A Review on JATROPHA CURCAS

Prathmesh Sangale[1*] Vaibhav Jadhav[2*] Gaurav Jadhav[3*]

1. Student at pratibhatai pawar college of pharmacy, Wadala Mahadeo, shrirampur
2. Assistant professor at pratibhatai pawar college of pharmacy Wadala Mahadeo, shrirampur
3. Student at pratibhatai pawar college of pharmacy, Wadala Mahadeo, shrirampur

Abstract: Jatropha curcas L. commonly known as "physic nut" is an unusual species that shows aggressive characters. Plantation of Jatropha species is being undertaken at a huge scale for biodiesel production. The plants defoliated their leaves two times a year and have been shown to possess confident antinutritional factors. Seeds of Jatropha are detached from mature dehydrated fruits for oil extraction and ovary walls are cast-off. this study was to discover the effectiveness of different parts of Jatropha curcas plant against some selected human pathogens as antimicrobic agent which are known to cause diseases and to check antioxidant and phytochemicals from different plant sections of J. curcas. Plant extracts were studied by quantification of antimicrobial and phytochemical compounds. This study reveals that 20% ethanol stem extract of Jatropha curcas showed maximum antibacterial activity (40 ± 0.0 mm) against Klebsiella pneumonia. Water extract of root of J. curcas also withdrawn E. coli (35.25 ± 0.35 mm). The growth of K. pneumonia and Agrobacterium tumifaciens were also stopped when ethanol extract of J. curcas root applied to check their potential as antimicrobial agent. A complete study on the phytochemical contents and biological activities of the methanolic extract from different parts of Jatropha curcas Linn. was directed. The extracts of different plant parts contained various levels of phenolics, flavonoids and saponins. Latex and leaf extracts showed the uppermost antioxidant activity. In this study, the antifungal, antioxidant, enzyme inhibitory (α-amylase), phytochemical and cytotoxicity profle of Jatropha curcas seed oil and de-oiled seed slab extracts was determined. The antifungal activities were investigated against diferent phytopathogenic fungi including Colletotrichum coccodes, Pythium ultimum, Phytophthora capsici, Rhizoctonia solani, Bipolaris oryzae and Fusarium fujikuroi.

Keywords: Jatropha curcas, phytoconstituents, properties, chemical tests, extraction,

➢ Introduction:

Jatropha curcas is an associate of the Euphorbiaceae family and is commonly known as Barbados nut, physic nut or purging nut. It is a slight small tree or bush-like plant that breeds up to 5 m high. Extracts from J. curcas have been reported to have anti-inflammatory, anti-coagulant, anti-tumor, anti-parasitic and insecticidal properties. This plant has been used for abortion and wound healing (Ejelonu et al. 2010) [1]

In view of collective resistance to existing antimicrobial agents, some research has been performed worldwide to recognize herbal drugs, as they are identical important sources for discovering some new agents for treating various disorders related to bacterial infections. (Pan et al., 2012). According to the World Health Organization (WHO), about 80% of world's population rely on herbal medicines for some aspect of their key healthcare, and the worldwide annual market for herbal products methods approx. US$ 60 billion. With increasing resistance, also, antibiotics are occasionally associated with adverse side effects to the host, including hypersensitivity, immune-suppression and allergic reactions (Graul et al., 2009) [2]

Jatropha curcas L. is a drought unaffected perennial plant belonging to family euphorbiaceae. Plants can easily be grown on marginal soils to help reclaim land, Jatropha curcas L. is being cultivated as biodiesel crop in many tropical and sub-tropical areas, and can also be seen growing as fence about crop plants in many regions of India. Non-edible oil produced from these seeds is used as feed stock for production of bio-diesel. Press slab is used to improve soil and for the production of biogas. Apart from the oil Jatropha curcas is an important source of many phytochemicals with varying biological activities [3].

Medicinal plants are the sources to treatment diseases since earliest times and have been used as a source of drug to treatment of infection. The plant derivative medicines have been extraordinary contribution to human health, and has delivered a source of developing contemporary medicines and drugs compound and progresses of new prescriptions (Jain and Tripathi, 1991). Moreover, numerous active complex compounds found in medicinal plants that afford the abundant resource of energetic compound used for food industries, cosmetics and medicinal purpose (Ahmed et al., 2016). Jatropha curcas medicinal plant played key role in the convention of several purposes' disease enumeration fungal and bacterial adulteration (Khanna and Raison 1986). The generic name of Jatropha curcas originates from twin Greek words Jar'os means **doctor** and troph'e means **food** (Kumar and Sharma 2008) [4]

