# HYPOGLYCEMIC AND ANTIHYPERLIPIDEMIC EFFECTS OF ETHANOLIC FRUIT PEEL EXTRACT OF *CARICA PAPAYA (*Linn) IN AN ALLOXAN-INDUCED DIABETIC RATS

Comment [W1]: Improvement in the writing of plant scientific name and English are needed


**Background:** Diabetes mellitus is a severe health concern that is usually linked to a person's lifestyle and genetic variables. Its frequency of occurrence is alarming. Anti- medicines are costly and come with adverse effects. This study aims to evaluate the phytochemical, toxicity profile, antidiabetic and antihyperlipedemic effects of ethanolic fruit peel extract of *Carica papaya linn* in alloxan-induced diabetic rats.

**Methods**: The phytochemical composition was evaluated according to methods described by Trease and Evans [13]. Acute toxicity $_{(LD50,\ oral,\ rats)}$ based on Abdulmumin *et al*. [14]. Diabetes was induced in rats by intraperitoneal administration of alloxan monohydrate (120 mg/kg) while fasting. The rats were divided into 6 groups of 6 albino rats. Group 1 as normal control, group 2 as test control, and group 3 as standard (administrated with 0.1 mg/kg/day of glibenclamide). The ethanolic fruit peel extract of *Carica papaya linn* was administered to groups 4-6 at doses of 100, 200, and 500 mg/kg. 2-6 were induced with diabetes. Blood glucose levels were measured at 0, 3, 6, and 9 hours, 1, 3, 7, 14, 21, and 28 days, and the serum lipid profile was evaluated at the last 28 days.

**Results**: The ethanolic fruit peel extract of *Carica papaya* shows the presence of tannins, saponins, alkaloids, flavonoids, cardiac glycosides, terpenoids, and anthraquinones. The acute toxicity indicated that the fruit peel of *Carica papaya* is practically non-toxic to the experimental rats and its LD50 was found to be greater than 5000 mg/kg. There was a significant reduction in body weight from day 3 to day 28. The decreases in body weight were found in group 5. The extract of *Carica papaya* showed a significant ($p<0.05$) reduction of blood glucose levels from day 3 to 28. Similarly, oral administration of fruit peel extract of *Carica papaya linn* at 100, 200, and 500 mg/kg showed significant decreases in serum cholesterol, triglycerides, and low density lipoprotein (LDL-C) with increases in serum high density lipoprotein (HDL-C).

**Conclusion**: The ethanolic fruit peel extract of *Carica papaya* exhibited potent hypoglycemic and antihyperlipidemic potential in alloxan-induced diabetic rats due to some phytochemical constituent, and it was practically non-toxic to the experimental animals.


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**Keywords***:* Diabetics, Hypoglycemic, *Carica papaya*, Acute Toxicity, Phytochemicals, Antihyperlipedimic

## 1. INTRODUCTION

Diabetes mellitus is a global health problems, Its rate of occurrence is threatening and commonly associated with individual's lifestyle and genetic factors. People in the developing countries are more prone to the disease due to their exposure to the predisposing factors. Diabetes mellitus is a metabolic disorder associated with chronic hyperglycaemia and imbalance of carbohydrate, protein

and fat metabolism. It is characterized by deficiency in insulin secretion [1]. The diabetic state may result in the development of further metabolic disturbances such as dyslipidemia, weight loss, atherosclerosis, gangrene, retinopathy, renal disease, neuropathy and coma [2]. Diabetes mellitus constitutes a major health and socioeconomic burden for diabetic patients and the healthcare providers. The International Diabetes Federation (IDF) also reported that diabetic population in Africa is 19.8 million and this is expected to increase to 41.5 million in 2035 [3]. Anti-diabetic or hypoglycaemic drugs are highly available, but are often expensive and unaffordable due to poverty and usually present side effects. This has led to the belief that natural products are safer because they are more harmonious with biological systems.

