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Original Article

Evaluation of anti-diabetic, anti-pyretic and anti-cancer activities of ethyl acetate extract of *Jatropha curcas* linn fruits

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ABSTRACT

The present study justify the potentials of Jatropha curcas linn plant, member of Euphorbiaceae family. The pharmacological studies revealed that Jatropha curcas linn possess wound healing, anti-tumor, anti-metastatic, anti-bacterial, larvicidal, anti-inflammatory, anti-diabetic, anti-inflammatory and anti-arthritic activity. Jatropha curcas linn possess a number of traditional as well as medicinal uses. Jatropha is called by different names in different countries. In general it is also called as Purging tree, Physic nut, curcas nut, Rathan jyot, Barbados nut, Curcas bean, Kukui haole, Purge nut, Katamanak, Kattamanakku, Pepalam, Kadaharalu, Jepal, Kanana Randa.

Key words: Jatropha curcas, Anti-inflammatory, anti-diabetic, anti-arthritic, anti-tumor, anti-metastatic

INTRODUCTION

Medicinal plants have been used as a source of medicine to treat illness since ancient times, as plant derived medicines have made huge contributions to human health, their role is immensive in the development of new drugs. The medical herbs may become the base for development of a medicine, a natural blue print for the development of the new drugs or a phytomedicine to be used for the treatment. The chemical compounds present in the herbal products are a part of the physiological functions of living organisms and hence they are thought to have better compatibility with the human body [1].

OBJECTIVES AND PLAN OF WORK

- To **collect and authenticate** the plant material (fruits of *Jatropha curcas* Linn)
- To **extract** the plant material (fruits of *Jatropha curcas* Linn)
- To **conduct the preliminary phytochemical** screening and finding out the phytoconstituents present in the ethyl acetate extract of fruits of *Jatropha curcas* Linn
- To estimate the **amount of phytoconstituents** present in the ethyl acetate extract of *Jatropha curcas* Linn by means of Quantitative chemical tests.
- To perform the **acute toxicity studies of extract** of *Jatropha curcas* Linn by OECD Guidelines 423
- To carry out the **haemolytic assay** for further anticancer screening procedure.
- To determine the **anti-pyretic activity** of extracts of *Jatropha curcas* Linn
  - Yeast induced pyrexia model
- To determine the in vitro **anti-diabetic** activity of extract of *Jatropha curcas* Linn
  - Alpha amylase inhibition method
- To determine the **anti-cancer** activity of extract of *Jatropha curcas* Linn by DLA cells
  - *In vitro* study
  - *In vivo* study

MATERIALS

Plant Material: The parts used were fruits, collected from Kollam District, Kerala, India.

Animals used for the study: Albino Wistar female rats weighing (200±20g) provided by Pushpagiri College of Pharmacy were used for Anti-Inflammatory activities in this study. Albino swiss male mice with 25g and 30g ranges provided by Amala Cancer Research Centre, Trichur were used for DLA model through this study. Mice and Rats were housed in laboratory transparent plastic cages. Animals were manipulated in strict compliance

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with widely accepted ethical guideline for animal experimentation and kept under poor germ conditions at 24°C and 50-60% humidity and were allowed for food and water *ad libidum* prior to the experiments. Light cycles was artificially controlled to provide 12h of light (12:12 light and dark sequence). The use and care of animals in the experimental protocol has been approved by Institutional Animal Ethical Committee (IAEC) **(Ref.No.PCP/2015/IAEC/1776/03))** following the guidelines of the Committee for Purpose of Control and Supervision of Experiments on Animals (CPCSEA), Government of India.

METHODS

Collection and authentication of *Jatropha curcas* fruits: The fresh fruits of *Jatropha curcas Linn* were collected from Kollam District, Kerala, India. The fruits were authenticated by Dr. Kavitha R, Assistant Prof.of Botany, Government College, Nattakom, Kerala, India. Voucher specimen Number: 106

Preparation of plant extracts [3]: The fruits of *Jatropha curcas* were dried under sunshade for 28 days, powdered by using a blender and weighed. The dried fruit powders were extracted by soxhlet extraction method for 3 hrs at 40-60°c. Ethyl acetate extracts was concentrated to dryness. The extract was dark green solid. The dried extract thus obtained was preserved at 30° C and was used for further studies

