ijlpr 2021; doi 10.22376/ijpbs/lpr.2021.11.6.P67-76

International Journal of Life science and Pharma Research

ISSN 2250-0480

Research Article

Antidiabetic Activity of Ficus Lacor Buch

Effect Of Fruit And Cork Extract Of *Ficus Lacor* Buch Ham On α/β -Glucosidase, α -Amylase, Lipase, Glucose Absorption And Uptake

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Abstract: Fruits of the plant *Ficus Lacor* Buch. Ham. were used traditionally for treatment of diabetes mellitus. The present study was undertaken to evaluate the antidiabetic potential of the plant using *in vitro* approach. Effect of *Ficus Lacor* Buch. Ham. was evaluated using α/β -glucosidase, α-amylase and lipase enzyme inhibition assay methods. The glucose absorption in intestine was evaluated using everted rat jejunum while glucose uptake was evaluated using isolated rat hemidiaphragm. Fruit and cork ethanolic extract was prepared by using soxhlation extraction method. *In vitro* assay of α-glucosidase showed that IC_{50} value of fruit extract was 83.03 µg/ml and cork extract 88.32 µg/ml when compared with control group acarbose. β-glucosidase enzyme was inhibited by fruit and cork extract of plant with IC_{50} value of fruit and cork extract 132.71 µg/ml and 171.93 µg/ml. The extracts further quantify α-amylase inhibitory activity of fruit (IC_{50} 77.93 µg/ml) and cork (IC_{50} 111.94 µg/ml) extract. Lipase inhibitory assay indicated the effect of plant extract on lipase enzyme was not prominent when compared to orlistat. Absorption of glucose through everted rat jejunum was reduced significantly (P ? 0.05) when compared with standard metformin. Effect of fruit and cork extract on rat hemidiaphragm exhibited significant (P ? 0.05) increase in glucose uptake when compared with standard metformin. Result suggests *Ficus Lacor* Buch. Ham. is effective in inhibiting carbohydrate metabolizing enzymes α/β –glucosidase and α-amylase while lipase enzyme was not affected. Fruit and cork extract of the plant was found to reduce significantly glucose absorption in everted rat jejunum. The significant increase in glucose uptake was observed in isolated rat diaphragm. The result reveals *that Ficus Lacor* Buch. Ham. acts by inhibiting carbohydrate metabolizing enzymes, reducing glucose absorption in intestine and increasing glucose uptake in hemidiaphragm.

Keywords: *Ficus Lacor* Buch Ham, α/β-glucosidase, α-amylase, lipase, jejunum, hemidiaphragm, anti diabetic

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Received On 16 June, 2021
Revised On 21 October, 2021
Accepted On 11 November, 2021
Published On 26 November, 2021

Funding This research did not receive any specific grant from any funding agencies in the public, commercial or not for profit sectors.

Citation Mule V. S. and Naikwade N. S. , Effect Of Fruit And Cork Extract Of Ficus Lacor Buch Ham On A/B -Glucosidase, A -Amylase, Lipase, Glucose Absorption And Uptake.(2021).Int. J. Life Sci. Pharma Res.11(6), P67-76
http://dx.doi.org/10.22376/ijpbs/lpr.2021.11.6.P67-76

1. INTRODUCTION

Diabetes mellitus (DM) is a group of disorders characterized by an abnormality in carbohydrate, protein and fat metabolism resulting in an elevated blood glucose level.[1] Depending on insulin availability and sensitivity of insulin, it is classified as insulin dependent diabetes mellitus (IDDM) and non-insulin dependent diabetes mellitus (NIDDM).[2,3] Diabetes mellitus is one of the common diseases affecting about 422 million people in year 2014 and number is expected to be increased to 628 million by the year 2045.[4] Considering many secondary complications associated with diabetes mellitus due to long-term hyperglycemia, it is essential to control blood glucose level within normal range.[5] Depending on type of diabetes, different approaches can be used to control and maintain blood glucose level within normal range. IDDM treatment is focused on increasing insulin level or mimicking the insulin like action, while in NIDDM treatment is focused on increasing the insulin sensitivity.[6] Different approaches to control blood glucose level may be achieved through different modes like reduced carbohydrate digestion, reduced glucose absorption, increased glucose uptake, inhibition of carbohydrate metabolism, reduced gluconeogenesis.[7,8] In prediabetic stage or in NIDDM, it's very important to reduce the dietary glucose absorption or increase the glucose uptake in target organ through increasing insulin sensitivity.[9] Dietary glucose absorption is the major reason to increase postprandial blood glucose level in diabetes mellitus. The dietary carbohydrates in gastrointestinal tract are digested by different metabolizing enzymes α-glucosidase, β-glucosidase and α-amylase which increases glucose absorption in small intestine causing postprandial hyperglycemia.[10] α and β-glucosidase are primary enzymes responsible for metabolism of dietary carbohydrates and are indirectly responsible to increase glucose absorption from small intestine. These two enzymes, if inhibited can be the effective target to control the hyperglycemia in diabetes mellitus.[11] Another enzyme, α-amylase also plays an important role in early metabolism of dietary carbohydrates resulting in to post prandial hyperglycemia due to increased glucose absorption in small intestine. The α-amylase enzyme can also be an effective target to control the post prandial blood glucose level.[12] Already allopathic drugs like acarbose and miglitol are available which acts by inhibiting dietary carbohydrate metabolism through inhibition of metabolizing enzymes.[13] The reduced glucose absorption through small intestine and increased glucose uptake by target organs is the major mechanism to reduce blood glucose level in diabetes mellitus. Many natural plants are proved to be effective against these enzymes which control metabolism of carbohydrates. Considering less side effects and cost effectiveness of plant-oriented drugs, they are gaining more popularity to be used amongst patients suffering from diabetes mellitus.[14] *Ficus Lacor* Buch. Ham. is commonly known as plaksha, a large evergreen plant belonging to the family maraceae. It is also commonly called as pitana, karpari or parkati.[15] Plant was proved to be used traditionally for treatment of arthritis, inflammation, snake bite, fever etc. The traditional beneficial claims may be due to active chemical constituent's long chain alcohols, sterols, beta-sitosterol, lanosterol, triterpenoid, alpha and beta amyrin, lupeol present in the plant.[16] The fruits of *Ficus Lacor* Buch. Ham. were used traditionally for treatment of diabetes mellitus.[17] Considering traditional claims, present study was undertaken to evaluate antidiabetic activity by *in vitro* approach and investigate the probable mechanism of *Ficus Lacor* Buch. Ham.