**Phytochemicals:** Plants produce Phytochemicals as a protection device. These phytonutrients works based on the specific substance. Served are antioxidants against cancer risks and other cell damages. This includes the carotenoids which are found in carrots and many fruits, the polyphenols which are abundant in grapes and certain types of teas, the allyl sulfides contained in garlic, onions, and leeks. Other phytochemicals like iso-flavones which are found in soy products help with the action of hormones in the body [4].

*Carica papaya* Linn., is an herbaceous plant with prominent leaves (20-60 cm long), and is a member of the *Caricaceae* family, indigenous to the tropical region of Mexico, Central America and northern South America. *C. papaya* is distributed throughout the tropics and subtropics where it is extensively cultivated. The characterized metabolites from the plant are chitinase, glutaminyl cyclase and cysteine endopeptidases of class-II and III from Carica latex[5]; linalool in fruit pulp, and alkaloids such as carpaine, pseudocarpaine, dehydrocarpaine I and II [6] and kaempferol and quercetin[7] in the leaves. On the other hand, there are reports that describe the therapeutic effect of *C. papaya* leaf on dengue and malaria [8] and as anti-inflammatory [9]. Other reports suggest that a fermented papaya preparation significantly reduces plasma glucose levels in healthy subjects and in patients with type 2 diabetes. The hypoglycemic activities of *Carica papaya* have been previously described for its fruit and leaves [10], nevertheless, the available information regarding the fruit peel is deficient [11]. The present study was designed to perform phytochemical analyses of *Carica papaya* fruit peel, toxicity study and to evaluate its hypoglycemic and antihyperlipidemic effects in an alloxan induced diabetic rats.

## 2. METHODS

### Collection and Identification Plant sample

The *carica papaya* fruit peel was collected from Wudil Local government, Kano state, Nigeria. It was authenticated at Biological Sciences Department, Kano University of Science and technology, Wudil, Kano, Nigeria.

### Preparation of Extract.

The fruits peel was washed with clean water and dried at room temperature, after which it was pulverized to coarse powder using mechanical grinder. *Carica papaya* fruit peel ethanolic extract was

**Comment [W6]:** it would be better to display the most recent data instead of the data reported in 2002

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prepared according to Gafna *et al*.,[12] method. One thousand grams (1000g) of the powder *Carica papaya* fruit peel was mixed and soaked in 2000cm$^3$ ethanol in a 2 litres conical flask, the content of the flask was mixed vigorously. The mixture was shaken and top covered with aluminum foil and kept for 48 hours. The ethanolic extract was obtained by filtration using whatman No1 filter paper and concentrated using vacuum evaporator at 60$^o$C in water bath (OSL200 water bath and shaker Grand instrument, Cambridge). The filtrate was evaporated to dry at 40°C producing brown color solid residue (yield: 35% w/w). The residue was weighed and stored in air and water proof containers, kept in refrigerator at 4°C. From this stock, fresh preparation was made whenever required.

Percentage yield(% w/w) =
Weight of the sample extract obtained (g) x 100
Weight of the powdered sampled used (g)

**Qualitative Phytochemicals Screening of *Carica papaya peel* extracts**

The extract obtained was subjected to various qualitative tests for identification of the constituents such as alkaloids, tannins, saponins, glycosides, steroids/triterpenoids, flavonoids and Anthraquinones, by using simple and standard qualitative methods described by Trease and Evans [13].

**Experimental Animals**

Healthy male Wistar albino rats weighing about 150–200 g were used. The animals were housed in poly propylene cages, maintained under standard conditions and fed with standard diet and water *ad-libitum* (12:12 h light:dark cycle; 25 ± 2°C, 35%–60% humidity).The Institutional Animal Ethical Committee of Kano University of Science And Technology, Wudil, approved the study protocol.

**Acute Toxicity Study evaluation of *Carica papaya peel* extracts**

The $LD_{50(Oral, rats)}$ were determined according to Abdulmumin *et al*.,[14] in the first phase the rats were divided into three groups of three rats each and were administered with 10 ,100, and 1000mg/kg of the ethanolic fruit peel extract of *Carica papaya* orally. The rats were observed for mortality and general behavior. In the second phase, the rats were group into five group of one rat each and were administered with ethanolic fruit peel extract of *Carica papaya* at varying dose of 1250, 2000, 2750, 3750 and 5000 mg/kg. The rats were observed for 24 hours for mortality and other signs of toxicity.

