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RESEARCH ARTICLE

PEPTIC ULCER PREVENTIVE AND HEALING EFFECTS OF PHYTOCHEMICALS IN THE FRUIT OF DENNETTIA TRIPETALA

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ABSTRACT

Dennettia tripetala fruits (DTF) is a multi-vitamins rich edible fruit mainly consume as food and seasoning among Africans. The fruit is traditionally used to treat many diseases. The phytochemistry, preventive and healing potential of DTF on peptic ulcer were investigated in this study. The anti-peptic ulcer was assessed using the ethanol-induced ulcer model. The various biochemical markers were used for oxidative stress, lipid metabolism and histopathology of stomach lining. The sample investigated has anti-ulcer effects which significantly indicating good links between the biochemical processes. The ulcer index at 100 mg/kg and 200 mg/kg decreased, thus reducing gastrointestinal discomfort. The extract at 100 mg/kg and 200 mg/kg showed high percentage of protection against ulcers. In addition, a significant increase ($p < 0.05$) was observed in HDL at 100 mg/kg and SOD at 200 mg/kg compared to the ethanol group. The treatment with 100 mg/kg DTF resulted in a significant ($p < 0.05$) reduction of the ulcers scores, with an even greater ($p < 0.05$) reduction observed at 200 mg/kg DTF.

KEYWORDS

Dennettia tripetala, secondary metabolites, anti-ulcer.

1. INTRODUCTION

Natural products from medicinal plants grown in Africa nations are generally system of cheap healthcare and alternative therapy (Gbenga-Fabusiwa et al., 2024; Salemcity et al., 2024; Anuoluwa et al., 2025). Phytochemicals are said to constitute the largest source of therapeutic agents in the entire continent. Africa is home to a remarkable diversity of medicinal plants and is also a focal point of human cultural diversity (Anyamele et al., 2023; Fayehun et al., 2024; Ololade et al., 2025a). The use of natural products as fundamental component of the African traditional healthcare system is perhaps the cheapest and the most assorted of all therapeutic systems. The majority of the medicinal plants have been found to contain active components such as terpenoids, alkaloids, polyphenols etc, which are the basis of their healing and curative properties (Chisamile et al., 2023; Mutombo et al., 2023; Ololade et al., 2024a). Several plants in Africa with promising potentials are used in pharmaceutical industries and drug development (Moiketsi et al., 2023; Chaachouay and Zidane, 2024; Ololade et al., 2025a). Dennettia tripetala is a medicinal plant grown in West Africa. D. tripetala fruit (DTF) has a spicy taste, which makes it highly appreciated by the inhabitants of its region, who consume it as food and seasoning. The fruit is commonly used to treat many diseases, suggesting a historical precedent for its effectiveness (Omage et al., 2021; Mordi et al., 2021). Ulcers are caused by imbalance between the stomach's digestion juices and the stomach lining's protective factors. This imbalance is usually caused by a bacteria infection most especially toxin from Helicobacter pylori or by taking some medications such as aspirin, ibuprofen, naproxen, or other nonsteroidal anti-inflammatory drugs (NSAIDs) (Gupta et al., 2023; Amalia et al., 2024). Helicobacter pylori (H. pylori) is a type of bacteria that infects your stomach. It can damage the tissue in your stomach and the first part of your small intestine (the duodenum). This can cause pain and inflammation. In some cases, it can also cause painful sores called peptic ulcers in your upper digestive tract. H. pylori can damage the protective lining of the stomach and small intestine. This can allow stomach acid to create an open sore (ulcer) (Elbehiry et al., 2023; Reyes, 2023; Ali and AlHussaini, 2024). Most people with H. pylori commonly develop an ulcer problem. Inflammation of the stomach lining. The prevalence of ulcers especially peptic ulcers, is a major health problem worldwide. Peptic ulcer disease, in particular, represents a major global health challenge, affecting millions of people from different populations. Characterized by open sores in the lining of the stomach, upper small intestine, or esophagus, peptic ulcer disease can cause debilitating pain, serious complications, and in extreme cases, death. Standard treatments, although effective, are often associated with side effects, such as high costs, side effects, and the risk of antibiotic resistance (Xie et al. 2022; Emmanuel et al., 2025). These limitations highlight the urgent need for alternative therapeutic strategies that are safe, effective, and affordable. This research aims to provide comprehensive scientific research information on the phytochemical composition, antioxidant and anti-ulcer properties of Dennettia tripetala fruits (DTF). This research supports traditional knowledge of medicinal plants, encouraging the integration of natural products into modern health practices.

2. MATERIALS AND METHODS

2.1 Ethical approval

The study strictly adheres to the guidelines established by the Institutional Animal Ethics Committee, regulated by the Committee for the Control and Supervision of Animal Experiments. All procedures involving animals were performed with the highest standards of supervision and ethical care to ensure their welfare and humane treatment.

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2.2 Collection and Identification of the Sample

The fruit samples were collected from Ondo, Nigeria, where it is grown as a vegetable. It was identified and authenticated as Dennettia tripetala G. Baker which belongs to the Annonaceae family. The voucher specimen of Dennettia tripetala fruit (DTF) was deposited in the herbarium of the University of Medical Sciences, Ondo, Nigeria with a registered number UNIMED PBTH 0187.

2.3 Preparation of the Extract

Air dried pulverized sample was extracted using combined solution of methanol and ethyl acetate (2:1) for at least 3 days with intermittent shaking after which it was subjected to filtration and the concentrated extract was refrigerated until use (Ololade et al., 2025b).

2.4 Phytochemical Analysis using GC-MS analysis with Rtx-1 and Rtx- 5ms columns

A Shimadzu Model GC-2010 Series gas chromatograph, coupled with a Shimadzu series mass-selective detector quadrupole mass spectrometer model GCMS-QP 2010 was used (Shimadzu, Kyoto, Japan). The conditions for the analyses were set as previously reported by Adesina et al., 2022; Ololade et al., 2024a.

2.5 Biochemical protocol

Inducing of the experimental rats, measurement of stomach lesions, preparation of tissue homogenate and preparation of Serum were carried out by methods previously used by Ghareeb et al., 2024. Bovine Serum Albumin (BSA) was used as a standard to determine the concentrations of protein, urea, creatinine, and albumin in the samples. Biochemical markers: Alanine Transaminase (ALT), Aspartate Transaminase (AST), Alkaline Phosphatase (ALP), Total Bilirubin (TBILI); Oxidative Stress Markers: Glutathione (GSH), Superoxide Dismutase (SOD), Catalase (CAT), Malondialdehyde (MDA); Lipid Metabolism Markers: Triglycerides (TRIG), Total Cholesterol (CHOL), Low-Density Lipoprotein (LDL), High-Density Lipoprotein (HDL) and histopathology of tissues were assayed by protocols used by Belinskaia et al., 2021; Ololade et al., 2025a.