Jatropha curcas Linn. is a versatile plant in the Euphorbiaceae family. The oil from J. curcas seed is regarded as a potential fuel substitute since 40 to 50% of J. curcas seed oil can replace diesel without any engine modification (Pramanik, 2003). Phytochemical analyses have shown that diverse parts of J. curcas plant contain phenolic, flavonoid, saponin and alkaloid complexes (Thomas et al., 2008). Currently, plant derived-bioactive complexes have received significant attention due to their therapeutic potential as antimicrobial, anti-inflammatory, anticancer and antioxidant activities (Rathee et al., 2009). Numerous studies have shown the antioxidant and anti-inflammatory properties of flavonoids and saponins extant in various plant extracts (Vanacker et al., 1995; Seyoum et al., 2006; Sur et al., 2001; Rathee et al., 2009).[5]

Natural drugs have the tendency to replace artificial drugs due to their adverse efects, gradual decrease in efcacy and emergence of resistance of target cells towards them. Drugs obtained from natural sources are considered ideal alternatives due to their small side efects and vast therapeutic applications (Ahmad et al. 2020). Herbal medicines found from more than 35,000 species of medicinal plants have been in use as traditional medicine for the dealing of diferent ailments since centuries (Shukla and Kumari 2019). Jatropha curcas, an important medicinal plant of the family Euphorbiaceae, is cultivated in various tropical and sub-tropical regions

of the world (Abou-Arab et al. 2019). The plant can reach to a height of 5–10 m with a life span of about 50 years and it usually gives fruits in the third year after cultivation (Carels 2009) [6]

In the current study, J. curcas seed oil and de-oiled seed slab extracts were examined for the presence of diferent phytochemicals. Antifungal actions of seed oil and de-oiled seed cake extracts against diferent plant pathogenic fungi including C. coccodes, P. ultimum, P. capsici, R. solani, B. oryzae and F. fujikuroi were investigated [6]

Jatropha curcas L. is a widely available tropical plant that often used for fencing by farmers. Nash (2005) reported the use of its seed oil as biofuel and its potential as a biopesticide. However, scientific evidence for the insecticidal effects of extracts of the plant against Sitophilus zeamis or its antifeedant effects are lacking. This education investigated the phytochemistry of the plant, its insecticidal, antifeedant and reproduction-inhibitory of Jide-Ojo et al. 45 J. curcas extracts against S. zeamis as well as its mammalian toxicity were directed.[7]

- **Data and material:**

  A typical jatropha plant:

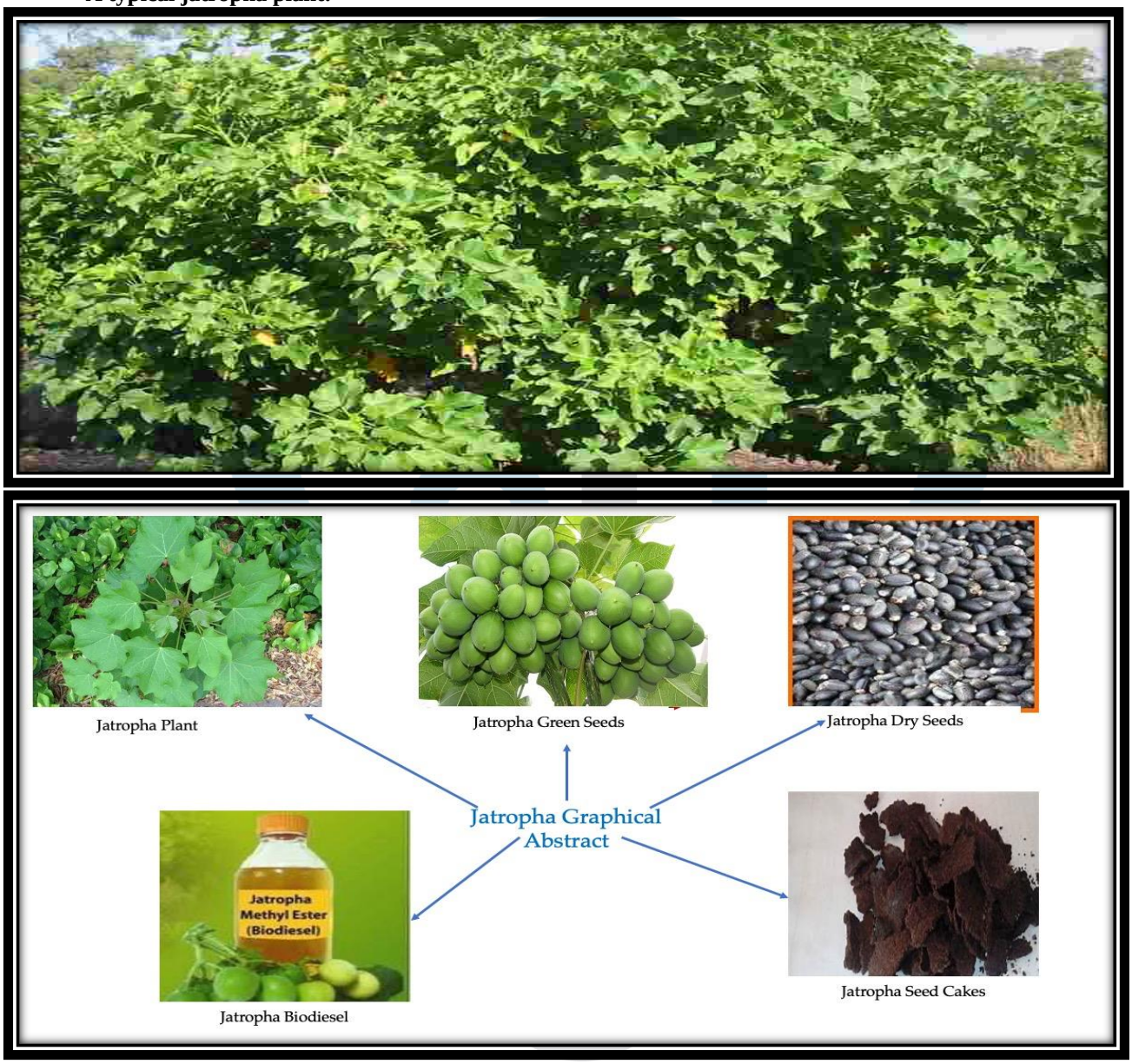


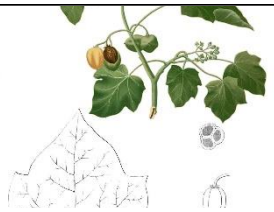
Fig.1&2: plant and geographical scource of Jatropha Curcas [9,10]

- **Morphology of Jatropha curcas**


leaves have three or five broad and shallow curved lobes


Its small pale yellow to greenish flowers


Growing 2-4 m in height


10-19cm long and 5-15 cm wide

1. **General information of jatropha curcas:**

1.1 Distinguish features of jatropha curcas

- Its stems are abundant and exude a watery sap when broken.

Scientific Name	Synonyms	Family	Common Names	Origin
Jatropha curcas L.	*Curcas curcas* (L.) Britt.	Euphorbiaceae	American purging nut, Barbados nut, Barbados purging nut, bed bug plant, big purge nut, black vomit nut, Brazilian stinging nut, Cuban physic nut, curcas bean, hell oil, physic nut, purge nut, purging nut, purging nut tree, tuba	Native to Mexico, the Caribbean, Central America (i.e., Belize, Costa Rica, El Salvador, Guatemala, Honduras and Nicaragua) and South America (i.e., Brazil, Bolivia, Peru, Argentina and Paraguay

- Its interchangeably decided leaves have three or five broad and shallow curved lobes.
- are borne in transportable clusters in the forks of the upper leaves.

Cultivation	Physic nut (*Jatropha curcas*) was deliberately presented into Australia at some time in the late 1800's. It has mainly been refined as a hedging plant or garden ornamental around mining sites and homesteads in the northern parts of Australia.
Naturalized Distribution	This species has a scattered distribution throughout the coastal and sub-coastal districts of northern and north-eastern Australia. It is most common in the north-western parts of the Northern Territory (particularly around Darwin) and in northern Queensland. It is occasionally also naturalized in the coastal regions of central and southern Queensland and is present in the inland regions of the Northern Territory. The two main infestations in the Northern Territory are located near Pine Creek and Kapalga
Habitat	A weed of tropical and sub-tropical environments that is found in disturbed sites, pastures, open woodlands, waste areas, abandoned gardens and along roadsides

Habit	An upright (i.e., erect) shrub or small tree usually growing 2-4 m tall. This species often loses its leaves during the dry season (i.e., it is deciduous
Reproduction and Dispersal	This species reproduces by seed and also vegetatively via suckers originating from the roots and crown, Seeds may be spread short distances when they are explosively unconfined, while most long-range dispersal probably occurs in water or in mud adhering to animals and vehicles. The spread of this species is also aided by its careful cultivation in home gardens.

Table1.2 cultivation of jatropha curcas

Table 1.2 general cultivation and information about jatropha curcas

1.1 Stems and leaves:

The elder stems are thick and softly woody, with the younger ones are sometimes somewhat hairy (i.e., puberulent).

The leaves are consecutively arranged along the stem and borne on stalk (i.e., petioles) 6-14 cm long. They are relatively large (10-19 cm long and 5-15 cm wide) and plane and shiny in appearance. These leaves have heart-shaped (i.e., cordate) bases and three or five thin lobe with rounded or pointed tip (i.e., obtuse to acute apices).