**Collection of Blood Samples**

Blood samples were collected by the retro orbital plexus puncture method from overnight fasted rats under light ether anesthesia.

**Induction of diabetes using alloxan monohydrate.**

A single dose (120 mg/kg, b.w., i.p.) of alloxan monohydrate (Sigma Ltd., USA) dissolved in normal saline was used for induction of type 2 diabetes in rats after overnight fasting [ 15]. After 1 h of alloxan administration, the animals were fed standard food and water *ad-libitum*. The animals were stabilized for a week and animals showing blood glucose level more than 250 mg/dl were selected for the study.

**Experimental design**

A total of thirty (30) wister rats were used in this study. And were randomly selected and oup into 6 of 5 rats each. Group 1 served as normal control and were given water and standard diet *ad-libitum*. Group 2- 6 were allowed to fast for 12 hrs and induced with a single dose 120 mg/kg, intraperitonealy of alloxan monohydrate which was dissolved in normal saline a a vehicle. Group 2 served as negative control while group 3 were treated with standard drug (0.1 mg/kg/day of glibenclamide.) finally group 4-6 were administered orally with low, medium and high dose of 100, 200, and 500 mg/kg/day of *Carica papaya* ethanolic fruit peel extract respectively. Fasting blood glucose was determined at 0, 3, 6, and 9 h after administration. Treatment was continued for 28 consecutive days. Fasting blood glucose levels were estimated at 0, 3, 6, 9 hrs 1, 3, 7, 14 and 28 days.

**Determination of blood Glucose level**

Blood glucose levels were estimated using Accu-Check Active® glucose strips and test meter device (Accu-Chek Extra Care, Roche Diagnostics India Pvt. Ltd), which measures the blood glucose level by GOD–POD method (Glucose oxidase-peroxidase method) [16].

**Serum lipids profile determination**

On day 28, blood was collected from overnight fasted rats under ether anesthesia by retro orbital plexus puncture method and was kept aside for 30 min for clotting. By centrifuging the same sample at 6000 rpm for 20 min, the serum was separated and was analyzed for cholesterol by CHOD–PAP method (Cholesteroloxidase-Phenol+amino phenazone), [17] and triglycerides by GPO method (Glycerol-3-phosphate oxidase). VLDL, VHDL [18].

**Statistical Analysis**

The data was statistically analyzed at P-value ($p<0.05$) significantly accepted and a comparison between the groups was performed using one-way analysis of variance (ANOVA), followed by Tukey's test to compare the differences between treatments. All the values were expressed as mean±SEM

## 3. RESULTS AND DISCUSSION

**Qualitative Phytochemicals Screening of Ethanolic Fruit Peel Extract of *Carica papaya***

The presence of tannins, saponins, alkaloids, flavonoids, cardiac glycosides, terpenoids, and anthraquinones was discovered in an ethanolic fruit peel extract of Carica papaya (Table 1.0). Tannins have long been known for their therapeutic qualities and for their physiological action as potent anti-microbials [19]. Saponins are used as expectorants and emulsifiers, and they also have antifungal properties. Alkaloids have been proven to have antibacterial and anti-inflammatory properties. Flavonoids and glycosides are widely utilized in herbal medicine for the treatment of a variety of disorders [20]. Terpenoids have been shown to have antibacterial, anti-hyperglycemic, and immunomodulatory properties [19], while anthraquinones are widely employed to protect plants from a variety of diseases and have high antimicrobial properties [20].