2.6 Statistical Analysis

All values were expressed as the mean ± S.E.M. of triplicate. Data were analyzed using one-way ANOVA followed by the Duncan multiple range test for analysis of biochemical data using SPSS (16.0). Values were considered statistically significant at $P < 0.05$.

3. Results And Discussion

3.1 GC-MS analysis of *D. tripetala extract*

Chemical constituents of the fruit extract of D. tripetala analyzed using GC-MS. A total of thirty - three (33) phytochemical were identified which accounted for 99.76% of the total constituents of the extract. The most abundant compositions were: β-phenylethyl benzoate (19.70%), 1,4-dimethyldecahydroquinolin-4-ol (16.00%), 3,5-dihydroxy-6-methyl-2,3-dihydro-4H-pyran-4-one (12.90%), 5,5-dibutyl-6(5H)-imino-2,4(1H,3H)-pyrimidinedione (10.80%), α-methyl-D-galactopyranoside (9.30%), diethyl phthalate (7.10%) and 2,3-diphenylbutane (6.98). The secondary metabolites found in this study are pertinent for medicinal investigation because peptic ulcers are typified by oxidative stress, inflammation, and microbial infections. The phytochemicals such as polyphenols, terpenoids, terpenes, etc in the sample investigated impacted synergistically to produce the expected anti-ulcer potential (Adesina et al., 2022; Fayehun et al., 2024; Salemcity et al., 2024).

Table 1: GC-MS of Screened Phytochemicals in the Extract of Dennettia tripetala Fruit (DTF)

Compound	Retention Index	Percentage Composition
m-picoline	787	0.38
γ-butyrolactone	825	0.20
2-chloro-1-methylpropyl acetate	862	0.54
3-hydroxymethylfuran	885	0.20
3-ethylpyridine	887	0.18
5-methyl-2-furyl) methanol	975	0.18
levulinic acid	1011	0.88
2,5-dimethyl-4-hydroxy-3(2H)-furanone	1022	0.90
1,2,3-propanetriol, 1-acetate	1091	0.90
2-pyridylacetone	1122	0.20
Benzeneethanol	1136	1.64
benzenemethanoic acid	1150	0.20
2,4-dihydroxy-2,5-dimethyl-3(2H)-furan-3-one	1173	0.80
8-methyl-8-azabicyclo[3.2.1]octan-3-amine	1179	0.46
2,6-dimethyl-3,7-octadiene-2,6-diol	1197	0.56
2,6-dimethyl-3,7-octadiene-2,6-diol	1197	0.90
2,6-dimethyl-1,7-octadien-3,6-diol	1227	2.70
3,5-dihydroxy-6-methyl-2,3-dihydro-4H-pyran-4-one	1269	12.90
octahydro-2,2'-bi-2H-pyran	1319	0.20
1,4-dimethyldecahydroquinolin-4-ol	1426	16.00
1-methyl-2-propylpentyl)benzene	1461	0.77
2,3-diphenylbutane	1637	6.98
diethyl phthalate	1639	7.10
tetrahydro-2-furanylmethyl 4-methylbenzoate	1703	0.46
α-methyl-D-galactopyranoside	1714	9.30
3-(1-aziridinyl)-N-[2-(2-pyridinyl)ethyl]-1-propanamine	1736	0.40
5,5-dibutyl-6(5H)-imino-2,4(1H,3H)-pyrimidinedione	1736	10.80
6-acetamido-1,4-benzodioxane	1757	0.85
2-methyl-5-(2,6,6-trimethyl-cyclohex-1-enyl)-pentane-2,3-diol	1766	0.45
β-phenylethyl benzoate	1833	19.70

Table 1 (cont): GC-MS of Screened Phytochemicals in the Extract of Dennettia tripetala Fruit (DTF)		
2,2-dimethyl-3-[3-methyl-5-(phenylthio)pent-3-enyl]oxirane	1950	0.28
sulfurous acid, 2-pentyl undecyl ester	2171	0.50
10-undecenyl hexofuranoside	2651	1.25
Percentage Total		**99.76**

3.2 Ulcer Index and Percentage Protection Results

The ulcer index and percentage protection results (Figure 1 and 2) showed that ethanol group had the highest ulcer index value of 4.2, which ascertained ethanol's potent ulcerogenic attributes and its ability to cause obvious mucosal damage in stomach. This supported the findings of Wang et al. (2024), who emphasized that peptic ulcers can be induced through excessive alcohol consumption. Which was also asserted that the pathophysiology of ethanol-induced stomach ulcers is synonymous to the clinical presentation of human peptic ulceration, which makes ethanol a valid and mostly used model for such experimental studies. The administration of fruit extract from DTF significantly reduced stomach ulceration in a dose-dependent manner. According to the data shown in Figure 1 or 2 and the graphical representation, both 100 mg/kg and 200 mg/kg dosages of DTF extract gives notable protective effects against ethanol-induced stomach lesions. Particularly, the ulcer index values for the 100 mg/kg and 200 mg/kg treatment groups were 1.3 and 1.0, correspondingly. These values indicated a substantial reduction in ulcer severity compared to the ethanol control group. In addition, the 200 mg/kg dose exhibited a comparable anti-ulcer effect to the standard drug cimetidine, which gave an ulcer index of 1.1. This result shows that the fruit extract of DTF has potent anti-peptic ulcer properties like that of standard anti-ulcer drugs. The noticed reduction in ulcer index was due to the presence of bioactive compounds present in the extract, such as phenolics, flavonoids and tannins, which contributed to the increment in the antioxidant activity, inhibited acid secretion and enhanced the mucosal defense. Figure 2 showed the results of the protective effects of different treatments against ethanol-induced injury to stomach tissues. The ethanol-only group (0% treatment) exhibited no protection against peptic ulcer formation. As a matter of fact, the use of ethanol significantly escalated ulceration in the stomach tissues, in agreement with its well-known mucosal damaging effects due to their corrosive effects on the gastrointestinal lining. The development of ulcers is strongly linked to the acidity (pH) of stomach juice and the deteriorating the mucosal defense barrier. Moreover, co-administration of 100 mg/kg of DTF with ethanol resulted in 45.83% protection against ulceration. This medium level of protection shows that the extract has active phytochemicals proficient for mitigating mucosal damage. When the dosage was increased to 200 mg/kg of DTF. The protection rate also increased to 58.33%, which shows a dose-dependent effect of the extract. This observation means that higher doses of the fruit extract are more effective in sheltering the stomach lining from ethanol-induced injury, due to increased concentrations of bioactive compounds that promoted mucosal healing and defense. Strikingly, the standard treatment group, which acquired a known anti-ulcer drug, gave a protection level of 54.17%. Even though this value is a little lower than that observed with the 200 mg/kg DTF group, it is within a comparable range, supporting that the fruit extract at higher doses may be as efficient as conventional treatments. These findings shows the potency of DTF as a natural alternative for mitigating peptic ulcers.