Preliminary phytochemical screening of extracts of *Jatropha curcas* linn [4,5]: The ethyl acetate extract of *Jatropha curcas Linn* fruits was subjected for the following tests for identification of various active constituents

1. Test for carbohydrates

a) Fehling's Test: Mix equal volume of Fehling's solution A and Fehling's solution B and boil for 1 min and equal volume of extract. Heat in boiling water bath for 5-10 min. Formation of brick red precipitate on heating indicates the presence of carbohydrates.

b) Benedict's Test: To 5ml of Benedict's reagent, 1ml of extract solution was added and boiled for 2min and cooled. Formation of red precipitate showed the presence of carbohydrates.

2. Test for steroid

a) Libermann burchard test: Mix 3ml of test solution with 3ml of acetic anhydride .It was heated and then cooled .Few drops of conc. sulphuric acid was added .A blue colour appeared.

3. Test for Saponins

a) Foam Test: The extract was vigoursly shaken with water, formation of persistent foam indicate the presence of saponins.

4. Test for Flavanoids

a**)** Sodium hydroxide test: Addition of increasing amount of NaOH to the extract shows yellow colour which decolourises after addition of an acid.

5. Test for Tannins

a) Lead Acetate Test: A fraction of extract was treated with few drops of lead acetate solution would result in the formation of white precipitate indicate the presence of tannins.

6. Test for Phenolic compounds.

a) Ferric chloride test: In beakers, 5ml of each previous filtered extracts were taken and 1ml of $FeCl_3$ (1%) and 1ml $K_3(Fe(CN)_6)$ (1%) were added. The appearance of fresh radish blue colour indicated the presence of polyphenols.

7. Test for cardiac glycosides

a) Keller-Killiani test: To extract solution, added glacial acetic acid,5% ferric chloride and concentrated sulphuric acid. Reddish brown colour appears at junction of two liquid layers and upper layer appears bluish green

***In vitro* anti-diabetic activity [6,7]**

α Amylase Inhibition Method: A mixture of 500µl test(100µg/ml) and 500µl of α amylase solution prepared in 0.02 M sodium phosphate buffer (pH 6.9 with 0.0006 M NaCl) was incubated at 25°c in a BOD incubator for 10 min . 500µl of pre-incubated 1% starch solution in 0.02 M phosphate buffer pH 6.9 was added to the above mixture. The reaction mixture was then incubated at 25°c for 10 min. The reaction was stopped by adding 1.0 ml di-nitro salicylic acid color reagent. The test tubes were incubated in a boiling water bath for 5 min and then cooled to room temperature. The reaction mixture was then diluted by adding 10 ml distilled water and absorbance measured at 540 nm

Control reaction representing 100% enzyme activity did not contain any compound

% inhibition = (Ac - As) / Ac* 100

Ac = absorbance of control

As = absorbance of test

***In vitro* haemolytic activity of the extract [8,9,10]**

Preparation of erythrocytes suspension: 5ml of blood was collected from the rabbit ear vein in a tube containing sodium citrate. The blood was centrifuged at 1500 rpm for three minutes in a laboratory centrifuge. Plasma (supernatant) was discarded and the pellet was washed three times

with sterile phosphate buffer saline solution (pH 7.2±0.2) by centrifugation at 1500 rpm for 5 min. The cells were re-suspended in normal saline to 0.5%.

Activity

- ✓ *In vitro* haemolytic activity was performed by spectrophotometer method
- ✓ A volume of 0.5 ml of the cell suspension was mixed with 0.5 ml of the plant extracts (125, 250, 500 and 1000 µg/ml concentrations in phosphate buffer saline).
- ✓ The mixtures were incubated for 30 min at 37°C in a incubator. The mixture was centrifuged at 1500 rpm for 10 min in a laboratory centrifuge.
- ✓ The free haemoglobin in the supernatant was measured in UV-Visible spectrophotometer at 540 nm.
- ✓ Phosphate buffer saline and distilled water were used as minimal and maximal haemolytic controls.
- ✓ Each experiment was performed in triplicates at each concentration.
- ✓ The level of percentage hemolysis by the extracts was calculated according to the following formula
- ✓ Here: At is the absorbance of test sample.
- ✓ An is absorbance of the control (saline control)
- ✓ Ac is the absorbance of the control (water control)

Assay of haemolytic activity[9]

Preliminary Test: Prepare a serial dilution of the plant material extract with phosphate buffer PH 7.4 T.S and blood suspension (2%) using 4 test tubes. As soon as the tubes have been prepared, gently invert them to mix, avoiding the formation of foam. Shake again after 30 min interval and allow standing for 6 hrs at room temperature. Examine the tubes and record the dilution at which total haemolysis has occurred, indicated by a clear red solution without any deposit of erythrocytes.