2. MATERIALS AND METHODS

2.1 Chemicals

Standard drug acarbose and metformin were obtained from Yarrow Chem Products Ltd, Mumbai, India. Other experimental chemicals used were of analytical grade.

2.2 Plant Material

Fresh fruits and cork of *Ficus Lacor* Buch. Ham. were collected in the month of May from Insuli, Sawantwadi, Dist. Sindhudurg, Maharashtra, India. The specimen was authenticated and deposited at the Department of Botany, Shri. Pancham Khemraj Mahavidyalay, Sawantwadi, Maharashtra, India (voucher number 12-B/226/2020 1).

2.3 Preparation of Extract

The collected fruits and cork were air dried without direct exposure to sunlight, coarsely powdered and alcoholic extract prepared using Soxhlet apparatus.[18] Extract was dried by solvent evaporation at 40°C using a rotary evaporator and dried extract was stored in airtight container at 2 - 8°C for further use in experiment.

2.4 Experimental Animals and Ethical Approval

Adult female Wistar rats weighing between 200 to 250 g of body weight were used in the study. All animals were housed at the institutional animal house at an appropriate temperature of (26±1°C) and light controlled (12 hr light: 12 hr dark) room with provision of food (Nutrivet Life Sciences, Pune, Maharashtra, India) and drinking water *ad libitum* was provided to them. The study protocol was approved by the Institutional Animal Ethical Committee of Yashwantrao Bhonsale College of Pharmacy, Sawantwadi, India (Approval No: CPCSEA/IAEC/2019-20/01).

2.5 α-Glucosidase Inhibition Assay

The α-glucosidase enzyme inhibition assay was performed using yeast enzyme α-glucosidase, which acts on substrate 10 mM paranitrophenyl-α-D-glucopyranoside ($_P$NPG). A stock solution of α-glucosidase enzyme was prepared in 100 mM phosphate buffer, pH 6.8. In study different plant extract concentrations (20, 40, 60, 80, 100 and 120 µg/ml) were prepared in dimethylsulfoxide. About 10 µl of different concentrations of plant extract were mixed with 320 µl of 100 mM phosphate buffer (pH 6.8) and 50 µl of 10 mM $_P$NPG in the buffer. Resultant reaction mixture was incubated at 30°C for 5 minutes. In this mixture 20 µl of buffer with 0.5 mg/ml of the enzyme was added, the reaction mixture was incubated at 30°C for 5 minutes. At the end 3.0 ml of 50 mM sodium hydroxide was added which liberates p- nitrophenol and its absorbance was measured at 410 nm wavelength. The enzyme without plant extract was used as a control. Acarbose was used as standard and prepared with same concentrations as that of plant extract and procedure is repeated for standard.[19,20] Percentage inhibition is calculated by using formula 1 shown below

$$Percentage\ inhibition\ = \frac{Absorbance\ of\ control - Absorbance\ of\ test}{\text{Absorbance of control}} \times 100$$

2.6 β-Glucosidase Inhibition Assay

Different concentrations of plant extract (20, 40, 60, 80, 100 and 120 µg/ml) were prepared in dimethylsulfoxide. Take 0.2 ml of all those concentrations to which 0.4 ml of substrate p-nitrophenyl- β-D-glucopyranoside (1 mg/ml) and 0.4 ml phosphate buffer (pH 5) was placed in a tube and incubated at 37°C for 10 minutes. In this about 0.2 ml of enzyme solution β-glucosidase (20 mg/ml) was added and incubated for another 30 minutes at 37°C. The reaction was terminated by adding 2.6 ml of buffer (pH 10). At the end, absorbance was measured at 410 nm wavelength. The enzyme without plant extract was used as a control. Acarbose was used as standard and prepared with same concentrations as that of plant extract and procedure is repeated for standard. Percentage inhibition is calculated by using formula 1.[20,21]