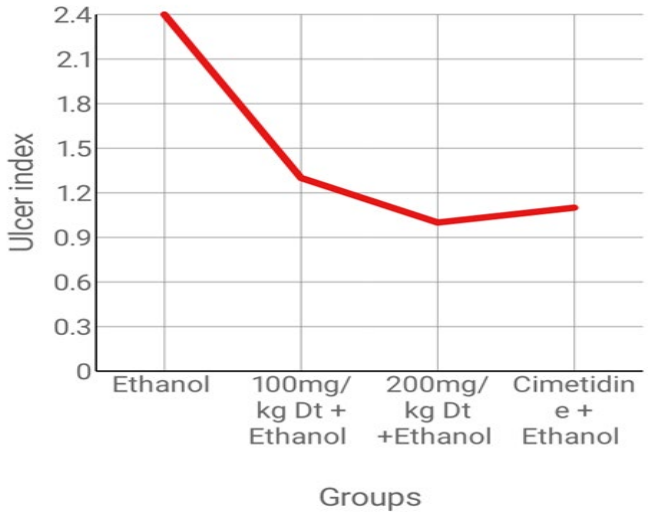

Figure 1: Showing ulcer index in the female albino rats

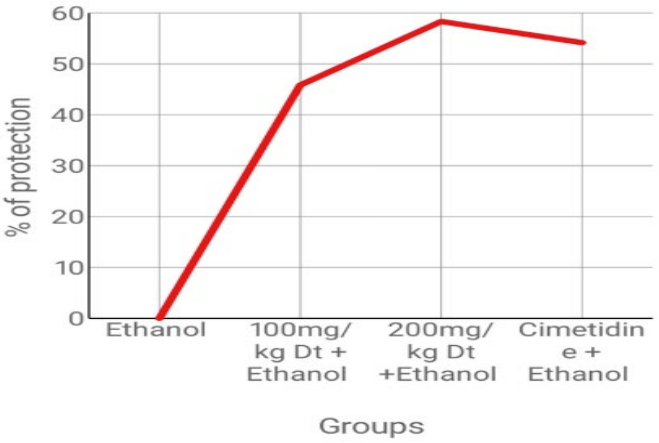

Figure 2: Showing percentage of protection against ulcer

Table 2: Effect of DTF Extract on Gastro-specific Enzymes, Protein and Albumin					
	Corn oil vehicle (control)	**Ethanol Only**	**100 mg /kg b.w. DTF + Ethanol**	**200 mg /kg b.w. DTF + Ethanol**	**100 mg Cimetidine + Ethanol**
ALT	62.13 ± 3.38	78.33 ± 5.94	68.60 ± 8.91	77.73 ± 5.86	68.60 ± 6.02
AST	157.97 ± 20.33	281.60 ± 14.40	206.10± 3.06	178.33±20.45	188.47± 15.79
ALP	189.10 ± 12.13	320.03± 27.41	162.83±23.73	227.83±59.57	127.57±4.38
TBILI	2.55±0.28	2.38±0.27	2.96±0.56	1.96±0.15	3.20±0.10
TPRO	77.23±3.85	94.17±2.18	78.23±5.54	78.23±5.30	79.07±4.26
ALB	32.40±0.91	34.03±1.78	33.37±3.46	28.37±0.64	31.25±3.55

DTF = Dennettia tripetala fruit, ALT = alanine amino transferases, AST = aspartate amino transferases, ALP = alkaline phosphatase, TBILI = total bilirubin, TPRO = total protein, ALB = albumin

Values shown are mean ± standard error of mean of three (3) rats per group. Mean differences were considered significant at ($P < 0.05$).

3.3 Biochemical Effects Of *D. Tripetala* On Some Biochemical Biomarkers

From Table 2 and Figure 3, the ALT results revealed the significant ($p < 0.05$) increase in the induced rats serum with Ethanol only (78.33 ± 5.94) when compared with the control (62.13 ± 3.38). Significant decrease ($p < 0.05$) was observed in DTF 100 mg/kg (68.60 ± 8.91) and 100 mg Cimetidine + Ethanol which is the standard treated group (68.60 ± 6.02) in comparison with the ethanol only group. There was insignificant ($p > 0.05$) reduction in DTF 200 mg/kg (77.73 ± 5.86) in comparison with ethanol only (78.33 ± 5.94). AST revealed significant increase ($p < 0.05$) in the induced rat serum with ethanol only (281.60 ± 14.40) in comparison to the control (157.97 ± 20.33) but there was significant ($p < 0.05$) decrease in the DTF 100 mg/kg (206.10± 3.06), 200 mg/kg (178.33 ± 0.45) and 100 mg Cimetidine + Ethanol (188.47 ± 15.79) when compared with ethanol only group. DTF 200 mg/kg shows significant ($p < 0.05$) decrease compared with the standard drug Table 2 and Figure 3. ALP result shows significant ($p < 0.05$) increase in the induced rat's serum with Ethanol only (320.03 ± 27.41) compared with the Control group (189.10 ± 12.13). Significant ($p < 0.05$) reduction was observed in the DTF 100 mg/kg (162.83 ± 23.73), DTF 200 mg/kg (227.83 ± 59.57) and 100 mg Cimetidine + Ethanol (127.57 ± 4.38) compared with the ethanol group Table 3 and Figure 1. Alanine amino transferases (ALT) which is also termed as serum glutamic pyruvic transaminase (SGPT) plays a vital role in gluconeogenesis (the process that helps the body to form glucose. Increase in ALT, AST and ALP enzymes increases ulcer in the stomach (Jing-Feng et al. 2024). Enhancement of ALT, AST and ALP enzymes in ethanol only groups are all indicative of stomach injury while their reduction proves extract's possession of healing agent which attenuated the marked increase of the enzymes.