	Test tube no.			
	1	2	3	4
Plant material extract + phosphate buffer + blood suspension	0.10	0.20	0.50	1
	0.90	0.80	0.50	-
	1.00	1.00	1.00	1.00

- If total haemolysis is observed only in tube 4,use the original plant material extract for main test
- If total haemolysis is observed in tubes 3,4 prepare a twofold dilution of the original plant material extract with buffer
- If total haemolysis is observed in tubes 2,3,4,a fivefold dilution of the original plant material extract with buffer
- If after 6 hrs, all four contains ,a red solution, prepare a tenfold dilution of original plant material extract with buffer
- If total haemolysis is not observed in any of the tubes, repeat the preliminary test using concentrated plant material.

Main Test: Prepared a serial dilution of the plant material extract ,undiluted or diluted as determined by the preliminary test, with phosphate buffer PH 7.4 TS and blood suspension (2%) using 13 test tubes. Carry out the dilutions and evaluations as in the preliminary test but observe the results after 24 hrs. Calculate the amount of medicinal plant material in g, or of the preparation in g/ml, that produce total haemolysis. To eliminate the effect of individual variation in resistance of the erythrocyte suspension to saponin solution, prepare a serial dilution of saponin R in the same manner as described above for plant material extract. Calculated the quantity.

Serial dilution for main test

	Test tube no.												
	1	2	3	4	5	6	7	8	9	10	11	12	13
Plant extract	0.40	0.45	0.50	0.55	0.60	0.65	0.70	0.75	0.80	0.85	0.90	0.95	1.00
Phosphate buffer pH 7.4(ml)	0.6	0.55	0.50	0.45	0.40	0.35	0.30	0.25	0.20	0.15	0.10	0.05	-
Blood suspension (2%) ml	1	1	1	1	1	1	1	1	1	1	1	1	1

Haemolytic activity was calculated using the formula

H.A = 1000 * A/B where

1000 = The defined haemolytic activity of saponin R

A = Quantity of saponin R that produce total haemolysis (g)

B = Quantity of plant material that produce total haemolysis (g)

***In vitro* anticancer activity**

Cell line: DLA cell lines were supplied by Amala Cancer Research Centre, Thrissur, Kerala, India. The cells were maintained by intraperitoneal inoculation of 1×10^6 viable cells in mice.

Procedure: Dalton's lymphoma cells were grown in the swiss albino mice in ascites form in transplanting the cells from other tumour bearing mice. Ascites develop within 10 to 14 days and the cells are drawn carefully with a syringe under sterile conditions. These are washed with a phosphate buffer containing saline (0.2 M phosphate buffer pH 7.4 containing 0.15 M sodium chloride), several times to remove them from RBC and other cells. These are counted and diluted with PBS. A serial dilution of the extracts were mixed with cells to have a concentration of 1 million cells per ml and incubated at 37oC for 3 hours. Immediately after the incubation1% trypan blue solution was added to the medium and in this process the dead cells absorb the dye and could be easily counted under the microscope. The cytotxicity could be measured by the counting the number of dead cells for different concentrations of drug and the minimum concentration of the drug required for 100% cytotoxicity determined. The cytotoxic effect determined in the ethyl acetate extract.

***In vivo* screening**

Acute toxicity studies [11]: The acute oral toxicity studies of ethyl acetate extract of *Jatropha curcas Linn* fruits was carried out as per the guidelines set by the Organisation for Economic Co-operation and Development (OECD-423). Three animals were used for each step of the study. The animals were made to fast prior to dosing (food was withdrawn 3 hours before administration) following the period of fasting. The animals were weighed and the extracts were administered in a single dose, as 1% suspension in CMC, by oral intubation, food was withheld for the study with a dose of 5mg/kg and the dose was increased step by step to 50,300 and 2000mg/kg body weight. The mortality of the animals dosed at one step will determine the next step. The procedure flow chart describes the procedure for each of starting doses.

