.03

Table 9: Effect of routine containers on mean concentrations of LFT Concentrations of the random group

Parameters mmol/L	Plain	Lithium	EDTA	Fluoride Oxalate	F-value	P-value
TP (g/L)	77.55±18.48	75.33±19.66	59.45±8.37[a,b]	71.88 ± 2.90[c]	0.33	0.05
ALB (g/L)	47.04 ± 3.02	50.11 ± 11.01	45.03 ± 4.83	44.84 ± 4.08	0.59	0.33
GLO (g/L)	30.51±1.33	25.22± 60	14.42±3.13[a,b]	35.04 ±2.08[c]	0.87	0.05
ALP (U/L)	167.87±55.13	170.32±44.13	15.90 ±6.72[a,b]	28.41±14.96[a,b,c]	1.33	0.04
AST (U/L)	35.90±22.77	40.10±32.56	5.50 ± 2.17[a,b]	21.30 ± 6.04[a.b.c]	2.35	0.03
ALT (U/L)	7.80 ± 1.40	11.20 ± 5.67	23.63±1.66[a,b]	9.30 ±3.80[c]	8.33	0.04

Table 10: Multiple comparison of the diet types on liver biochemical parameters

Parameters	Control	Carbohydrate	Protein	Lipid	F-value	P-value
TP (g/L)	51.90±0.88	67.00±4.90[a]	76.38±3.76[a]	84.34±24.70[a,b,c]	8.91	0.00
ALB(g/l)	45.10±0.88	45.10±1.53	47.73±4.16	47.43±3.69	1.55	0.23
Glob (g/L)	6.80+1.23	21.90±3.84[a]	28.65±6.78[a]	36.91±4.16[a,b,c]	6.64	0.23
ALP (U/L)	199.00±8.76	131.99±8.28[a]	147.94±29.54[a]	197.36±41.60[b,c]	3.88	0.02
AST (U/L)	86.70±2.62	25.00±3.46[a]	33.00±7.07[a]	43.60±1.30[a,b,c]	17.84	0.00
ALT (U/L/	26.70±2.62	7.67±2.51[a]	8.50±0.70[a]	7.60±0.89[a]	121.48	0.00

Tables 1 and 2 show the age and gender distributions of the study. Table 3 shows a significant increase (P<0.05) in concentrations of total protein and albumin in the fasting, starvation, and starvation groups, when compared to

the control. Similarly, globulin concentration decreased in the starvation group when compared to the control and random groups. On the contrary, activities of ALP, AST, and ALT decreased significantly ($P<0.05$) in the various sampling conditions, when compared to the controls, using fluoride oxalate. Table 4 shows a significant decrease ($P<0.05$) in concentrations of total protein, whereas albumin increases in the fasting, starvation, and starvation groups when compared to the controls using K_2EDTA. However, globulin decreased significantly in the fasting, starvation, and random conditions when compared to the control. The decrease was more pronounced in the fasting and starvation groups when compared to the control and random groups. On the contrary, activities of ALP, AST, and ALT increased significantly ($P<0.05$) in the controls, compared to the various sampling conditions. Table 5 shows a significant increase ($P<0.05$) in the concentrations of total proteins and globulin in fasting, starvation, and random, compared to the controls using plain containers. Similarly, a significant decrease ($P<0.05$) in the activities of ALP, AST, and ALT was observed in the fasting, starvation, and random groups when compared to the control. Furthermore, random samples tend to be significantly increased ($P<0.05$) in the activities of the stated liver enzymes when compared to the fasting and starvation groups. Table 6 shows a significant increase ($P<0.05$) in the concentrations of total proteins and globulin in fasting, starvation, and random, compared to the controls in lithium heparin containers. Similarly, a significant decrease ($P<0.05$) in the activities of ALP, AST, and ALT was observed in the fasting, starvation, and random groups when compared to the control. Table 7 shows a significant decrease ($P<0.05$) in the concentrations of globulin in EDTA when compared to other containers, whereas that of fluoride oxalate increased. In a similar vein, activities of ALP and AST decreased significantly ($P<0.05$) in the EDTA container, when compared to other containers in fasting samples. Table 8 shows a significant decrease ($P<0.05$) in the concentrations of globulin in EDTA when compared to other containers. In a similar vein, activities of ALP and AST decreased significantly, whereas ALT increased ($P<0.05$) in the EDTA and fluoride oxalate containers, when compared to other containers in starvation conditions. Table 9 shows a significant decrease ($P<0.05$) in the concentrations of total protein and globulin in EDTA when compared to other containers. In a similar vein, activities of ALP and AST decreased significantly, whereas ALT increased ($P<0.05$) in the EDTA container, when compared to other containers under random conditions. Table 10 shows a significant decrease ($P<0.05$) in concentrations of total protein and globulins in the control group when compared to other treatment groups. Also, ALP, AST, and ALT significantly decreased ($P<0.05$) in all treatment groups compared to the controls. Furthermore, the lipid group shows a significant increase ($P<0.05$) in ALP and AST activities when compared to the carbohydrates and protein groups, respectively.