Total Bilirubin (TBILI) concentrations were displayed in various experimental groups in Table 2 and Figure 3. Bilirubin concentration in Ethanol only group (2.38±0.27) was slightly reduced in comparison with the control group (2.55±0.28). Enhanced increment ($p<0.05$) was observed in DTF 100 mg/kg (2.96±0.56) when compared with Ethanol only. Marked ($p<0.05$) decrease was however observed in DTF 200 mg/kg (1.96±0.15) when compared with DTF 100 mg/kg. High significance increase ($p<0.05$) was recorded in Cimetidine + ethanol (3.20±0.10) when compared with other experimental groups. Hypobilirubinemia is displayed in ethanol only and DTF 200 mg in TBILI concentrations in experimental animals when compared with control group. Hypobilirubinemia connotes (low) level of bilirubin, the study also showed that the bilirubin concentration was correlated with recovery from extreme study that shows the correlation between extreme and the mortality (Poynard et al., 2023; Tavakoli et al., 2024).

Pre-treatment with extract at DTF 100 mg increased bilirubin level which is comparable to the standard drug treated group while at DTF 200 mg gave rise to low bilirubin levels. Significant ($p<0.05$) increase in protein (T. PRO) concentration of the ethanol induced rat only (94.17±2.18) when compared with control group (77.23±3.85) was observed. Significant reduction ($p<0.05$) was observed by other experimental groups. Difference between DTF 100 mg (78.23±5.54) and 200 mg (78.23±5.30) was non - significant ($p>0.05$) Table 3 and Figure 2. Excessive protein intake can disrupt the balance of our diet, potentially leading to adverse health effects. High dietary protein intake can cause proteinuria (Gang-Jee et al., 2020). Adequate protein is supportive to heal pressure, ulcer and the high intake has an odd impact on healing. Proteinuria was observed in ethanol only group in our findings and this indicates damage of functional integrity of stomach tissues architecture while mitigative effect of fruit extract was observed in the reduction of total protein levels in the serum of experimental rats (Montoro-Huguet et al., 2021).

Albumin concentration (ALB) is displayed in Table 2 and Figure 4 in all experimental groups. Marked increase ($p<0.05$) of ALB was observed in Ethanol only group (34.03±1.78) when compared with the control group (32.40±0.91). Slight reduction was observed in DTF 100 mg/kg (33.37±3.46) in comparison with Ethanol only. Enhanced reduction level ($p<0.05$) was however observed in DTF 200 mg/kg (28.37±0.64) when compared with 100 mg/kg Cimetidine + Ethanol (31.25±3.55) which is the standard group. Albumin is a significant modulator of plasma entotic pressure and transporter of endogenous and exogenous (i.e., drugs) ligands in the stomach. It transports endogenous ligands such as bilirubin, ions, fatty acids, and exogenous ligands such as boxfish drugs. Albuminuria in ethanol induced group was effectively attenuated by the varying doses of extract (DTF 100 and 200 mg). DTF 200 mg however proved to be more potentiated. Severely elevated albumin levels can lead to albuminuria, which exacerbates gastrointestinal symptoms and increases the prevalence of ulcers (Iniestra-Ayllón et al., 2025; Rashidian et al., 2025). Albuminuria is also related with an increased risk of coronary artery disease, heart failure, stroke, arrhythmias, and micro vascular disease (Barzilay et al., 2024; Joshua et al. 2024).