The time interval between treatment groups was determined by the onset, duration and severity of toxic signs. Treatment of animals at the next dose should be delayed until one becomes confident of survival of the previously dosed animals. The animals were observed individually at every 30 minutes, periodically during the first 4 hours, and daily thereafter for a total of 14 days". The time at which signs of toxicity appear and disappear was observed systematically and recorded for each animal. Additional signs of toxicity such as changes in body weight, skin and fur, eyes and mucous membranes, respiratory system circulatory system, autonomous system, central nervous system, somatomotor activity and behaviour pattern were also recorded.

Attention was given to observe the tremors, convulsions, salivation, diarrhoea, lethargy, sleep and coma. The absence or presence of compound related mortality of the animals dosed at one step will determine the next step. Any mortality during the experiment was observed and recorded

***Invivo* anti-pyretic activity[10]**

Model used for the study: Yeast induced pyrexia model was used to determine the antipyretic activity of *Jatropha curcas* fruit extracts

Experimental design

Group I: animals served as control

Group II: animals were treated with yeast via subcutaneous injection (10ml/kg).

Group III: animals were administered with yeast (10 ml/kg) and the standard drug paracetamol (150mg/kg b.w.), orally

Group IV: animals were administered with yeast (10ml/kg,) and with ethyl acetate extract of *Jatropha curcas* Linn(30 mg/kg)orally

Group V: animals were administered with yeast (10ml/kg,) and with ethyl acetate extract of *Jatropha curcas* Linn(60mg/kg), orally

Experimental procedures: Pyrexia was induced by subcutaneous injection of 10% w/v of brewer's yeast (10 ml/kg) suspended in 0.5 % (w/v) methyl cellulose solution. Basal rectal temperature was measured before the injection of yeast, by inserting digital clinical thermometer to a depth of 2 cm into the rectum. The rise in rectal temperature was recorded 19 hours after yeast injection Paracetamol 150 mg/kg body weight was used as the standard antipyretic drug. Rectal temperature of animals was noted at regular intervals following the respective treatments. The temperature was measured at first, second and third hour after drug administration.

***In-vivo* anticancer activity[12]:** Swiss albino mice weighing 25–28 g were housed in conventional cages with free access to water and fed ad libitum and kept at constant room temperature (22–25 °C) with 12 h of light and darkness. The animals were acclimatized to the laboratory for 2 week's before the inception of experiments. All the animal experiments were duly approved by the Institutional Animal Ethics Committee (743/03/abc/ CPCSEA dt3.3.03) Guidelines.

Procedure: *In vivo* cytotoxic studies were carried out on Swiss albino mice. Ascitic fluid wad drawn from the peritoneal cavity of the tumour bearing albino mice and washed with PBS to free them from cell debris. RBC etc. And diluted in PBS at a concentration of 1 million cells per ml. This cell

suspension was transferred to the peritoneal cavity of the 16 albino mice at a concentration of one million cells. The animals were divided into two groups of eight each, one million cells. The animals were divided into two groups of eight each, one experimental and the control. All the experimental animals were given 1 ml of the extract by oral feeding from the second day after transplanting the tumour and continued for twenty days. The control animals were left as such without any medicine. The development of ascites was examined alone with the longevity of the animals in both experimental and control. This experiment can give an idea regarding the role of the medicine in preventing the multiplication of the cells in the peritoneal cavity and thereby the possible effect in cancer treatment.[13,14,15,16]

RESULTS

Preparation of ethyl acetate extract of *Jatropha curcas* linn fruits: The ethyl acetate extract of *Jatropha curcas* fruits were prepared by using the soxhlet extraction procedures.

Preliminary phytochemical screening of ethyl acetate extract of *Jatropha curcas* linn fruits: The *Jatropha curcas* extracts were subjected to phytochemical screening. The results indicated the presence of carbohydrates, steroids, cardiac glycoside, saponins, flavanoids, alkaloids, tannins, polyphenols (**table 1**).

***In vitro* haemolytic activity:** The effect of ethyl acetate extract of fruits of *Jatropha curcas* Linn on haemolytic activity is shown in table. The highest and lowest concentration were tested .The results obtained indicated that all the concentration of extract had no haemolytic activity when compared to control **(table 2**).