2.7 α-Amylase Inhibition Assay

The pancreatic amylase is used as an enzyme, while starch is used as a substrate for amylase enzyme. The substrate starch (2 mg) was suspended in 0.2 ml, 0.05 M Tris-HCl buffer with pH 6.9 containing 0.01 M $CaCl_2$, the resultant solution was boiled for 5 minutes. The starch solution was incubated for 10 minutes at 37°C. In reaction mixture, 0.2 ml 50% dimethyl sulfoxide and 0.1 ml pancreatic amylase (0.2 ml) was added and incubated for 10 minutes at 37°C. The reaction was stopped by adding 0.5 ml 50% acetic acid. The reaction mixture was centrifuged at 3000 RPM for 5 minutes at 4°C. The absorbance was measured at 595 nm wavelength. The enzyme without plant extract was used as a control. Acarbose was used as standard and prepared with same concentrations as that of plant extract and procedure is repeated for standard. Percentage inhibition is calculated by using formula 1.[20,22]

2.8 Lipase Inhibition Assay

Lipase activity was measured, by using the substrate p-nitrophenyl butyrate (p-NPB). Different concentrations of plant extract (like 20, 40, 60, 80, 100 and 120 mg/ml) were prepared in dimethylsulfoxide. 10 µl of extract and orlistat was taken in test tubes to which freshly prepared lipase (1mg/ml) about 40 µl was added. The tubes were incubated at 37°C for 15 minutes. Then to each tube, substrate 170 µl p-NPB (10 mg/ml) was added and tubes were incubated again for 5 minutes at 37°C. At the end of incubation period, absorbance was read at 405 nm wavelength. The enzyme without plant extract was used as a control. Orlistat was used as standard and prepared with same concentrations as that of plant extract and procedure is repeated for standard. Percentage inhibition is calculated by using formula 1.[20,23]

2.9 Measurement of Glucose Absorption in the Everted Rat Jejunum

Female wistar rats weighing between 200 to 250 g were selected for study purpose. The selected animals were fasted for 24 hr before starting the experiment. The animals were sacrificed by cervical dislocation and dissected to expose small intestines. The part of small intestine located in between duodenum and ileum was identified which was used for further study purpose. The selected jejunum was placed in ice-cold Krebs Ringer solution. The selected rat jejunum was rinsed by using buffer solution and everted inside out with the help of glass rod. It was cut into 5 cm pieces (n = 3). All the pieces were tied tightly from one side while the other side is loosely (knotted) to add glucose solution in it. Through loosely tied end, 2 ml of glucose solution was injected and knots were tightened; care was taken that no solution came out during this process. The jejunum pieces filled with glucose were incubated in 30 ml of the Krebs Ringer solutions in beakers with following grouping-

1. Krebs Ringer solution (control);
2. Krebs Ringer solution and different concentrations of metformin;
3. Krebs Ringer solution and different concentrations of plant extract.

All above group preparations were kept in an incubator in an atmosphere of 95% oxygen and 5% carbon dioxide at 37°C for 90 minutes. After 90 minutes of incubation, glucose sample inside each piece of jejunum were determined by glucose estimation kit. Final result was calculated as glucose absorption (mg) or glucose transported per gm of tissue weight by using following formula.[24,25]

$$Glucose\ absorbed\ (mg) = \frac{(\text{Glucose after absorption} - \text{Glucose before absorption})}{\text{Weight of Jejunum (gm)}}$$

2.10 Measurement of Glucose Uptake in Isolated Rat Hemi-Diaphragm

Female Wistar rats with body weight between 200 to 250 g were selected for study purpose. The selected animals were fasted for 24 hours before starting the experiment. The animals were sacrificed by cervical dislocation and dissected to remove diaphragm. The selected diaphragm was placed in ice-cold Krebs Ringer solution in an atmosphere of 95% oxygen and 5% carbon dioxide. Each diaphragm was cut into two equal hemi-diaphragms and weighed. The hemidiaphragm (n = 3) were incubated in 2 ml of the Krebs Ringer solutions in beakers with following grouping-

1. Krebs Ringer solution (control);
2. Krebs Ringer solution and different concentrations of metformin;
3. Krebs Ringer solution and different concentrations of plant extract.

Make sure that before placing the diaphragm in the kerb's solution, sample was collected from medium for glucose estimation. The tissue was kept for incubation for 90 minutes at 37°C and shaken periodically. At the end of the incubation

period, again Krebs solution sample was collected for glucose estimation. The results obtained were expressed as the amount of glucose utilized by the hemi-diaphragms in mg of glucose per gram of tissue during the 90-minute incubation period. Glucose in krebs ringer media was determined by glucose estimation kit. Final result was calculated as glucose absorption (mg) or glucose transported per gm of tissue weight by using following formula.[25,26]

$$\text{Glucose uptake (mg)} = \frac{(\text{Glucose before uptake} - \text{Glucose after uptake})}{\text{Weight of diaphragm (gm)}}$$

3. STATISTICAL ANALYSIS

The statistical analysis of the results was performed by using software Graphpad prism version no: 5.0. The results obtained were expressed as mean ± SEM (standard error of mean). The statistical analysis of data was made by analysis of variance (ANOVA) followed by Dunnett's test. A value of $P < 0.05$ was considered significant.