9. DISCUSSION

The demographic presentation captured both age brackets and gender (Tables 1 & 2). This portrayal reflects the unbiased and unskewed tendencies of the study, which form the foundation of empirical studies. Empirical studies are typically designed to rule out bias by applying random sampling and non-discriminatory tendencies. This study followed the same approach as posited in other empirical studies.[19-20]

The effects of sampling conditions were investigated on basic routine sample containers used in medical laboratories (Tables 3-6). The sampling conditions were categorized into control, fasting, starvation, and random. These were individually subjected to the routine containers and statistically compared for a significant difference. The comparison of the control sera to the various sampling conditions using the individual routine containers revealed a significant difference. The increase or decrease in the concentrations or activities of the liver function parameters of the controls compared to other groups could be attributed to the predetermined concentrations of the control. The significant differences observed are not of clinical implication, as controls are guides for the assurance of accuracy and precision of laboratory results.[21]

Moreover, the sampling conditions as related to the individual routine containers indicated significant differences in some of the liver function parameters (Tables 3-6). Globulin concentration decreased in the starvation group when compared to the control and random groups, using fluoride oxalate anticoagulant (Table 3). The decrease could be attributed to the prolonged deprivation of exogenous proteins and carbohydrates; hence, glycogenolysis, leading to the conversion of proteins to energy. Furthermore, random samples tend to be significantly increased in the activities of the AST, ALT, and ALP when compared to the fasting and starvation groups in a plain container (Table 5). The increase in liver function enzymes resulting from random sampling could be due to diet types, considering the central role of the liver in food digestion and detoxification. The stance of this study on the influence of diets on liver function parameters has been validated by other researchers. [11,12,22-23]

Furthermore, the effect of the routine anticoagulants on the individual sampling conditions was investigated. Fasting, starvation, and random samples exhibited a significant decrease in concentration of globulin in K^2EDTA, whereas it increased in fluoride oxalate, when compared to plain and lithium heparin containers (Table 7-9). In a similar vein, activities of ALP and AST decreased significantly in the EDTA container when compared to other containers in fasting, starvation, and random samples (Table 7-9). A decreased concentration of total protein in the K^2EDTA container was also observed in random sampling (Table 9). The pattern of the alterations observed could be attributed to the inhibitory and chelating tendencies of K^2EDTA compared to other routine containers. These alterations could be explained by the mechanisms of the affected anticoagulants, making K^2EDTA and fluoride oxalate a bad choice of sample containers for LFTS.

The mechanism of ethylenediaminetetraacetate (EDTA) is to prevent blood coagulation by forming a stable chelate with calcium ions in the aqueous phase.24 In addition, the pH value of blood is between 7.35 - 7.45, whereas the pH value of K2EDTA is 8.0. On the other hand, fluoride oxalate is commonly used as an anticoagulant for blood glucose determination, as it inhibits enolase. These factors could deprive proteins and enzymes of their natural configuration, leading to the altered concentrations or activities observed in some of the liver function parameters. The mechanisms advanced for K_2EDTA and fluoride oxalate above are in contrast to those of lithium heparin, which affect the antithrombin III (AT-III), by inactivating serine protease, thereby preventing platelet aggregation. The role is restricted to platelets, hence the suitability for protein estimation. The findings of this study contradicted that of Llies et al.[25,] though of protein profiling, where heparin plasma evidenced a high number of detectable proteins, low global variance, and a high similarity to EDTA and citrate plasma, and may therefore also be a useful test tube for blood protein profiling.