Assay of haemolytic activity

Preliminary test: The serial dilutions of the plant ethyl acetate extract of *Jatropha curcas* fruits was done in order to find out the concentration at which total haemolysis has occurred, and it was found the plant extract concentration in the second test tube had shown complete haemolysis, a fivefold dilution was made in accordance with the procedure, and a serial dilutions of the plant material extract was made using 13 test tubes **(table 3 and table 4**) **(fig: 1)**

Main test: The serial dilutions of the plant extract as determined by the preliminary test was carried out with phosphate buffer pH 7.4 and blood suspension using 13 test tubes and was found that none of the test tubes had shown haemolysis among the 13 test tubes

***In-vitro* anti-diabetic activity:** The higher and lower concentration were tested. The results obtained indicated that all the concentrations of the extract showed significant anti diabetic activity by α amylase inhibition method. **(table5) (fig 2)**

***In-vitro* anticancer activity:** The higher and lower concentration were tested. The results obtained indicated that all the concentrations of the extract showed significant anti-cancer activity by Dalton's lymphoma ascites cell method. (**table 6)(fig:3)**

Acute toxicity studies: The acute toxicity studies of ethyl acetate extracts of fruits of *Jatropha curcas Linn* conducted as per the OECD guidelines 423 revealed that the extract did not produce mortality at 300 mg/kg . So 1/5 th doses ie, 60 mg/kg and 30 mg/kg were selected for screening procedures

***In-vivo* anti-pyretic activity:** The effect of ethyl acetate extract of fruits of *Jatropha curcas* Linn on yeast induced pyrexia (**table 7) (fig: 4)**

Group I: animals served as control

Group II: animals were treated with yeast via subcutaneous injection (10ml/kg).

Group III: animals were administered with yeast (10 ml/kg) and the standard drug paracetamol (150mg/kg b.w.), orally

Group IV: animals were administered with yeast (10ml/kg,) and with ethyl acetate extract of *Jatropha curcas* Linn (30 mg/kg) orally

Group V: animals were administered with yeast (10ml/kg,) and with ethyl acetate extract of *Jatropha curcas* Linn (60mg/kg), orally

***In-vivo* anti-cancer activity by DLA method**

The DLA method for evaluating the anti-cancer activity by studying the increase in life span of tumor bearing animals for 20 days revealed that the fruit extract showed an increase in the life span of animals when compared to control. **(table 8)**

DISCUSSION

Preliminary phytochemical screening of extracts of *Jatropha curcas linn:* The ethyl extract of *Jatropha curcas* exhibited higher solubility and so ethyl acteate extract was chosen for the further screening procedures for the determination of anti-diabetic, anti-pyretic and anti-cancer activity, showed α- amylase inhibitory activity at various concentrations starting from 100µg/ml to 500µg/ml respectively and showed 67.70% and 82.55% inhibition respectively which could be attributed to the presence of polyphenols flavonoids, Similarly, *Jatropha curcas* fruit extracts at the starting concentration from 10µg/ml to 200 µ/ml and found to process the cytotoxicity of 60 % at the

concentration of 200µg/ml and 18 % at the concentration of 10 µg/ml, can prevent the tumor cells multiplication in the DLA induced mice and increased the mean survival time and life span of mice. So, these indicate that the extract possess the antitumor properties.

An attempt has been made in the present study to evaluate the *in-vivo* anti-pyretic activity of the ethyl acetate extract of *Jatropha curcas* fruits using yeast induced pyrexia method, and the results stated that with the increasing concentration of the extract there was decrease in body temperature. It is therefore to speculate that the phytoconstituents present in this plant extracts might responsible for the observed anti-diabetic, anti-pyretic and anti-cancer activity of the *Jatropha curcas* fruit extract.

CONCLUSION

In conclusion the present study revealed the anti-diabetic, anti-pyretic and anti-cancer protocol of *Jatropha curcas* Linn fruits. All the scientific datas and observation leads to the conclusion that these support the traditional use of *Jatropha curcas* linn fruits for treating the above stated diseases. Further research is required to isolate the bioactive constituents that are originally or accurately responsible for the reported biological activity.