1.2 Flower and fruits:

The pale yellow to greenish colored flower are small and inconspicuous. They are borne in loose clusters on short stalk (i.e., peduncles) in the fork (i.e., axils) of the upper leave or at the tips of the branches (i.e., in terminal or axillary panicles). Flowering occur throughout the year, but is most abundant during the wet season.

The fruit is a fleshy capsule that is initially green in colour, but turn yellow and then dark brown as it mature. These fruits (3-4 cm long) are oval (i.e., ellipsoid) or almost round (i.e., sub-globular) in shape and usually contain three large seed. The smooth textured seeds (17-20 mm long) are mostly brown or black in colour, with some fine yellow stripe. They are hard and slightly bean-shaped (i.e., reniform).

1.3 Environmental impact:

Physic nut (*Jatropha curcas*) is not a predominantly aggressive weed, and tend to spread relatively slowly. However, it is drought resistant and will grow under a wide range of climatic and soil condition. It is regarded as an environmental weed or potential environmental weed in many part of northern Australia. Plant are usually found in disturbed area, especially around abandoned homestead and mines.

Physic nut (*Jatropha curcas*) competes with native species or prairie plants can eventually form dense thickets or colonies. If it is allowed to establish widespread population over time, it may threaten some of Australia's rangeland communities. For example, it is regarded as posing a threat to biodiversity in the Einasleigh and Desert Upland bioregion in inland northern Queensland.

1.4 Other impacts:

The fresh seeds are highly poisonous to human, especially to children, and can be mistaken for peanut. They are also toxic to livestock, though few instance of stock poisoning have been reported in Australia.

Physic nut (*Jatropha curcas*) compete with pasture plant and dense thicket may reduce pasture efficiency. It may also act as an alternative host for insect pest of cotton crop.

1.5 Legislation:

This species is declared under legislation in the following states and territorie:

- Northern Territory: A - to be eradicated (through all of the Territory), and C - not to be introduced into the Territory.

- Western Australia: P1 - trade, sale or movement into the state prevented (throughout the entire state), and P5 - to be controlled on public and local government land (in the Broome, Derby-West Kimberley, Halls Creek and Wyndham-East Kimberley local authority areas).

1.6 Similar plant species:

Physic nut (*Jatropha curcas*) is very similar to bellyache bush (*Jatropha gossypiifolia*) and relatively similar to castor oil plant (*Ricinus communis*). These three species can be distinguished by the following difference:

- physic nut (*Jatropha curcas*) has leave that are shallowly divided into 3-5 rounded lobe (i.e., they are palmately lobed) and hairless (i.e., glabrous). The small flower have five greenish-yellow petal and are borne in small branched clusters. Its fruiting capsule are usually dull yellow and hairless (i.e., glabrous).
- bellyache bush (*Jatropha gossypiifolia*) has leaves that are deeply divided into 3-5 pointed lobes (i.e., they are palmately lobed) and covered in sticky hairs (i.e., glandular pubescent). The small flowers have five red petals and are borne in small branched clusters. Its fruiting capsules are usually bright glossy green and sometimes sparsely hairy (i.e., sparsely pubescent).
- castor oil plant (*Ricinus communis*) has leave that are usually divided into 7-9 pointed lobes (i.e., they are palmately lobed) and hairless (i.e., glabrous). Separate male and female flower (both lacking petals) are borne together in large elongated cluster (8-15 cm long), with the male flower below the female flowers. Its immature fruiting capsule are densely covered in soft blunt spine, but are hairless (i.e., glabrous). [11]

2.1. Collection and preparation of sample:
Various part of Jatropha curcas plant were collected (root, seed, stem, leaf, and flower) from surrounding of Institute of Plant Science, University of Sindh, Jamshoro, and was authenticated at the herbarium unit of the Department of Plant Science. The different part of Jatropha curcas were taken and put into polyethylene bag, and brought to Institute of Biotechnology and Genetic Engineering (IBGE) laboratory. Then it has been washed with distilled water to avoid any microbial growth.[4]

2.2. Extraction and preparation of plant extracts:
Different parts of J. curcas extracts were prepared in solvent and water and left to soak at room temperature (21–22 C) for 24 h. The extract was strained through muslin or cheese cloth, centrifuge and store at 4 C for further experiment. Various biochemical test like total sugar, reducing sugar, and protein were investigated from prepared extracts along with phytochemical test such as phenolic compounds, flavonoids, antioxidant and antimicrobial activity [4]