Additionally, the effect of consumption of dietary types on LFTS was investigated using the biological macromolecules such as carbohydrates, lipids, and proteins. The study revealed a significant decrease in concentrations or activities of liver function parameters in the control group when compared to other treatment groups (Table 10). Furthermore, the lipid group exhibited a significant increase in ALP and AST activities when compared to the carbohydrates and protein groups, respectively (Table 10). The observation concerning the control comparison to other groups of diets is due to the predetermined concentrations and activities of the liver function parameters, as mentioned above. The increase in ALP and AST activities could be attributed to the central role of the liver in the metabolism of lipids. The liver is the leading site for lipid metabolism, involving not only fatty acid beta-oxidation but also de novo synthesis of endogenous triglycerides and ketogenesis.[26] Furthermore, the relationship between lipid metabolism and liver function enzymes has been reported.[27] This could be buttressed by the reported abnormal LFTS in obesity, where increased serum activities of aminotransferase were observed.[28] On the contrary, the findings of Purkins et al.[12] and Wei et al.,[29] posited an increase in some liver function enzymes as a result of a high-carbohydrate diet.

In summarizing the findings of this study, the choice of containers for liver function tests is hierarchically plain > lithium heparin > fluoride oxalate > K_2EDTA. The use of the last two containers should be discouraged based on the inhibitory and chelating properties of the anticoagulants. Furthermore, on the sampling condition and diet types, starvation and high-fat diets are instigators of a lot of liver metabolic pathways, which could have a direct effect on liver function tests. These empirical findings could be of clinical advantage in advancing medical laboratory results accuracy and precision, especially on liver function tests.

10. CONCLUSION

The findings of the study have shown the suitability of plain and lithium heparin containers in the estimation of liver function tests. Furthermore, the preference for random or fasting sampling, comparable to starvation, is empirically bolstered. Additionally, the effect of dieting on liver function test implicated a high-lipid diet on AST and ALP activities, and this could impede the accuracy and precision of LFTS, and be detrimental to the clinical management of the diseases associated with the utility of liver function parameters.

11. REFERENCES

1. Trefts E, Gannon M, Wasserman DH. The liver. Curr Biol. 2017; 6:27(21):1147-1151.
2. Devarbhavi H, Asrani SK, Arab JP, Nartey YA, Pose E, Kamath PS. Global Burden of Liver Disease: 2023 Update. Journal of Hepatology. 2023;79(2).