4. RESULTS

4.1 α-Glucosidase Inhibition Assay

Investigation of α-glucosidase enzyme inhibitory activity was performed using *in vitro* α-glucosidase inhibition assay method. The results revealed inhibition of α-glucosidase enzyme was concentration dependent for acarbose, fruit and cork ethanoic extract of *Ficus Lacor* Buch. Ham. Results showed, fruit extract exhibited strong enzyme inhibitory action which is comparable with acarbose. The cork extract showed comparatively weak enzyme inhibitory activity. The IC_{50} value of acarbose was found to be 45.24 µg/ml while the IC_{50} value of fruit and cork extract was found to be 83.03 µg/ml and 88.32 µg/ml respectively. The IC_{50} value specifies fruit extract was found to be more effective than cork extract. (Figure 1 and Table 1)

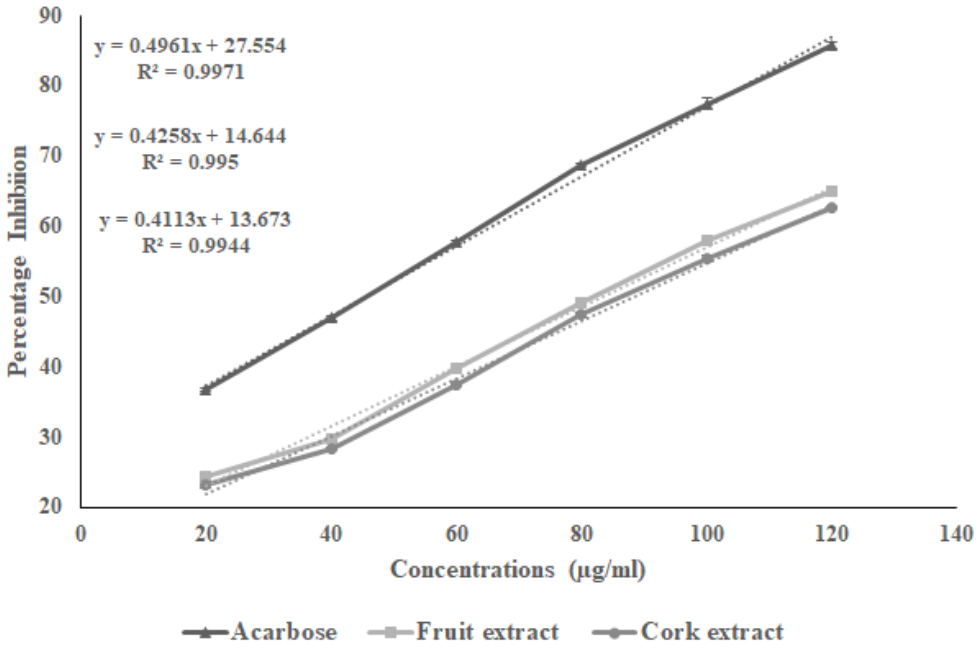


Fig 01: α-glucosidase inhibition assay for fruit and cork extract of F. Lacor Buch. Ham.

Table 01: Median inhibitory activity (IC_{50}) of fruit and cork extract of F. Lacor Buch. Ham. in α-glucosidase inhibition assay

Sample	IC_{50} (µg/ml)
Standard Acarbose	45.24±0.38
Fruit extract of *F. Lacor Buch.* Ham.	83.03±0.59
Cork extract of *F. Lacor Buch.* Ham.	88.32±0.86

Values are mean ± SD; (n = 3)

4.2 β-Glucosidase Inhibition Assay

Results revealed, acarbose fruit and cork extract exhibited concentration dependent inhibition of enzyme β-glucosidase,. Percentage inhibition at higher concentration (120 µg/ml) was found to be 58.63 % for acarbose, while it was found to be comparatively less in fruit extract (45.04%) and cork extract (37.36%). The result showed fruit and cork extract are less effective than acarbose but results are comparable with acarbose. Fruit extract was found to be more effective with IC_{50} value 132.71 µg/ml than cork extract with IC_{50} value 171.93 µg/ml. (Figure 2 and Table 2)