2.3 Plant materials and crude extracts preparation:
The J. curcas fresh whole plant (Euphorbiaceae) was collected from the farm of the Faculty of Agriculture, University Putra Malaysia and identified by Mr. Shamsul Khamis from the Institute of Bioscience, University Putra Malaysia. A voucher specimen (SK1764/2010) was deposited in the Phytomedicinal Herbarium, Institute of Bioscience, University Putra Malaysia, Serdang, Selangor. The fresh J. curcas leave, stem bark, root and latex were collected and freeze-dried to achieve constant weight followed by grinding. Five-gram sample was soaked in 50 ml 80% (v/v) aqueous methanol and stirred overnight at ambient temperature. Each sample was centrifuged at 3000×g for 10 min and the supernatant was kept at - 20°C. The extraction was repeated twice. The supernatants were pooled and evaporated by using a vacuum rotary evaporator (Buchii, Switzerland) to obtain the dry crude extract. The extracts were re-dissolved in methanol for antioxidant or in dimethyl sulfoxide for anti-inflammatory and cytotoxicity assay [5]

2.4 Total phenolic and flavonoid compounds:
The total phenolic and flavonoid compound in the extracts remained determined according to Ismail et al. (2010). Results of total phenolic and flavonoid compounds were expressed as mg of gallic acid and rutin equivalents per gram dry matter (DM) respectively. Total saponins Total saponins of extract were determined according to Makkar et al. (1999) and results were expressed as mg diosgenin equivalent/g DM. [5]

Table 1. Total phenolic, flavonoid and saponin contents of different parts of *J. curcas* plant.

Sample	Total phenolic[a] (mg/g DM)	Total flavonoid[b] (mg/g DM)	Total saponin[c] (mg/g DM)
Leaf	38.8±2.14	1.4±0.12	66.2±0.32
Stem bark	6.1±0.16	0.1±0.01	58.0±0.96
Root	8.0±0.15	1.1±0.10	58.0±1.08
Latex	26.0±0.91	16.3±0.30	96.7±0.73

Fig 3: total phenolic, flavonoid and saponin content of jatropha curcas plant [5]

2.5 Phytochemical screening of plant material:

Phytochemical characterization of the leaf of J. curcas was carried out by screening for the presence tannin, phlobatanin, cardiac glycoside, anthraquinones, saponins, steroids, terpenoids and flavonoids. For tannin, 5 g of each portion of plant extract was stirred with 10 ml of distilled water and filtered as described by Trease and Evans (1998). Blue black, green, or blue-green precipitate formed following the addition of few drops of 5% ferric chloride was taken as evidence for the presence of tannins. Deposition of a red precipitate when aqueous solutions of leaf extract was boiled with 1% (v/v) HCl was taken as evidence for the presence of phlobatannin (Trease and Evans, 1998). Salkowski's test, as described by Sofowora (1993), was used to test for cardiac glycosides. Leaf extract (0.5 g) was dissolved in 2 ml of chloroform prior to the careful addition of 1% (v/v) H2SO4 to form a lower layer. A reddish-brown colour at the interface was taken as evidence for the cardiac glycoside. Borntrager's test was used for the detection of anthraquinones (Heyde et al., 1984). Plant material (5 g) was shaken with 10 ml benzene and filtered. Ammonia solution (5 ml, 10%) was added to the filtrate and a pink, red, or violet colour formed in the ammoniacal (lower) phase was recorded as an indication of the presence of free anthraquinones. Concentration of saponin, steroids and terpernoids were measured as described by Sofowora (1993). Plant materials (0.5 g) were mixed with acetic anhydride (2 ml) in the presence of concentrated H2SO4 (2 ml) to measure the concentration of steroid. For terpenoids, plant materials (0.5 g) re-suspended in distilled water was mixed with chloroform (2 ml) in the presence of concentrated H2SO4 (3 ml). Colour change in the presence of re-suspended plant materials and diluted ammonium solution (5 ml) was to estimation the concentration of flavonoids. For tannin, phlobatannin and cardiac glycoside, weight of precipitate formed per gram plant sample was recorded. The intensity of colour change observed for unknown sample were compared spectrophotometrically to the colour of standard solution of known concentrations of saponin, terpenoids or flavonoids [7]

Table 1. Phytochemical composition of *J. curcas* leaf extract.

Phytochemical	Concentration (mg/kg)
Alkaloid	23.5 ± 2.31
Tannins	75.9 ± 4.70
Phlobatannins	17.2 ± 6.10
Saponins	124.8 ± 10.52
Terpenoids	41.1 ± 2.41
Flavonoids	64.3 ± 1.13
Cardiac glycosides	131.5 ± 9.23
Anthraquinones	BD
Steroids	62.2 ±3.32

Values are Mean ± SEM with n = 3. BD = Below detectable limit.

Fig 4. Phytochemical composition of jatropha curcas leaf extract [7]

3 Different phytochemical tests of jatropha curcas

3.1 Tests for flavonoids:

Shinoda test to the extract samples little magnesium turnings/lead acetate and few drops of conc. hydrochloric acid were added after the appearance of cherry red color in few minutes which indicated the presence of flavonoids.