**Table 1.0 Qualitative Phytochemicals Screening of Ethanolic Fruit Peel Extract of *Carica papaya***

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| S/No | Phytochemical | Ethanol extract |
|---|---|---|
| 1. | Tannins | +++ |
| 2. | Saponins | + |
| 3. | Alkaloids | + |
| 4. | Flavonoids | ++ |
| 5. | Cardiac Glycosides | +++ |
| 6. | Terpenoids | + |
| 7. | Anthraquinones | +++ |

**Key**: +=Trace, ++=Moderate, +++= High,++++=Very High,- =Absent

**Acute Toxicity Evaluation of Ethanolic Fruit Peel Extract of *Carica papaya***

The acute lethal study of ethanolic fruit peel extract of *Carica papaya* (Table 2.) shows that no any mortality within 24 hours oral administration of the extract in both phase one and 2 respectively and the LD50 oral rats was found to be greater than 5000 mg/kg body weight.

**Table 2: First Phase $LD_{50}$ (Oral, rat) of Ethanolic Fruit Peel Extract of *Carica papaya***

| Doses in (mg/kg) | Ethanol extract | |
|---|---|---|
| PHASE I | No: of Rat | Mortality |
| 10 | 3 | 0/3 |
| 100 | 3 | 0/3 |
| 1000 | 3 | 0/3 |
| PHASE II | | |
| 1250 | 1 | 0/1 |
| 2000 | 1 | 0/1 |
| 2750 | 1 | 0/1 |
| 3750 | 1 | 0/1 |

| | | |
|---|---|---|
| 5000 | 1 | 0/1 |

$LD_{50}$ Oral, rats of ethanolic fruit peel extract of *Carica papaya* > 5000mg/kg body weight of rats.

The liver is the major site of detoxification in the body for drugs and toxins [21]. The $LD_{50}$ for a particular substance is essentially the amount that can be expected to cause death in half (i.e., 50%) of a group of some particular animal species, usually rats or mice. It is usually expressed as the amount of chemical administered (e.g., milligrams) per 100 grams (for small animals) or per kilogram (for bigger subjects) of the body weight of the test animal [22]. The LD50 obtained at the end of the study is reported in relation to the route of administration of the test substance, e.g., $LD_{50}$ (oral), $LD_{50}$ (dermal) etc. The most frequently performed lethal study is the oral $LD_{50}$. Results obtained from oral studies are important for drugs, food and accidental domestic poisonings. Generally, the smaller the $LD_{50}$ value, the more toxic the substance is and vice versa. $LD_{50}$ values can be compared to other values using a toxicity scale [22].

**Effects of Ethanolic Fruit Peel Extract of *Carica Papaya* on Weight of The Rats In An Alloxan (120 mg/kg. i.p.) Induced Diabetes Rats**

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The effect of ethanolic fruit peel extract of Carica papaya on the weight of rats in an alloxan-induced diabetes study was evaluated for 0–14 days at intervals of 3 days, 7 days, and 14 days at doses of 100 mg/kg, 200 mg/kg, and 500 mg/kg in groups 2–5, while groups 1 and 2 served as normal and test control, respectively, and group 3 was given 0.1 mg/kg/day glibenclamide as the standard drug (table 3). Body weight gain in the normal group varied from 3 to 14 days. A significant reduction (p 0.05) was also found in the diabetic rats when compared with normal control. However, from day 3 to 14, there was a considerable decline in body weight. Body weight loss was observed in group 5, which received 500 mg/kg of ethanolic fruit peel extract of Carica papaya (Table 3). After 14 days, there was a significant decrease in body weight in alloxan-induced diabetic rats. Similarly, the same findings were made in a number of experimental studies on diabetes [23, 24]. The rise in body weight seen in diabetic-induced rats demonstrated that anabolic effects had outweighed catabolic activities. And the weight loss indicated that catabolism had persisted. In the diabetic state, beta-cell death and insulin secretion dysfunction generate physio-metabolic abnormalities such as a decrease in body weight growth. The diabetic rats induced by alloxan were presented with these changes [25].