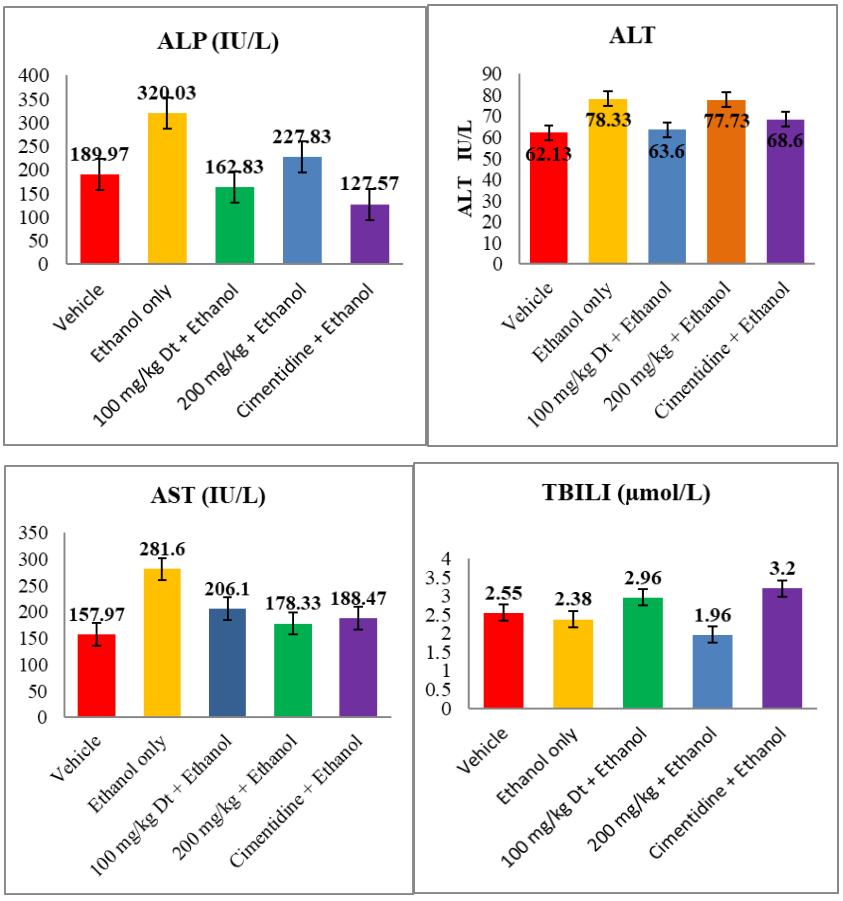

Figure 3: Effect of DTF extract on peptic specific enzymes and bilirubin levels

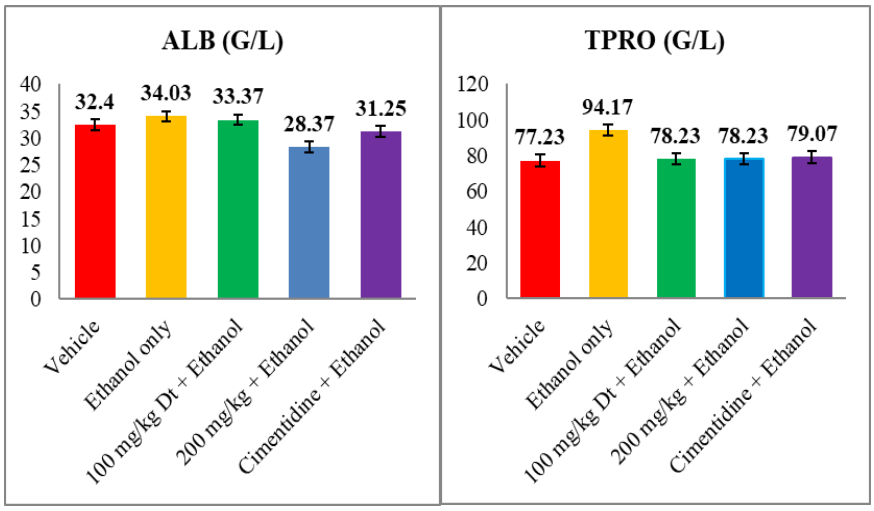

Figure 4: Effect of DTF extract on albumin and protein activities

Table 3: Effect of D. tripetala extract on kidney biomarkers and lipid profile

	Corn oil (vehicle) Control	Ethanol only	100mg/kg DTF + Ethanol	200mg/kg DTF + Ethanol	Cimetidine + Ethanol
UREA (mg/dl)	10.31±0.58	15.52±2.53	11.76±1.48	10.25±0.90	10.08±2.13
CREA (µmol/l)	103.90±4.73	124.18±3.12	108.66±14.12	101.69±7.42	113.09±2.39
TRI (mmol/l)	1.31±0.90	2.94±0.62	2.21±0.21	1.55±0.28	2.53±0.61
CHOL (mmol/L)	2.97±0.19	3.95±0.34	2.87±0.29	2.65±0.37	2.91±0.42
HDL (mmol/L)	1.26±0.05	1.57±0.05	9.80±8.35	1.13±0.15	1.15±0.13
LDL (mmol/L)	0.65±0.20	1.68±0.27	0.42±0.10	0.82±0.35	0.61±0.43

TRI=Triglycerides, CHOL = Cholesterol, HDL = High Density Lipoprotein and LDL = Low Density Lipoprotein. Values shown are mean ± standard error of mean of three (3) rats per group. Mean differences were considered significant at (P<0.05).

Urea results revealed the significant ($p < 0.05$) increase in the induced rats serum with ethanol only (15.52±2.53) compared with the control (10.31±0.58). Marked reduction ($p < 0.05$) was observed in the varying doses of extract at 100 mg/kg (11.76±1.48), 200 mg/kg (10.25±0.90) and 100 mg Cimetidine + Ethanol which is the standard group (10.08±2.13) when compared with the ethanol only group Table 3 and Figure 5.

High concentration of urea leads to uremia which can have a strong impact on the stomach system and lead to uremic encephalopathy characterized by symptoms such as fatigue, confusion, seizures, stupor, and coma. Uremia in ethanol induced group was effectively attenuated by the varying doses of extract (DTF 100 and 200 mg). DTF 200 mg however, proved to be more potentiated. This is however comparable to the standard drug group which is the positive control.

Table 3 and Figure 5 depict creatinine concentration of the experimental albino rats groups. Enhanced ($p < 0.05$) increase of creatinine level was recorded in the induced rats serum with ethanol only (124.18±3.12) compared with the control (103.90±4.73). Significant decrease ($p < 0.05$) was observed in the varying doses of extract at 100 mg/kg (108.66±14.12), 200 mg/kg (101.69±7.42) and 100 mg Cimetidine + Ethanol which is th e standard drug treated group (113.09±2.39) when compared with ethanol only group. Creatinine is a compound measured in the plasma and serum. Higher levels of creatinine were linked to an increased risked of ulcer disease in people with severe disease. In fact, high serum creatinine levels correlate with high mortality in patients (Ávila et al., 2025). Creatinine supplies energy to your stomach and may also promote brain health. Creatinine supplementation has been used as a nutritional strategy to help individuals recover from injury related to ulcer (Forbes et al. 2022). Enhanced creatinine levels in Ethanol induced group was effectively attenuated by the varying doses of extract (DTF 100 and 200 mg). DTF 200 mg however proved to be more potent. This further proved gastro-protective effect of DTF on the stomach tissues. High creatinine was observed in ethanol-induced only group (124.18±3.12) because of the induced ethanol. Creatinine level increased drastically due to the anti-diuretic effect of alcohol which increases and raises the concentration of creatinine (Demnitz et al., 2020). High level of creatinine due to ethanol inducement increase more gastrointestinal symptoms, symptoms of ulcerative colitis and a higher prevalence of peptic ulcer and other forms of inflammatory bowel disease (Bajgai et al., 2022).

Triglycerides (TRI) levels outlined in Table 3 and Figure 5. TRI results revealed the significant ($p < 0.05$) increase in the induced rats serum with ethanol only (2.94±0.62) compared with the control (1.31±0.90). Significant decrease ($p < 0.05$) was observed in the varying doses of extract at 100 mg/kg (2.21±0.21), 200 mg/kg (1.55±0.28) and 100 mg Cimetidine + Ethanol which is the positive control group (2.91±0.42) when compared with the ethanol only group. Triglycerides help store unused calories and provide energy for the body. Triglycerides are the primary form of energy storage in both plants and animals. Elevated triglyceride levels in the blood are referred to as hypertriglyceridemia. When both cholesterol and triglyceride levels in the blood exceed the desired range,

the condition is known as hyperlipidemia (Luna-Castillo et al. 2022). High levels of TRI in ethanol only cause hypertriglyceridemia. A high level of a certain type of fat (triglyceridemia) in the blood refers to a fasting plasma triglyceride measurement that is elevated, usually above 95% (Enkhtugs et al., 2024; Alcover et al., 2025).