3.2 Tests for cardiac glycosides Keller-Killiani test (test for deoxy sugars)

This test was carried out by extracting the drug with chloroform and the extract was evaporated to dryness; then, 0.4 ml glacial acetic acid containing trace amounts of ferric chloride was added. After transferring it to a small test tube, 0.5 ml of conc. Sulphuric acid was added by the side of test tube. Appearance of blue color of acetic acid layer indicated the presence of cardiac glycoside.

3.3 Tests for saponin glycosides

Froth formation test Two ml of each extract sample was placed with water in a test tube and shaken well. Formation of stable froth (foam) designated the presence of saponin glycosides. [2]

3.4 Tests for tannins:

Ferric chloride test Different extract sample were treated with ferric chloride solution, in which the appearance of blue and green colors indicated the presence of hydrolysable

3.5 Tests for steroids and triterpenoids:

Salkowski test Different extract samples were treated with few drops of concentrated Sulphuric acid. Appearance of red and yellow color at the lower layer indicated the presence of steroids and triterpenoids respectively (Harborne, 1998; Kokate, 2006).

3.6 Liebermann-Burchard's test

the extract (2 mg) was dissolved in 2 ml of acetic anhydride, heated to boiling, cooled and then 1 ml of concentrated sulfuric acid was added along the side of the test tube. A brown ring formation at the junction and the turning of the upper layer to dark green color complete the test for the presence of phytosterols.

3.7 Quantitative estimation

Estimation of total phenolic content the total phenolic content in the plant material was determined according to the Singleton and Rossi method, with approximately modifications (Singleton, 1965). Estimation was done by folin-ciocalteu method, where phenolic compounds form a blue complex. The gallic acid was used as a standard solution. 0.5ml of the test extract solution was mixed with 2.5ml of 1N folin-ciocalteu reagent and was incubated for 5 minutes and then 2ml of 75 g/L sodium carbonate was added tracked by distilled water. After incubation at room temperature for 2 hours, absorbance of reaction mixture was measured at 760nm against blank as methanol. The total phenolic content was expressed in µg of gallic acid equivalent (GAE) of dry plant material. The linearity choice for this assay was determined as 0.5-5.0mg/l GAE (R2=0.999), giving an absorbance range of 0.050-0.555 absorbance units (Kajaria et al., 2012; Sharma et al., 2012).

3.8 Estimation of total flavonoid content

Total flavonoid content in plant material was determined calorimetrically according to the method described by Lamaison and Carret (Lamaison, 1990) by using quercetin as the standard. Here, 5ml of 2% aluminum chloride in methanol was mixed with the same volume of test solution. After incubation of 10 minutes, absorbance was measured at 415nm against blank sample. The total flavonoid content was determined using a standard curve of quercetin at 0-50µg/ml. The average of three readings was used and then expressed in µg quercetin equivalent to flavones per mg of extract [2]

3.9 Reducing power

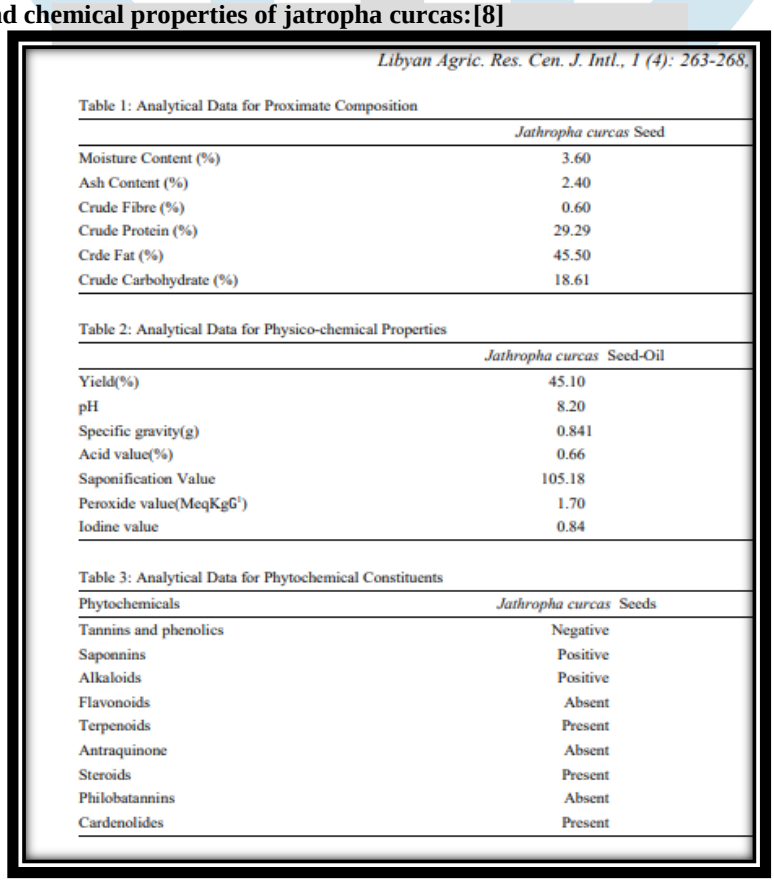
Reducing power was determined according to the developed method (Kajaria et al., 2012). A 2.5 ml solution of the extract (100-800 mg/ml) was mixed with equal volume of phosphate buffer (0.2 M, pH 6.6) and 1% potassium ferricyanide and placed in water bath at 50ºC for 20 min. Then, it was cooled rapidly and 2.5 ml of 10% trichloroacetic acid was added and vortexed. This incubation mixture was centrifuged at 3,000 rpm for 10 min and its 5 ml supernatant was mixed with equal volume of distilled water and 1 ml of 0.1% ferric chloride. It was additional incubated at room temperature for 10 min and the absorbance was read at 700 nm. The reducing property of the test sample was standardized against quercetin and expressed as the difference in optical density (OD) from control as well as the test as 0.1, and expressed as µg/ml. A higher degree of absorbance indicates the stouter reducing power. Thin layer chromatography