3. Lippi G, von Meyer A, Cadamuro J, Simundic AM. Blood sample quality. Diagnosis (Berl). 2019; 26;6(1):25-31.
4. Gowda S, Desai PB, Hull VV, Math AA, Vernekar SN, Kulkarni SS. A review on laboratory liver function tests. Pan Afr Med J. 2009; 22:3:17.
5. Smith L, Villaret-Cazadamont J, Claus SP, Canlet C, Guillou H, Cabaton NJ, Ellero-Simatos S. Important Considerations for Sample Collection in Metabolomics Studies with a Special Focus on Applications to Liver Functions. Metabolites. 2020; 12:10(3):104.
6. Bayot ML, Tadi P. Laboratory Tube Collection. [Updated 2023 Aug 8]. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2025 Jan-. Available from: https://www.ncbi.nlm.nih.gov/books/NBK555991/
7. Kolahdoozan S, Sepanlou SG, Sharafkhah M, Shaker E, Shayanrad A, Malekzadeh R, Merat S, Poustchi H. Effect of Storage Temperature and Time on Stability of Liver Enzymes in Blood Serum. Arch Iran Med. 2020; 1:23(5):296-301.
8. Cruickshank-Quinn C, Zheng LK, Quinn K, Bowler R, Reisdorph R, Reisdorph N. Impact of Blood Collection Tubes and Sample Handling Time on Serum and Plasma Metabolome and Lipidome. Metabolites. 2018;4:8(4):88.
9. Kanamaru M, Nagashima S, Uematsu T, Nakashima M. Influence of 7-day hospitalisation for Phase I study on the biochemical laboratory tests of healthy volunteers. Jpn J Clin Pharmacol Ther. 1989;20:493–503.
10. Kobayashi M, Yamada N, Shibata H, Nishikawa T. Elevation of serum transaminase value after administration of non-toxic drugs in some volunteers for Phase I trials: a study on the selection of volunteers. Jpn J Clin Pharmacol Ther. 1991;22:497–500.
11. Merz M, Seiberling M, Hoxter G, Holting M, Wortha HP. Elevation of liver enzymes in multiple dose trials during placebo treatment: are they predictable? J Clin Pharmacol. 1997;37:791–8.
12. Purkins L, Love ER, Eve MD, Wooldridge CL, Cowan C, Smart TS, Johnson PJ, Rapeport WG. The influence of diet upon liver function tests and serum lipids in healthy male volunteers resident in a Phase I unit. Br J Clin Pharmacol. 2004;57(2):199-208.
13. Zebedee LU, Jeremiah ON, Soroh AE, Agoro ES. Haematological presentations in acute and chronic tramadol intoxication. Toxicol Forensic Med Open J. 2020; 5(1): 26-36.
14. Wankasi MM, Agoro ES, Ikimi CG. Vitreous Humour Biochemical Parameters as Indicators for Corroborating Acute Sniper (Dichlorvos) Induced Death . J Forensic Toxicol Pharmacol. 2020; (2)168.
15. Wankasi MM, Agoro ES, Eidangbe AP. Effects of Acute Alcohol Intoxication on Vitreous Renal Biochemical Parameters in Rabbits. Int. J. Pharm. Sci. Rev. Res. 2020; 62(1): 168-172
16. Agoro ES, Anyiam IV. The Effect of Okra (Abelmoschus esculentus) on the Hepatic Metabolism of Carbohydrates and Lipids. Asian J. Biol. Sci. 2023; 16 (2): 195-201.
17. Alabrah PW, Wankasi MM, George GS, Agoro ES. Effect of Body Mass Index (BMI) on Concentrations of Serum Lipid Profile and Electrolytes in Students of Niger Delta University, Wilberforce Island, Bayelsa State, Nigeria. Annals of Applied Bio-Sciences. 2022; 8(1):11-17.
18. Araoye MO. Sample Size Determination in Research Methodology with Statistics for Health and Social Sciences. Nathadex Publishers, Ilorin. 2004;pp 115-121
19. Markham JL, Richardson T, Stephens JR, Gay JC, Hall M. Essential Concepts for Reducing Bias in Observational Studies. Hosp Pediatr. 2023; 1:13(8):234-239.
20. Ambroggio L, Cotter JM, Hall M. Methodological progress note: a clinician's guide to propensity scores. J Hosp Med. 2022;17(4):283–286
21. Sharma H. Statistical significance or clinical significance? A researcher's dilemma for appropriate interpretation of research results. Saudi J Anaesth. 2021;15(4):431-434.
22. Rosenzweig P, Brohier S, Zipfel A. Data on placebo in healthy volunteers: impact of experimental conditions on safety, and on laboratory and physiological variables during phase I trials. Therapie. 1996;51:356–7.
23. Rosenzweig P, Miget N, Brohier S. Transaminase elevation on placebo during Phase I trials: prevalence and significance. Br J Clin Pharmacol. 1999;48:19–23.
24. Banfi G, Salvagno GL, Lippi G. The role of ethylenediamine tetraacetic acid (EDTA) as in vitro anticoagulant for diagnostic purposes. Clin Chem Lab Med. 2007;45(5):565-76.

25. Ilies M, Iuga CA, Loghin F, Dhople VM, Thiele T, Völker U, Hammer E. Impact of blood sample collection methods on blood protein profiling studies. Clinica Chimica Acta. 2017;471:128-134.
26. Zou P, Wang L. Dietary pattern and hepatic lipid metabolism, Liver Research. 2023; 7(4):275-284.
27. Rudnick DA, Davidson NO. Functional Relationships between Lipid Metabolism and Liver Regeneration. Int J Hepatol. 2012:549241.
28. El-Eshmawy MM. Impact of obesity on liver function tests: is nonalcoholic fatty liver disease the only player? A review article. Porto Biomed J. 2023; 16:8(5):228.
29. Wei Y, Zhang H, Zhang S, Li H. The influence of diet upon liver function indices of healthy volunteers resident in a Phase I clinical trail. Am J Transl Res. 2019; 15:11(5):3187-3194.