The CHOL results revealed the significant ($p < 0.05$) increase in the induced rats serum with ethanol only (3.95±0.34) compared with the control (2.97±0.19). Significant decrease ($p < 0.05$) was observed in the varying doses of extract at 100 mg/kg (2.21±0.21), 200 mg/kg (1.55±0.28) and 100 mg Cimetidine + Ethanol which is the standard treated group (2.91±0.42) when compared with the ethanol only group. There was significant ($p < 0.05$) reduction in DTF 200 mg when compared with control group Table 3 and Figure 5. Cholesterol plays a crucial role in several bodily functions, such as cell building and repair, as well as the production of bile and hormones. Cholesterol, a fat-like waxy substance, aids in the formation of cell membranes, hormones, and vitamin D (Paukner et al., 2022; Giraldo-Lorza et al., 2024). Hypercholesterolemia, or high cholesterol, is a significant risk influence on development of atherosclerotic plaques. As lipids accumulate in the vessel wall, smooth muscle cells migrate into the lesion, eventually forming a fibrous plaque that encapsulates the lipid core, protecting it from exposure to the vessel lumen. Cholesterol levels, particularly the ratio of cholesterol to total lipids in very-low-density lipoprotein cholesterol, do not directly influence or cause ulcers (Cao et al., 2022; Mytych et al., 2024).

The HDL results in Table 3 and Figure 6 revealed the significant ($p < 0.05$) increase in the induced rats serum with ethanol only (1.57±0.05) in comparison with the control (1.26±0.05). Significant decrease ($p < 0.05$) was observed in DTF 200 mg/kg (1.13±0.15) and 100 mg Cimetidine + Ethanol which is the standard treated group (1.15± 0.13) when compared with the ethanol only group. DTF 100 mg/kg (9.80±8.35) however, had high significant ($p<0.05$) increment of HDL in DTF in comparison to other experimental albino rats groups. High-density lipoprotein (HDL) cholesterol is often called "good" cholesterol because it aids in removing other types of cholesterol from the bloodstream. Reduced levels of HDL cholesterol have been affiliated to an increased risk of peptic ulcers. HDL contributes to the removal of cholesterol from tissues, including the vascular arterial walls, and supports endothelial function by exerting antioxidant, anti-inflammatory, and anti-apoptotic effects. Additionally, HDL plays a role in endothelial repair, angiogenesis, and enhancing the survival of endothelial cells in the stomach (Jomova et al., 2025).

The LDL results in Table 3 and Figure 6 revealed that there was significant ($p < 0.05$) elevation in the induced rats serum with ethanol only (1.68±0.27) compared with the control (0.65±0.20). Significant decrease ($p < 0.05$) was observed in the varying doses of extract at 100 mg/kg (0.42±0.10), 200 mg/kg (0.82±0.35) and 100 mg Cimetidine + Ethanol which is the standard treated group (0.61±0.43) when compared with the ethanol only group. LDL cholesterol is often acknowledged to as "bad" cholesterol, and elevated levels have been linked to a higher risk of developing ulcer disease. Low levels of LDL cholesterol are associated with dyspepsia, a condition related to peptic ulcers. Increase in LDL levels in ethanol only group indicates ulceration in the stomach tissue while the decrease level of extract at varying doses demonstrated their gastro-protective activity (Abbas et al., 2024; Ololade et al., 2025b).