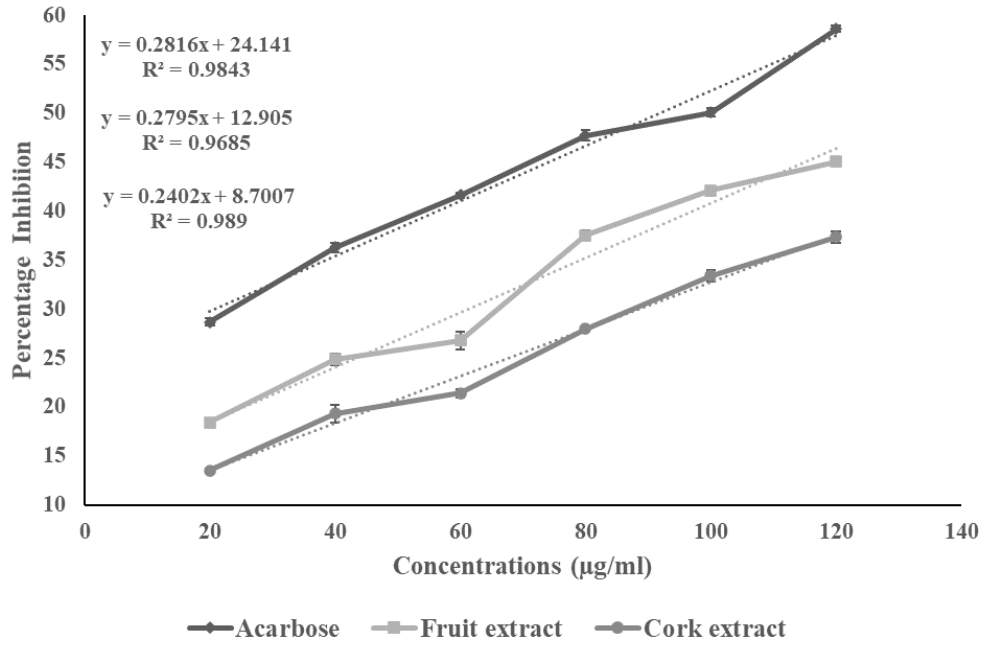


Fig 02: β-glucosidase inhibition assay for fruit and cork extract of F. Lacor Buch. Ham.

Table 02: Median inhibitory activity (IC_{50}) of fruit and cork extract of F. Lacor Buch. Ham. in β -glucosidase inhibition assay

Sample	IC_{50} (µg/ml)
Standard Acarbose	91.82±0.87
Fruit extract of *F. Lacor Buch.* Ham.	132.71±0.84
Cork extract of *F. Lacor Buch.* Ham.	171.93±1.04

Values are mean ± SD; (n = 3)

4.3 α-Amylase Inhibition Assay

Fruit and cork extract was assessed for α-amylase inhibition by using *in vitro* α-amylase inhibition assay method. Result reveals fruit and cork extract inhibits α-amylase enzyme in concentration dependent manner at different concentrations from 20 µg/ml to 120 µg/ml. The enzyme inhibiting ability was found to be comparable with standard drug acarbose. The comparative study indicates, fruit extract was more effective than cork extract, but both are comparatively less effective than acarbose. IC_{50} value of fruit extract (77.93 µg/ml) is lower than cork extract (111.94 µg/ml) indicating the effectiveness of fruit extract. Acarbose was found to be more effective with IC_{50} value of 54.84 µg/ml. (Figure 3 and Table 3)

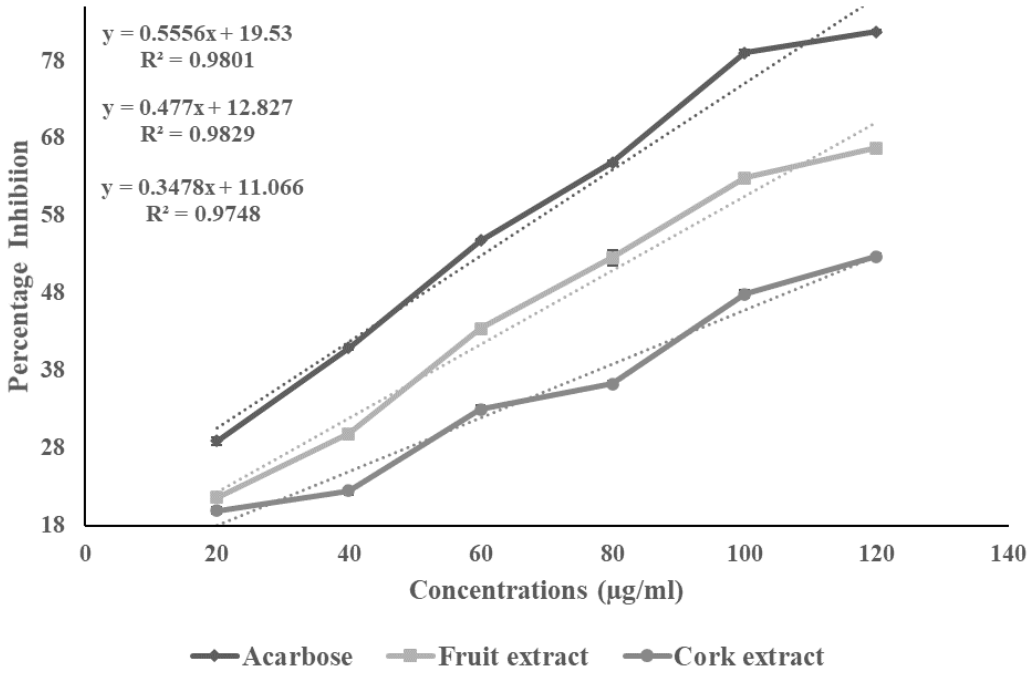


Fig 03: α-amylase inhibition assay for fruit and cork extract of F. Lacor Buch. Ham.