**Table 3: Effect of Ethanolic Fruit Peel Extract of *Carica Papaya* On Weight Of The Rats In An Alloxan Induced Diabetes Rats**

| Group/doses | Weight of the rats in (g) | | | |
|---|---|---|---|---|
| | 0 days | Day 3 | Day 7 | Day 14 |
| **Group 1** Normal control | 150.75±19.62 | 153.0±19.30 | 154.5±10.24 | 156.5±20.24 |
| **Group 2** Test control induced with 120 mg/kg of alloxan | 125.5±1.43* | 122.33±1.53* | 120.20±1.73* | 110.0±1.33* |
| **Group 3** Induced +0.1 mg/kg/day of glibenclamide | 120.25±5.22[a] | 121.0±19.30[b] | 124.5±20.24[c] | 132.0±1.73[d] |
| **Group 4** Low dose of 100mg/kg of EFPECP | 121.75±1.71[a] | 124.0±2.16[b] | 128.5±2.12[c] | 130.5±3.12[d] |
| **Group 5** Low dose of 200mg/kg of EFPECP | 127.25±1.7[a] | 132.25±1.71[b] | 134.5±2.12[c] | 143.5±4.12[d] |
| **Group 6** High dose of 500 mg/kg of EFPECP | 125.0±1.83[a] | 138.25±1.26[b] | 142.5±2.13[c] | 151.5±2.22[d] |

Results are expressed as mean ±S.E.M, n = 5
Values with asterisks are significantly different at $p<0.05$ when compared with the normal rats.
Values in the same column and row with the same superscript are significantly different at $p<0.05$ when compared with the test control.
EFPECP= ethanolic fruit peel extract of *Carica papaya*

**Effect of Ethanolic Fruit Peel Extract of *Carica papaya* on Blood Glucose Level In An Alloxan (120 mg/kg. i.p.) Induced Diabetes Rats.**

The effects of ethanolic fruit peel extract of *Carica papaya* were evaluated in alloxan-induced diabetic rats. There was a significant rise ($p<0.05$) in serum blood glucose levels in group 2 when compared to the normal control group. This suggests that alloxan causes diabetes by damaging the pancreas' incretin β-cells, resulting in β-cell necrosis mediated by reactive oxygen species (ROS) with increases in calcium concentration, which leads to β-cell destruction [26]. Thus, at 120mg/kg, alloxon caused partial death of β-cells, despite the fact that the animal could become irreversibly diabetic with the possibility of regeneration [27]. The injection of 0.1 mg/kg/day glibenclamide resulted in a significant reduction in serum blood glucose levels in group 2 from 3–28 days (Table 4).

Glibenclamide showed its antihyperglycemic effect by stimulating insulin release from pancreatic β-cells, which reduced hepatic clearance and suppressed the secretion of glucagon. It is the second generation sulfonylurea that inhibits the process of gluconeogenesis [28]. Similarly, acute and chronic administration of ethanolic fruit peel extract of *Carica Papaya* at the doses of 100, 200, and 500 mg/kg for a period of 28 days showed that there was a significant ($P$ <0.05) reduction in the elevated blood glucose level when compared with the test control group. The decrease is in line with that of group 3 administered with standard drugs. Groups 4 and 5, on the other hand, showed a significant decrease in blood glucose levels after chronic administration of 100 and 200 mcg/kg for 28 days, but no significant changes at 3–14 days (Table 4).

**Table 4: Effect of Ethanolic Fruit Peel Extract of *Carica papaya* on Blood Glucose Level In An Alloxan (120 mg/kg. i.p.) Induced Diabetes Rats**