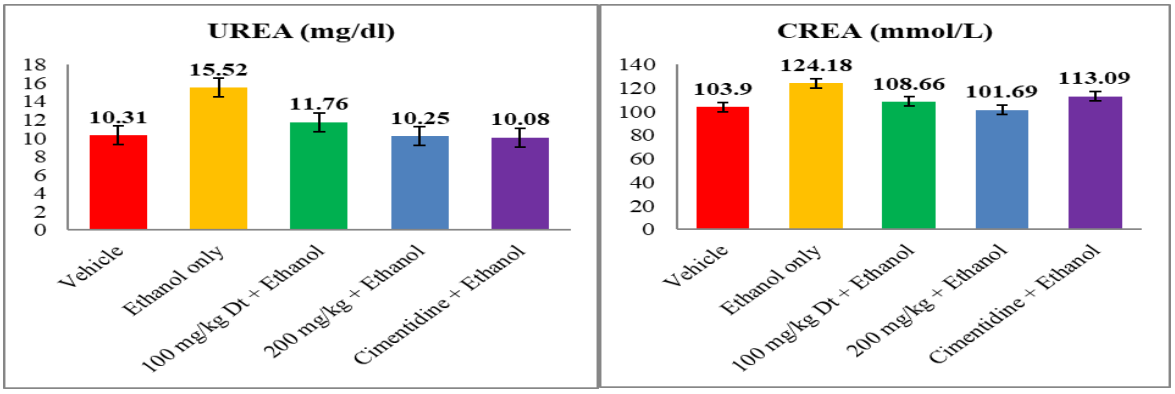

Figure 5: Effect of DTF Extract on Urea and creatinine levels

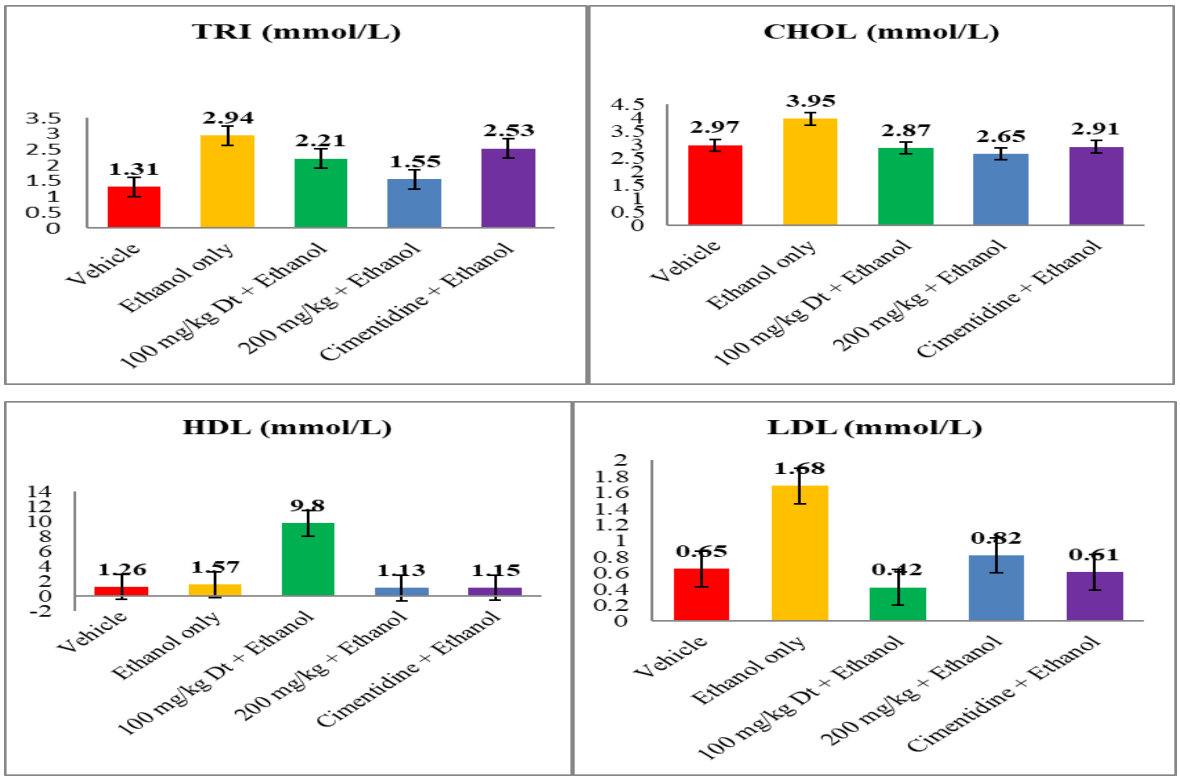

Figure 6: Effects of DTF Extract on Lipid Profile Markers

Table 4: Effect of DTF Extract on Antioxidant Markers

	Control (Vehicle)	Ethanol Only	100 mg/kg DTF+ Ethanol	200 mg/kg DTF + Ethanol	Cimetidine + Ethanol
GSH	22.28±1.08	27.44±0.87	24.34±0.49	24.55±0.93	26.51±0.19
SOD	2.91±0.20	2.90±0.04	2.86±0.09	2.93±0.05	2.92 +_0.13
CAT	10.59±0.19	15.73±0.45	13.06±0.78	12.98±0.81	11.24±1.55
MDA	0.92±0.04	1.83±0.08	1.34±0.08	1.69±0.15	1.01±0.08

GSH – Glutathione reductase, SOD - Superoxide dismutase, CAT - Catalase, MDA – Malondialdehyde

Antioxidant markers are presented in Table 4 Figure 7. The GSH results revealed the significant ($p < 0.05$) increase in the induced rats serum with ethanol only (27.44±0.87) compared with the control (22.28±1.08). Significant decrease ($p < 0.05$) was observed in the varying doses of extract at 100 mg/kg (24.34±0.49), 200 mg/kg (24.55±0.93) and 100 mg Cimetidine + Ethanol which is the standard drug treated group (26.51±0.19) when compared with the ethanol only group. There was non-significant ($p > 0.05$) increment between extract varying doses at 100 mg and 200 mg/kg DTF groups. Reduced glutathione (GSH) is essential for protecting cells against oxidative damage and the toxic effects of

electrophilic xenobiotics. It plays a key role in maintaining redox balance and is a vital component of the antioxidant defense system, particularly in the stomach. Glutathione reductase activity was increased in both intracellular compartments by ethanol exposure (Georgiou-Siafis et al., 2023).

Table 4 and Figure 7 present SOD levels in the experimental female albino rats. There is insignificant ($p>0.05$) increase in the SOD of the induced rats with ethanol induced only group (2.90±0.04) in comparison with the control group (2.91±0.20). Significant decrease ($p < 0.05$) was observed in the varying doses of extract at 100 mg/kg (2.86±0.09) when compared with control and ethanol only groups. Standard drug treated group 100 mg Cimetidine + Ethanol (2.92±0.13) was slightly significant ($p<0.05$) when compared with the control only group. Marked increase ($p<0.05$) was however observed in 200 mg/kg DTF group (2.93±0.05) in comparison to all experimental groups. This is however comparable to the standard group. DTF extract at 200 mg/kg was able to increase SOD levels in the stomach, thereby making it to scavenge free radicals which tends to harm stomach cells and tissues. SOD, as an antioxidant been the primary line of defense, tend to reduce ulcer. Ethanol metabolism leads to increased formation of O2 and simultaneously enhances the activity of superoxide dismutase (SOD), which helps mitigate free radical production in cells. SOD is a crucial antioxidant enzyme that serves as a defense mechanism against oxidative stress in the body (Zheng et al., 2023; Ololade et al., 2025a).

The CAT results revealed the significant ($p < 0.05$) increase in the induced rats serum with ethanol only (15.73±0.45) compared with the control (10.59±0.19). Significant decrease ($p < 0.05$) was observed in the varying doses of extract at 100 mg/kg (13.06±0.78), 200 mg/kg (12.98±0.81) and 100 mg cimetidine + ethanol which is the standard drug treated group (11.24±1.55) when compared with the ethanol only group. There was slight significant ($p < 0.05$) increment between DTF 100 mg/kg and 200 mg/kg. There is significant increase ($p<0.05$) in extract at 100 mg/kg in comparison to the standard drug treated group Table 4 and Figure 7. Catalase (CAT) is a crucial antioxidant enzyme that plays a significant role in mitigating oxidative stress by breaking down hydrogen peroxide into water and oxygen. It is primarily found in peroxisomes. CAT is involved in ethanol metabolism, where it enhances the ethanol group (15.73 ± 0.45), producing reactive oxygen species (ROS) through ethanol, which then interacts with the CAT-H2O2 complex. Thus, in addition to its established role as a catalytic antioxidant, CAT may also be integral to xenobiotic metabolism (Rasheed, 2024; Anwar et al., 2024).

MDA results in Table 4 and Figure 7 revealed the significant ($p < 0.05$) increase in the induced rats serum with ethanol only (1.83±0.08) compared with the control (0.92±0.04). Significant decrease ($p < 0.05$) was observed in the varying doses of extract at 100 mg/kg (1.34±0.08), 200 mg/kg (1.69±0.15) and 100 mg Cimetidine + Ethanol (1.01±0.08) which is the standard treated group when compared with the ethanol only group. Malondialdehyde (MDA) is widely recognized as an oxidative stress indicator and serves as a physiological metabolite that reflects the effects of oxidation on MDA levels in patients. It indicates the disproportion between reactive oxygen species (ROS) and the biological process's capacity to neutralize these transient intermediates (Cordiano et al., 2023; Ololade et al., 2025b). The MDA activity increased drastically after the infiltration of ethanol into the rats for ulceration therefore increasing the oxidative stress (MDA). It was observed that oxidative stress was triggered with the induction of ethanol only while been ameliorated in the extract treated groups making our extract to be potent.