3.10 Thin layer chromatography

(TLC) was used to separate the different parts of J. curcasextract into different spots on the chromatoplate. The chromatoGrams were developed on the microscope slide, dried and observed visually for the various parts of the plant extract components. The developing solvents used in the different extracts are hexane, chloroform, and benzene with a ratio of 9:1 (Kajaria et al., 2011, Sharma et al., 2012). The retention factor was calculated using the following equation: [2]

$$\mathbf{Rf} = \frac{\text{Distance moved by the substance (cm)}}{\text{Distance moved by the solvent (cm)}}$$

Fig 5. Different physical and chemical properties of jatropha curcas:[8]



Libyan Agric. Res. Cen. J. Intl., 1 (4): 263-268,

Table 1: Analytical Data for Proximate Composition

	Jathropha curcas Seed
Moisture Content (%)	3.60
Ash Content (%)	2.40
Crude Fibre (%)	0.60
Crude Protein (%)	29.29
Crde Fat (%)	45.50
Crude Carbohydrate (%)	18.61

Table 2: Analytical Data for Physico-chemical Properties

	Jathropha curcas Seed-Oil
Yield(%)	45.10
pH	8.20
Specific gravity(g)	0.841
Acid value(%)	0.66
Saponification Value	105.18
Peroxide value(MeqKgG^{1})	1.70
Iodine value	0.84

Table 3: Analytical Data for Phytochemical Constituents

Phytochemicals	*Jathropha curcas* Seeds
Tannins and phenolics	Negative
Saponnins	Positive
Alkaloids	Positive
Flavonoids	Absent
Terpenoids	Present
Antraquinone	Absent
Steroids	Present
Philobatannins	Absent
Cardenolides	Present

3.11 Free Amino Acids:
Free amino acids were estimated following the method outlined in Sadasivam and Manickam, Powdered sample (0.5 g) was homogenized in ten times volume of 80% ethanol. Homogenate was centrifuged at 2000 g for 20 minutes and supernatant was collected. Supernatant (0.1 ml) was mixed with distilled water (1.9 ml) to make up 2.0 ml. 1.0 ml of ninhydrin (4% ninhydrin in methyl cellosolve and stannous chloride dissolved in 0.2 M citrate buffer mixed in equal volume) was added to it and kept in boiling water-bath (ninhydrin being a powerful oxidizing agent decarboxylates alpha amino acids and produces bluish-purple complex). After 20 minutes 5.0 ml of diluent (Equal volume of n-propanol and distilled water) was added to it and absorbance was recorded at 570 nm with spectrophotometer. Concentration of total free amino acid is expressed in mg·g−1 dry weight as glycine equivalent.[3]

3.12 Phytic Acid:
Phytic acid was estimated following method of Wilcox et al.
Phytic acid is extracted in 0.4 mM HCl. 100 mg powdered sample was mixed thoroughly with 0.4 mM HCl (1.0 ml) followed by centrifugation at 10,000 g for 20 minutes. 0.1 ml supernatant was taken out and final volume was made 1.0 ml using distilled water. 1.0 ml of colorimetric reagent (3M H_2SO_4, 2.5% ammonium molybdate and 10% ascorbic acid varied in equal volume with two volume of distilled water) was added to it and kept at room temperature for one hour. Optical density was measured against blank at 650 nm with spectrophotometer. Concentration of phytic acid was calculated using K_2HPO_4 as standard and expressed in mg·g−1 dry weight [3]