| Groups/Doses | Blood Glucose Level Concentration (mg/dl) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | 0 hr | 3 hrs | 6 hrs | 9 hrs | Day 1 | Day 3 | Day 7 | Day 14 | Day 28 |
| **Group 1** Normal control | 87.5 ± 1.6 | 87.6 ± 1.3 | 87.9 ± 1.9 | 88.2 ± 1.5 | 88.3 ± 1.5 | 88.8 ± 1.3 | 89.7 ± 1.9 | 90.4 ± 1.3 | 89.9 ± 2.3 |
| **Group 2** Test control induced with 120 mg/kg alloxan | 202.3±4.3* | 206.4 ±3.1* | 209.3±3.7* | 211.4±3.1* | 216.5±2.7* | 221.3±1.2* | 228 ± 2.2* | 243.2±7.6* | 289.4±8.8* |
| **Group 3** Induced +0.1 mg/kg/day of glibenclamide | 225.3 ± 5.4[a] | 219.3 ±1.3[a] | 208.3±2.2[a] | 211. ±1.2[a] | 192.1 ± 3.6[a] | 154.2 ± 4.2[ba] | 120.7 ± 2.2[b] | 95.5 ± 1.4[a] | 85.5 ± 2.4[a] |
| **Group 4** Low dose of 100mg/kg of EFPECP | 232.3 ± 2.6[a] | 230.7 ±3.5[a] | 226.7±5.4[b] | 222.3±5.8[b] | 218.7 ± 5.5[a] | 214 ± 5.2[a] | 210 ± 5.2[a] | 178.3 ± 4.9[b] | 157.3 ± 3.4[b] |
| **Group 5** Low dose of 200mg/kg of EFPECP | 240.2 ± 4.5[a] | 235.2 ±5.1[a] | 229.4±7.3[b] | 226.2±6.6[b] | 220.8 ± 6.4[a] | 219.4 ± 4.8[a] | 210.6 ± 4.2[a] | 190.4 ± 3.3[c] | 145.4 ± 3.3[b] |
| **Group 6** High dose of 500 mg/kg of EFPECP | 245.3 ±11.8[a] | 210.1±10.4[a] | 195.3±6.1[d] | 185.3± 2.5[c] | 170.2± 10.2[b] | 150.4 ± 7.7[c] | 130.5 ±3.8[c] | 110.4 ± 2.3[d] | 88.4 ± 3.3[c] |

Results are expressed as mean ±S.E.M, n = 5
Values with asterisks are significantly different at $p<0.05$ when compared with the normal rats.
Values in the same column with the same superscript are statistically similar at $p<0.05$ when compared with the test control.
Values in the same column with the different superscript are significantly different at $p<0.05$ when compared with test control,
EFPECP= ethanolic fruit peel extract of *carica papaya*

The improvements in high blood glucose levels shown with ethanolic fruit peel extract after administration of *Carica papaya* fruit peel to an alloxan-induced diabetic rat could be attributed to a decrease in the rate of intestinal glucose absorption or an increase in peripheral glucose utilization [29]. Translocation of GLUT4 to the plasma membrane in muscle and brown adipose cells, as well as

overexpression of the uncoupling protein-1 in brown adipose tissue and hepatic gluconeogenesis, may all play a role in increased glucose catabolism and hyperinsulinemia [30]. Furthermore, the ethanolic fruits peel extract of *Carica papaya* may act by stimulating the remaining -cells with the release of more insulin, which is a possible mechanism for the β-cells that survived the effect of alloxan [32], while the ethanolic fruits peel extract of *Carica papaya* may act by stimulating the remaining β-cells with the release of more insulin. The ethanolic fruit peel extract of *Carica papaya* decreased the damage produced by alloxan on islets in this investigation, implying that the fruit peel extract is capable of cell regeneration [33].

**Effect Of Ethanolic Fruit Peel Extract of *Carica papaya* on Serum Lipids Profile In An Alloxan (120 Mg/Kg. I.P.) Induced Diabetes Rats.**

After 28 days of oral treatment with ethanolic fruit peel extract of *Carica papaya Linn*, the serum lipid profile of alloxan-induced diabetic rats was examined. When compared to the normal group, blood cholesterol, triglycerides, and lowdensity lipoprotein (LDL-C) levels were considerably higher ($p < 0.05$), whereas serum high density lipoprotein (HDL-C) levels were significantly lower ($p < 0.05$) (Table 5). When comparing group 5 to group 2 test control, the decreases and increases in serum lipid profile were shown to be statistically different ($p < 0.05$).