Table 03: Median inhibitory activity (IC_{50}) of fruit and cork extract of F. Lacor Buch. Ham. in α-amylase inhibition assay	
Sample	**IC_{50} (µg/ml)**
Standard Acarbose	54.84±0.73
Fruit extract of *F. Lacor Buch.* Ham.	77.93±0.98
Cork extract of *F. Lacor Buch.* Ham.	111.94±0.90

Values are mean ± SD; (n = 3)

4.4 Lipase Inhibition Assay

Lipase inhibition assay for fruit and cork extract was performed using *in vitro* lipase inhibition assay method. Orlistat at higher concentration of 120 µg/ml inhibited 68.62 % of lipase enzyme. Fruit extract at higher concentration of 120 µg/ml inhibited 20.42 % of lipase enzyme while cork extract inhibited 11.36 % of lipase enzyme. The results indicate the effect of fruit and cork extract on enzyme lipase was not prominent when compared with Orlistat. (Figure 4 and Table 4)

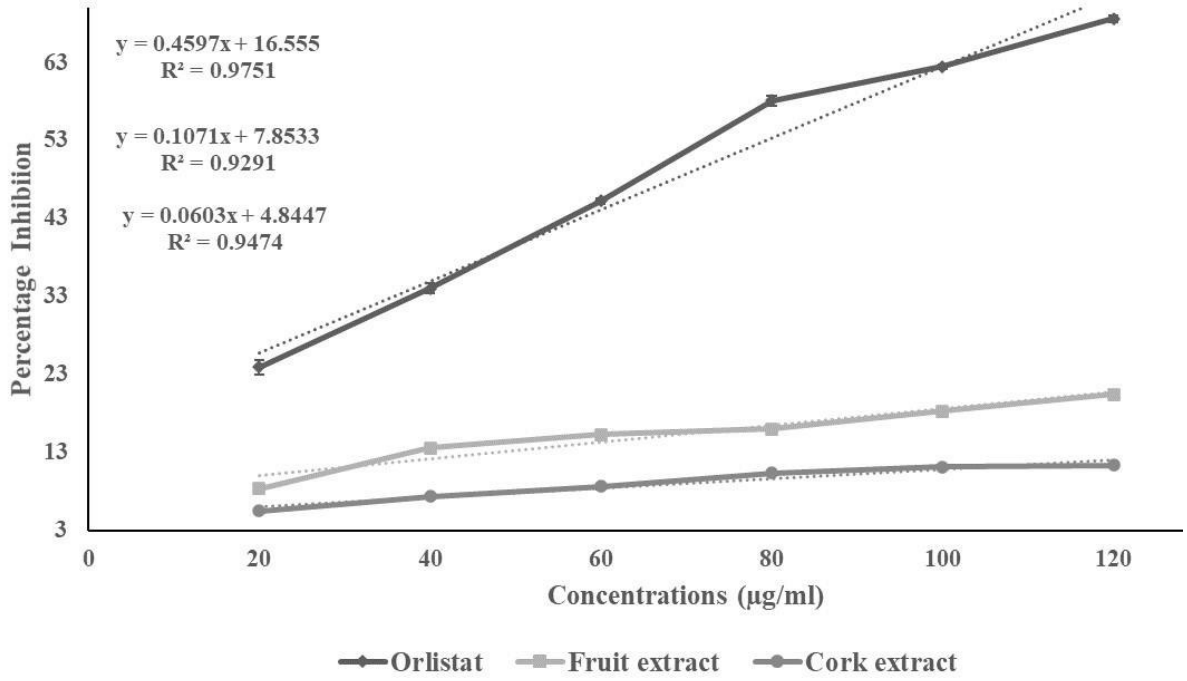


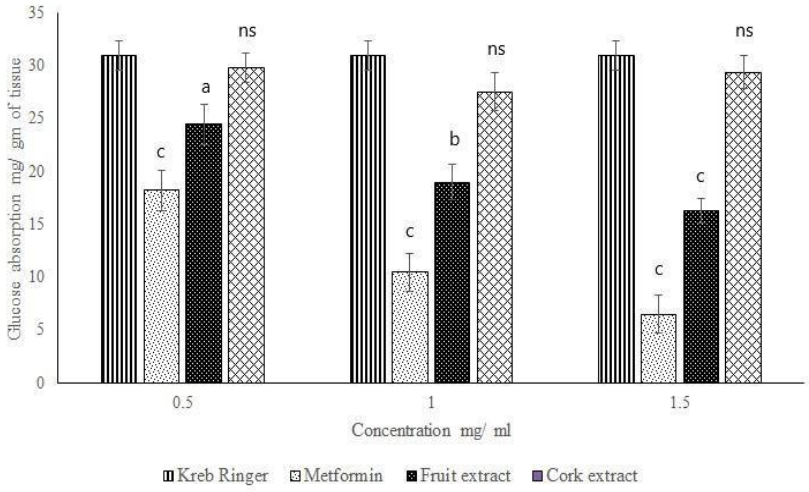
Fig 04: Lipase inhibition assay for fruit and cork extract of F. Lacor Buch. Ham.