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Table 1: PRELIMINARY PHYTOCHEMICAL SCREENING OF ETHYL ACETATE EXTRACT OF *JATROPHA CURCAS* FRUITS

Sl no:	Phytochemicals	Presence/absence
1	Carbohydrates	+
2	Proteins	-
3	Amino acids	-
4	Steroids	+
5	Cardiac glycosides	+
6	Saponins	+
7	Flavanoids	+
8	Alkaloids	+
9	Phenols	++
10	Tannins	++

(+ present),(-absent)

TABLE 2: RESULTS FOR HAEMOLYTIC ACTIVITY

Group	Absorbance value	Haemolysis %
Distilled water	1.64±0.04	100.0±2.4
Saline	0.094±0.009	0.0±5.2
50 µg/ml	0.061±0.005	-2.0±0.4
125µg/ml	0.078±0.007	-1.0±0.5
250µg/ml	0.073±0.011	-1.3±0.9
500µg/ml	0.072±0.009	-1.3±0.7
1000µg/ml	0.090±0.015	-0.22±0.55

(Values are mean± S.E.M, n=3)

TABLE 3: PRELIMINARY TEST RESULTS FOR *IN VITRO* HAEMOLYTIC ACTIVITY *OF JATROPHA CURCAS* LINN FRUITS.

CONCENTRATION(100µg/ml)	HAEMOLYSIS			
	0.10 ml	0.20 ml	0.50 ml	1 ml
Ethyl acetate extract	Nil	H.O	Nil	Nil

TABLE 4: MAIN TEST RESULTS FOR *IN VITRO* HAEMOLYTIC ACTIVITY *OF JATROPHA CURCAS* LINN FRUITS.

CONCENTRATION (20 µg/ml)	HAEMOLYSIS												
	0.4	**0.45**	**0.5**	**0.55**	**0.6**	**0.65**	**0.7**	**0.75**	**0.8**	**0.85**	**0.9**	**0.95**	**1**
Ethyl acetate extract	nil	nil	Nil	nil	nil	nil	nil	nil	nil	nil	nil	Nil	nil

TABLE 5: RESULTS FOR *IN VITRO* ANTI DIABETIC ACTIVITY

Drug Conc	absorbance	% inhibition
Control	1.1121	
100µg/ml	0.3592	67.70%
200µg/ml	0.3291	70.4%
300µg/ml	0.2722	75.52%
400µg/ml	0.2241	80.00%
500 µg/ml	0.1940	82.55%

(Values are mean± S.E.M, n=3)

TABLE 6: EFFECT OF ETHYL ACETATE EXTRACT OF *JATROPHA CURCAS* LINN FRUITS ON *IN VITRO* ANTI CANCER ACTIVITY USING DLA CELLS.

Sl.no	Drug concentration(µg/ml)	Percent cell death(DLA cells) in %	IC_{50}
1	200	60	
2	100	52	130 µg/ml
3	50	35	
4	20	26	
5	10	18	

Control tube contains only one dead cell, sample dissolves in DMSO

TABLE 7: ANTI PYRETIC ACTIVITY OF ETHYL ACETATE EXTRACT OF *JATROPHA CURCAS* LINN FRUITS ON YEAST INDUCED PYREXIA IN RATS

GROUPS	Before yeast injection	0 hr	1 hr	2 hr	3 hr
I (control)	37.16±0.07	37.23±0.08	37.68±0.16	37.51±0.14	37.71±0.21
II(positive control)	40.52±0.06	40.54±0.02	40.55±0.05	40.57±0.03	41.12±0.12
III(std)	40.52±0.04*	40.42±0.05*	38.48±0.07*	38.46±0.07*	38.38±0.08*
IV(EAJC) 30 mg/kg	40.32±0.07*	40.61±0.04*	39.721±0.04*	38.953±0.14*	38.683±0.03*
V (EAJC) 60 mg/kg	40.42±0.03*	40.67±0.02*	39.77±0.05*	39.18±0.08*	38.73±0.05*

Each value represents the mean ±S.E.M (n=6).P<0.01*(Significant) compared with control .P<0.05. Statistical analysis was done by one way analysis of variance (ANOVA) followed by Dunnet's multiple comparison test

TABLE NO 8: EFFECT OF ETHYL ACETATE EXTRACT OF *JATROPHA CURCAS* LINN FRUITS ON DLA INDUCED ASCITES TUMOR BEARING SWISS ALBINO MICE.