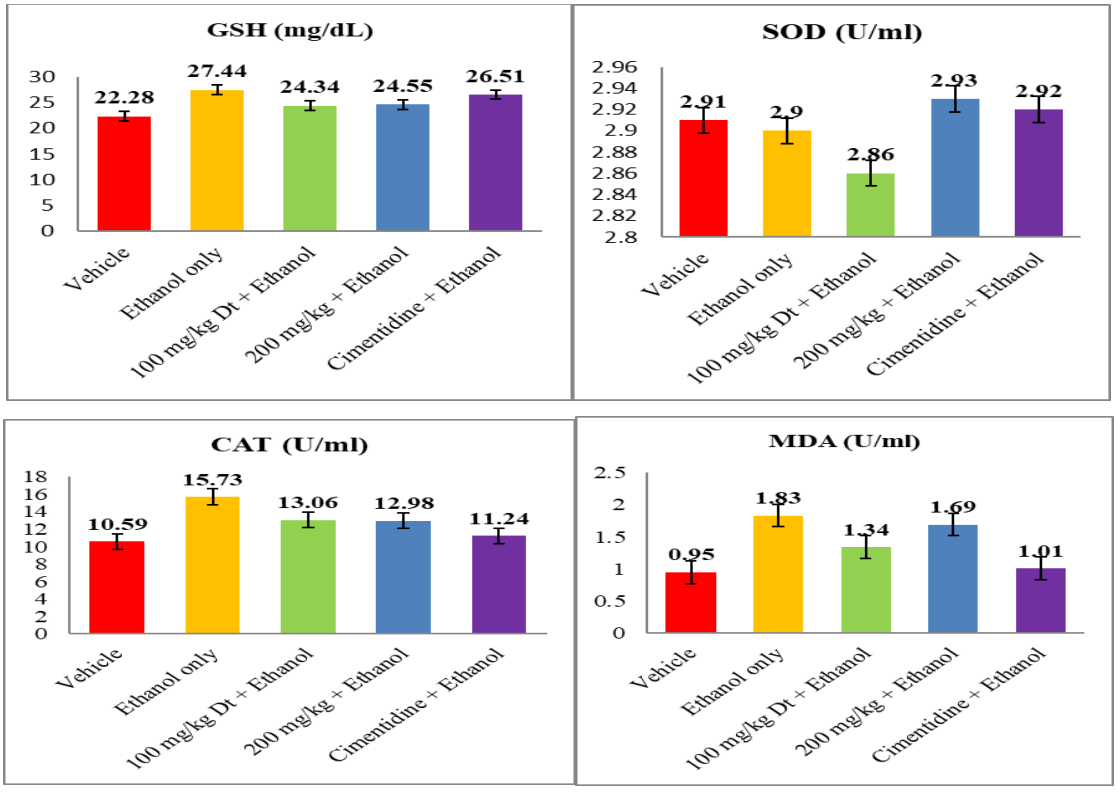

Figure 5: Showing the effect of DTF Extract on Antioxidant Markers

3.4 Histopathology

- **Control (vehicle):** The histological tissue section displays a healthy muscularis propria layer, intestinal crypts, and mucosal lining cells, with no signs of abnormalities. Normal stomach tissue is X100 H&E STAIN.
- **Ethanol only:** Histologic section of tissue shows partial loss of mucosa, mucosal glands displayed on a lamina propria containing intense infiltrates of inflammatory cells within the villi. Severe mucosal erosion is due to the ethanol that was induced for the ulceration in the rat. H & E STAIN X100.
- **100 mg/kg DTF + Ethanol:** The histological shows partial loss of mucosa mucosal glands displayed on a lamina propria containing intense infiltrates of inflammatory cells within the villi. Moderate mucosal erosion X100 H&E STAIN.
- **200 mg/kg DTF + Ethanol:** Histologic section of tissue shows partial loss of mucosa, mucosal glands displayed on a lamina propria containing intense infiltrates of inflammatory cells within the villi. Mild mucosal erosion. H & E STAIN X100.
- **Cimetidine + Ethanol**: The histological tissue section reveals the presence of a viable muscularis propria layer, intestinal crypts, and mucosal lining cells. No abnormalities were seen. Normal stomach tissue X100 H&E STAIN. This is similar to the findings made by Sadaf, 2022.

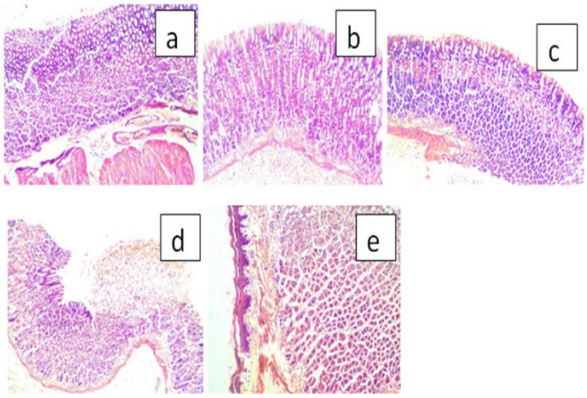

Plate 1: Photomicrograph of stomach tissues

Plate 1: Histological analysis of pre-treated stomach tissues sections of female albino rats. Stomach tissues were stained with H&E (×100).

- Control group (vehicle): Indicating normal stomach tissues, no abnormalities were seen.
- Ethanol only: showing severe mucosal erosion inflammatory cells.
- 100 mg/kg DTF + Ethanol: showing moderate mucosal erosion.
- 200 mg/kg DTF + Ethanol: showing mild mucosal erosion.
- Cimetidine + Ethanol: Showing normal stomach tissue, no abnormalities was seen.

4. Conclusion

This study showcased the growing of knowledge on natural interventions for peptic ulcers and the development of effective therapeutic strategies from D. tripetala. The medicinal fruit investigated have anti-ulcer effects which significantly indicating a link between the biochemical processes. The medicinal capacity of the plant are due to phytochemicals. The extract at different doses showed high percentage of protection against ulcers. The results showed that the sample has a high medicinal and anti-ulcer potential, which can be an alternative source of natural therapeutic agents. It is considered as a possible source to develop a new anti-ulcer agent.

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