Table 04: Median inhibitory activity (IC_{50}) of fruit and cork extract of F. Lacor Buch. Ham. in lipase inhibition assay	
Sample	**IC_{50} (µg/ml)**
Standard Orlistat	72.75±0.81
Fruit extract of *F. Lacor Buch.* Ham.	393.52±0.56
Cork extract of *F. Lacor Buch.* Ham.	748.84±0.75

Values are mean ± SD; (n = 3)

4.5 Measurement of Glucose Absorption in the Everted Rat Jejunum

Effect of metformin, fruit and cork extract of *Ficus Lacor* Buch. Ham. on glucose absorption in everted rat jejunum is shown in figure 5. After incubation for 90 minutes in Krebs ringer solution standard drug metformin, fruit and cork extract exhibited desired effects at different concentrations of 0.5, 1 and 1.5 mg/ ml. The effect of metformin was found to be concentration dependent in which at lower concentration of 0.5 mg/ ml, started to show the inhibition of glucose absorption, while at higher concentration inhibition of glucose absorption was maximum. Metformin at 1.5 mg/ ml significantly ($P < 0.001$) inhibits glucose absorption in everted rat jejunum when incubated for 90 minutes. Fruit and cork extract of *Ficus Lacor* Buch. Ham. also significantly ($P < 0.05$) inhibited glucose absorption in concentration dependent manner at different concentrations of 0.5, 1 and 1.5 mg/ ml. Fruit extract was found to be more effective than cork extract to reduce glucose absorption in everted rat jejunum. (Figure 5)

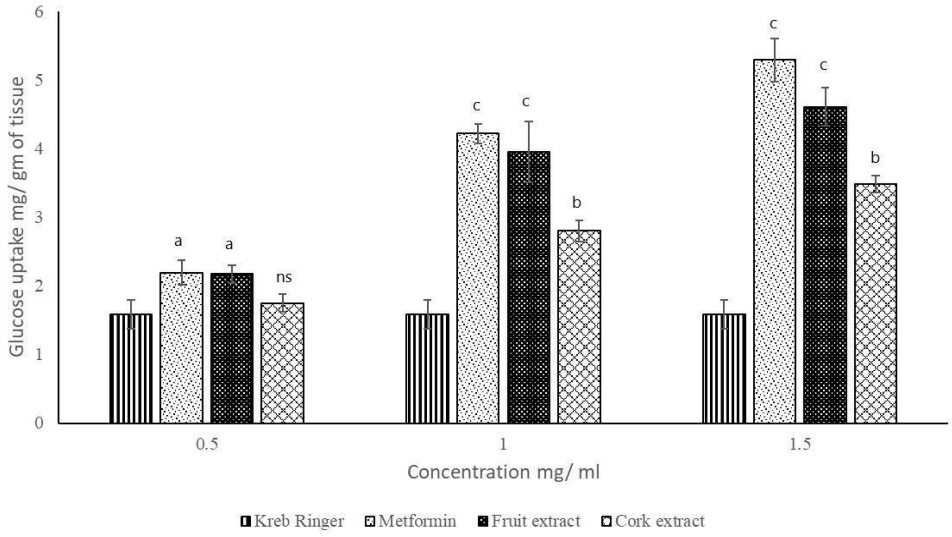


Values are expressed as mean±SEM (n = 3), $^{a}p < 0.05$, $^{b}p < 0.01$, $^{c}p < 0.001$, when compared with kreb ringer control group

Fig 05: Effect on glucose absorption in the everted rat jejunum for fruit and cork extract of F. Lacor Buch. Ham.

4.6 Measurement of Glucose Uptake in Isolated Rat Hemi-Diaphragm

The effect of metformin, fruit and cork extract of *Ficus Lacor* Buch. Ham. on glucose uptake in rat hemidiaphragm after incubation for 90 minutes in Krebs ringer is shown in figure 6. The result reveals that concentration dependent increase in glucose uptake by metformin from lower concentration of 0.5 mg/ ml to higher concentration of 1.5 mg/ ml was observed. The effect of metformin was found to be significant ($P < 0.001$) at higher concentration of 1.5 mg/ ml to increase glucose uptake in rat hemi diaphragm. Fruit extract of *Ficus Lacor* Buch. Ham. exhibited concentration dependent increase in glucose uptake by rat hemi diaphragm. The glucose uptake was found to be significant ($P < 0.05$) at concentration of 1 mg/ ml and 1.5 mg/ ml when compared with Krebs ringer solution. Cork extract of *Ficus Lacor* Buch. Ham. also increases glucose uptake in concentration dependent manner but it was found to be comparatively less than fruit extract. (Figure 6).