Groups	Dose	No. of animals	No of days survived	% increase in life span {t-c/c x 100}
Control	-	8/8	17.25±0.55	-
Cyclophosphamide	10 mg/kg	8/8	29.87±0.37**	73.15
fruit extract	60 mg/kg	8/8	27.61±0.45**	59.29

(Each value represents the mean ± S.E.M(N=8).**P < 0.01,* P<0.05 significantly, when compared with control group. Statistical analysis was done by one-way analysis of variance(ANOVA) followed by Dunnett's multiple comparison test)

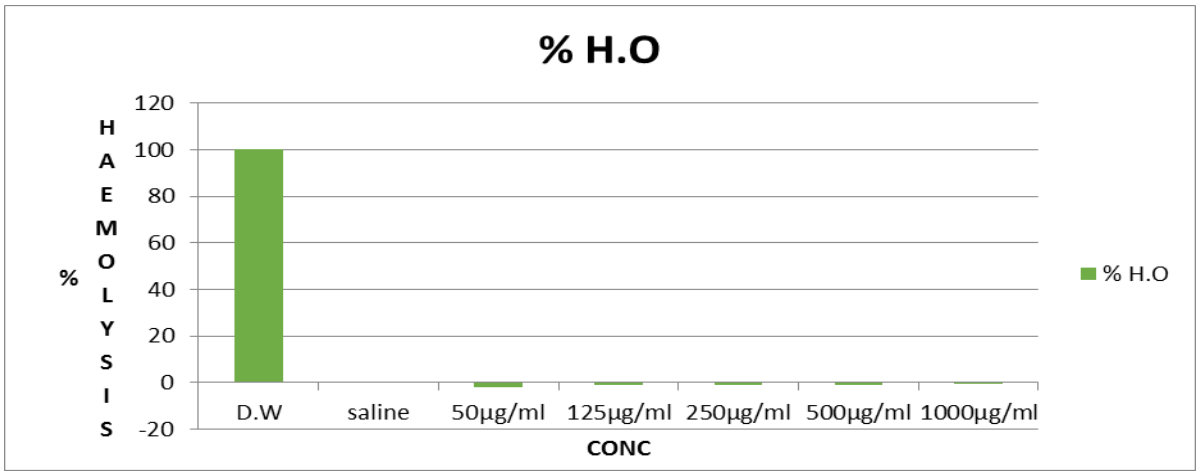
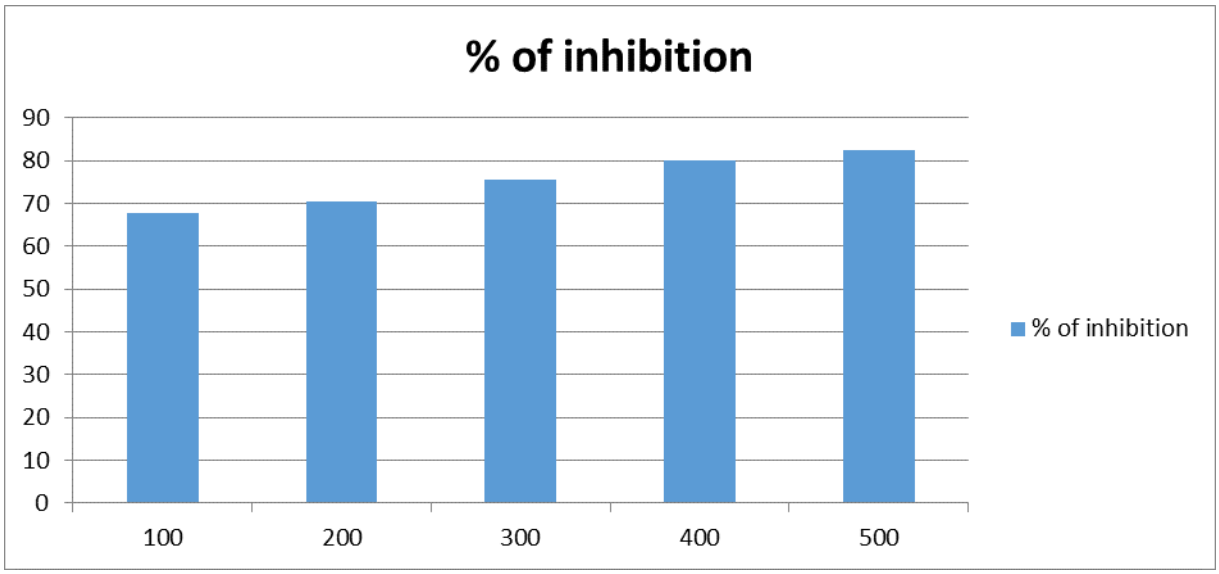