The increase in blood triglycerides, cholesterol, and LDL-C, as well as the decrease in serum HDL-C, indicated that lipid and protein metabolism were disrupted in diabetic rats [34,35]. Insulin shortage as a result of alloxon damage to the pancreatic cell leads to fat buildup in the bloodstream. Similarly, insulin secretion dysfunction may be linked to lipid metabolism in adipose tissue discharged into the bloodstream [36]. However, oral treatment of *Carica papaya linn* fruit peel extract at a dose of 500mg/kg resulted in significant reductions in serum cholesterol, triglycerides, and low density lipoprotein (LDL-C), as well as increases in serum HDL-C. (HDL-C). *Carica papaya* fruit peel extract has hypoglycemic and antihyperlipedemic properties due to biochemical constituents such as tannins, saponins, alkaloids, flavonoids, cardiac glycosides, terpenoids, and anthraquinones.. And they have been implicated in ameliorating clinical disorders and diseases related to oxidative stress [37].

Many plant extracts, particularly those discovered in Carica papaya linn fruit peel extract, have hypoglycemic and anti-hyperlipedemic properties through altering the activity of enzymes involved in antioxidant, glucose, and lipid metabolism [38]. These compounds inhibit intestinal-glucosidase, pancreatic lipase, and cholesterol esterase activities [40], stimulate insulin secretion, and improve hepatic glutathione levels [39]. They also inhibit intestinal glucosidase, pancreatic lipases, and cholesterol esterase activities. As previously reported [40], disarrangement in serum lipids caused by lipemia in rats was readjusted and returned to normal by the activity of these phytochemicals.

**Table 5: Effect of ethanolic fruit peel extract of carica papaya on serum lipids profile in an alloxan (120 mg/kg. i.p.) induced diabetes rats**

| Groups/Doses | Total cholesterol (mg/dl) | Triacylglycerol (mg/dl) | High density lipoprotein (mg/dl) | Low density lipoprotein (mg/dl) |
|---|---|---|---|---|
| **Group 1** Normal control | 63.61±2.24 | 86.14±11.4 | 31.18±1.31 | 25.12±1.10 |
| **Group 2** Test control induced with 120 mg/kg alloxan | 95.62 ±2.9* | 232.1±17.3* | 21.25±2.09* | 34.15±1.06* |
| **Group 3** Induced +0.1 mg/kg/day of glibenclamide | 60.31±2.34 a | 81.23±10.2 b | 29.28±1.21 c | 21.11±1.03 d |
| **Group 4** Administered with Low dose of 100mg/kg of EFPECP | 70.22 ±2.3a | 190.11±12.3b | 27.15±1.11 c | 27.25±1.16 d |
| **Group 5** Administered with Medium dose of 200mg/kg of EFPECP | 68.42 ±3.1 a | 120.20±11.2b | 30.17±1.22 c | 26.05±1.02 d |
| **Group 6** Administered with High dose of 500 mg/kg of EFPECP | 62.21±2.24 a | 90.13±11.1 b | 32.81±1.31 c | 20.51±1.44 d |

Results are expressed as mean ±S.E.M, n = 5
Values with asterisks are significantly different at $p<0.05$ when compared with the normal rats.
Values in the same column with the same superscript are significantly different at $p<0.05$ when compared with the test control.

## 4. CONCLUSION

The ethanolic fruit peel extract of *Carica papaya* exhibited potent hypoglycemic and antihyperlipidemic potential in an alloxan induced diabetic rats due to some phytochemicals constituent and its practically non-toxic to the wister rats.

**Comment [W12]:** Conclusion section is a place where we state the important findings obtained from the results. It does not repeat what has been stated in the abstract section.

COMPETING INTERESTS DISCLAIMER:

Authors have declared that no competing interests exist. The products used for this research are commonly and predominantly use products in our area of research and country. There is absolutely no conflict of interest between the authors and producers of the products because we do not intend to use these products as an avenue for any litigation but for the advancement of knowledge. Also, the research was not funded by the producing company rather it was funded by personal efforts of the authors.

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