Values are expressed as mean ± SEM (n = 3), $^{a}p < 0.05$, $^{b}p < 0.01$, $^{c}p < 0.001$, when compared with kreb ringer control group

Fig 06: Effect on glucose uptake in hemi-diaphragm for fruit and cork extract of F. Lacor Buch. Ham

5. DISCUSSION

Diabetes mellitus is a metabolic disorder characterized by imbalance between carbohydrate, protein and lipid metabolism may be due to reduced insulin secretion or increased insulin resistance.[27] Higher blood glucose level in diabetes mellitus may result in secondary diabetes complications as a result of continuously elevated blood glucose level. The treatment approaches are mainly focused on maintaining normal blood glucose level to avoid probable secondary diabetic complications. The common approach used to maintain blood glucose level within normal range is targeting the enzymes responsible for metabolism of carbohydrates which may elevate blood glucose level.[28] α-glucosidase, β-glucosidase and α-amylase are the enzymes responsible for metabolism of polysaccharides to glucose molecules which increases absorption of glucose responsible for hyperglycemia in diabetes mellitus.[29,30] Metabolism of lipids by lipase enzyme was also studied as dyslipidemia is common with diabetes mellitus.[31,32] α-glucosidase enzyme

hydrolyses glycoside bond in polysaccharides to release glucose molecule.[33,34] Fruit and cork extract of plant was found to inhibit α-glucosidase enzyme which was comparable with standard acarbose. Fruit and cork extract inhibit α-glucosidase enzyme which catalyzes the last step of carbohydrate metabolism resulting in reduced glucose release and reduced hyperglycemia in diabetes mellitus. The result reveals the effect is more at a higher concentration of 120 µg/ml for both fruit and cork extract of *Ficus Lacor* Buch. Ham. β-glucosidase enzyme which is also involved in metabolism of carbohydrates in the last step.[34] This metabolism results in formation of glucose molecules which are easily absorbed resulting in hyperglycemia. The result reveals that the enzyme was inhibited by both fruit and cork extract of *Ficus Lacor* Buch. Ham. which inhibits carbohydrates metabolism and reduces hyperglycemia. α-amylase is an important enzyme involved in starch metabolism which results in to formation of glucose molecules, which increases absorption of glucose and hyperglycemia.[35] The fruit and cork extracts showed inhibitory effect on α-amylase enzyme, and proved its beneficial effect to reduce starch metabolism and reduced the hyperglycemic effect in diabetes mellitus. Lipase is an enzyme responsible for metabolism of lipids which was inhibited by hypolipidemic drugs like orlistat.[36] The fruit and cork extract of the plant was found to have comparatively less effect on lipase enzymes indicating its inability to act on enzyme lipase. The previous study on different species of Ficus was found to be effective against different dietary carbohydrate metabolizing enzymes α/β -glucosidase, and α-amylase.[37] The active chemical constituent present in Ficus plant species is phytosterols, which may be the probable active constituent present in *Ficus Lacor* Buch. Ham. Fruit and cork extract of *Ficus Lacor* Buch. Ham. were studied for prediction of possible mechanisms through glucose absorption and glucose uptake. Glucose uptake study can be performed by different experimental *in-vitro* methods skeletal muscle cell line, isolated diaphragm and isolated rat jejunum.[38,39] The glucose uptake study was performed using isolated rat jejunum and rat hemidiaphragm.[40,41] The result revealed fruit extract of *Ficus Lacor* Buch. Ham. inhibits absorption of glucose in everted rat jejunum. The effect may be similar to metformin which acts by reduction of glucose transporters[42] in jejunum; the same result may be produced by *Ficus Lacor* Buch. Ham. Effect on uptake of glucose by hemidiaphragm indicates concentration dependent increase in glucose uptake from concentration 0.5 mg/ml to 1.5 mg/ml.

6. CONCLUSION

The fruit and cork extracts of *Ficus Lacor* Buch. Ham. revealed remarkable effect on different enzymes responsible for metabolism of carbohydrates in gastrointestinal tract. A remarkable effect was observed on enzyme α-glucosidase inhibiting metabolism of carbohydrates. Another enzyme β-glucosidase also inhibited in dose dependent manner by both fruit and cork extracts of plant. The enzyme α-amylase was inhibited in dose dependent manner and results were comparable with standard drug acarbose. Effects of fruit and cork extract of *Ficus Lacor* Buch. Ham. revealed non-significant effect on lipid metabolizing enzyme lipase indicating no alteration in lipid metabolism and its absorption in gastro intestinal tract. Glucose absorption in everted rat jejunum was inhibited significantly in dose dependent manner, indicating fruit extract is comparatively more effective than cork extract of *Ficus Lacor* Buch. Ham. The fruit and cork extract were found to increase glucose uptake in isolated hemi diaphragm significantly. Considering the effect of plant *Ficus Lacor* Buch. Ham. on different carbohydrate metabolizing enzymes and glucose absorption, it suggested an evidence for probable mechanism of action as natural medicine for treatment of diabetes.

7. ACKNOWLEDGEMENTS

Authors are thankful to the Principal, Yashwantrao Bhonsale College of Pharmacy, Sawantwadi, Maharashtra, India for providing necessary facilities.

8. AUTHORS CONTRIBUTION STATEMENT

The laboratory research work and manuscript preparation were done by Mr. V. S. Mule. The work was performed under the guidance and supervision of Dr. N. S. Naikwade. All the authors read and approved the final version of the manuscript.

9. FUNDING ACKNOWLEDGEMENT

This research did not receive any specific grant from any funding agencies in the public, commercial or not for profit sectors.

10. CONFLICT OF INTEREST

Conflict of interest declared none.

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