Figure 1: The Graph shows the negative value for % haemolysis indicating the absence of haemolytic activity



(x- axis : concentration); (y –axis : % inhibition)

Figure 2: The graph indicates the increasing % of inhibition with an increase in conc

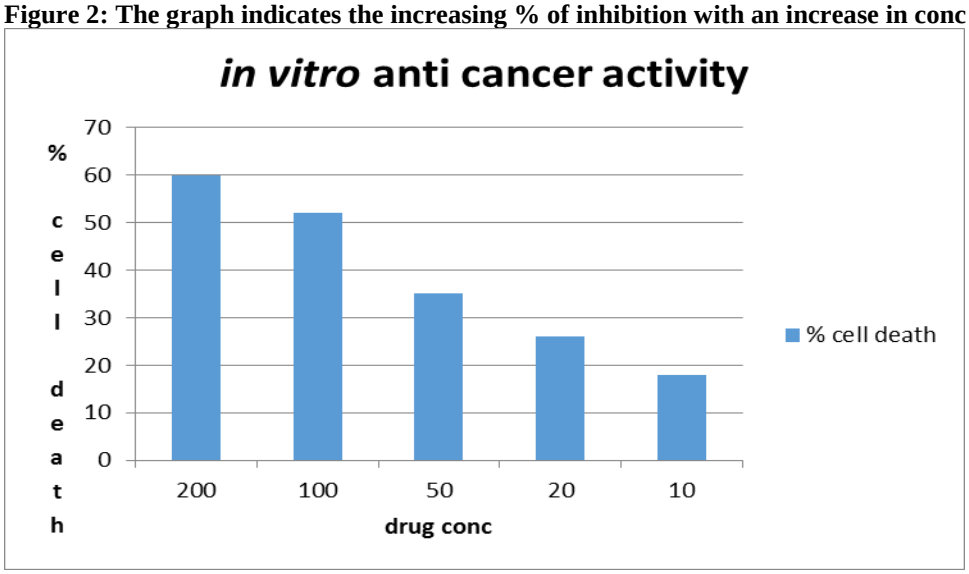


Figure 3: Graph indicates the increase in % cytotoxicity at different concentrations

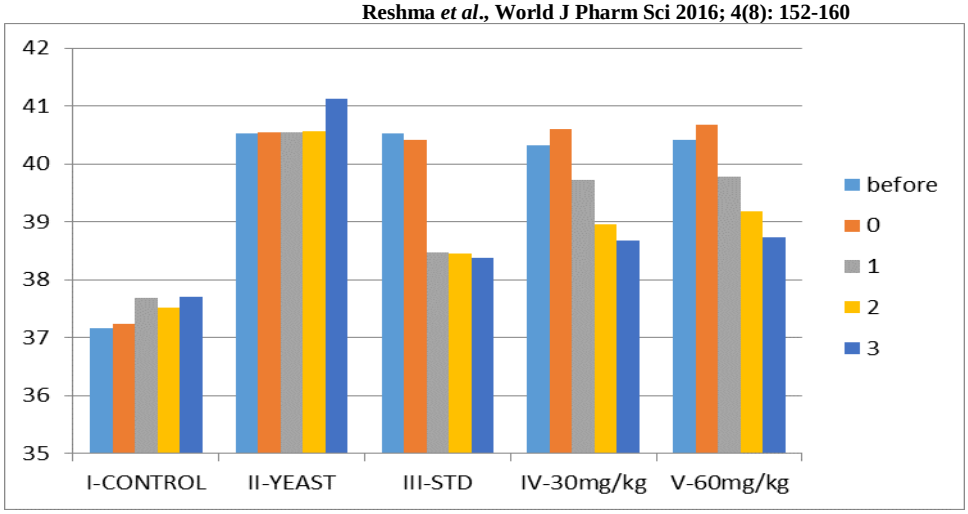


Figure 4: Effect of *Jatropha curcas* linn fruits on yeast induced pyrexia

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