3.13 Total Free Sugars:
Total free sugars were determined using anthrone method. Plant sample was boiled in 80% ethyl alcohol followed by centrifugation at 3000 g for five minutes. The residue was again crushed in 80% ethyl alcohol and then centrifuged. The supernatant was pooled together. The alcoholic extract (1 ml) so prepared was evaporated to 0.2 ml in a water bath and the volume was made up to 1 ml with distilled water. 1 ml HCl (1 N) was extra and the tubes were kept in boiling water bath for 40 minutes for hydrolysis. Anthrone reagent (4 ml; prepared by dissolving 500 mg anthrone in 720 ml chilled concentrated H_2SO_4) was then put to 0.5 ml of hydrolyzed extract and the tubes were subsequently reserved in boiling water bath for 10 minutes. After taking out from water bath and bringing it to room temperature, optical density was recorded at 620 nm. Computation of total free sugars was done using glucose standards. [3]

3.14 Starch:
Starch was determined by anthrone method. Residue (pellet) of the sample from which free sugars were extracted was dried in a roasting water bath at boiling temperature, subsequently 2 ml distilled water was added and then kept on a water bath for 15 minutes. Thereafter, cooled and 2 ml 9.2 N perchloric acid was added and stirred for 15 minutes, followed by centrifugation at 3000 g for five minutes. Supernatant was collected in 50 ml volumetric flask. 2 ml of 4.6 N perchloric acid was added again to the residue and stirred for 15 minutes then centrifuged. Finally, supernatants were combined and volume made up to 7.5 ml with distilled water. In an aliquot (0.1 ml) 4 ml of anthrone reagent was added. The tubes were then kept in a boiling water bath for 10 minutes and subsequently cooled on ice and brought to room temperature and optical density recorded at 620 nm. Computation was done using standard curve. [3]

3.15 Sodium, Potassium and Calcium
The analysis was done using flame photometer as adopted by Tiwari, one-gram dried powdered plant material was taken in a conical flask and digested in tri-acid mixture (H_2SO_4 + HNO_3 + $HClO_4$ in 9:3:1 ratio). The colorless digested material was filtered through What man filter paper number 1 into 100 ml volumetric flask making up the total capacity to 100 ml. 10 ml aliquot was then taken and made up to 25 ml with distilled water and was read directly on digital flame photometer, employing Na, K and Ca filters separately and percentage of Na, K and Ca was determined using standard curves.

3.16 Chloride
Chloride was estimated following Eaton et al. [23]. One-gram dry sample was boiled in distilled water (100 ml) on a water bath for 30 minutes. After cooling the extract was filtered and was titrated against 0.1 N $AgNO_3$ solution till a permanent piece red precipitate persists. [3]

4 Pharmacological and other activities of jatropha curcas:
4.1 Antioxidant activity:
Free radical rummaging activity Radical scavenging activity of extracts against stable DPPH (2,2- diphenyl-2-picrylhydrazyl hydrate) was determined spectrophotometrically as described by Ismail et al. (2010). The experiment was carried out in thrice and results were reported as percentage of inhibition and IC50 (required concentration to scavenge 50% of DPPH radicals). Ascorbic acid and quercetin were used as standard antioxidants.

4.2 Nitric oxide scavenging activity
The NO-scavenging activity of extracts was determined according to Tsai et al. (2007). The activity was expressed as percentage of inhibition and IC50 (extract concentration to quench 50% of the NO radicals released by sodium nitroprusside).

4.3 Anti-inflammatory activity:
The murine monocytic macrophage RAW 264.7 cell line (European Cell Culture Collection, CAMR, UK) was cultured in Dulbecco's Modified Eagle Media (DMEM) (2mM L-glutamine, 45 g/l glucose, 1 mM sodium pyruvate) with 10% fetal bovine serum (FBS). The cells were cultured at 37°C with 5% CO2 and were culture twice a week. The cells were seeded in 96-well tissue culture plates (1 x 10 6 cells/ml) and incubated for 2 h at 37°C with 5% CO2. Then, 100 µl of test extract in DMSO was then added and serially diluted to give a final concentration of 200 µg/ml in 0.1 % DMSO. Cells were then stimulated with 200 U/ml of recombinant mouse interferon gamma (IFN-) and 10 µg/ml Escherichia coli lipopolysaccharide (LPS) and incubated at 37°C for another 17 h. The presence of nitrite was determined in cell culture medium by Griess reagent and cell viability was detected by using MTT cytotoxicity assay as described by Ahmad et al. (2005). N-nitro-l-arginine-methyl ester (LNAME) was used as ion's inhibitor (control) at a concentration of 250 M.

4.4 Cytotoxicity:
Human hepatocytes Chang liver cells) and human colon adenocarcinoma (HT-29) cell lines obtained from the American Type Culture Collection (ATCC) were used in this study. Cells were grown at 37°C in humidified 5% CO2 and 95% air atmosphere in Dulbecco's Modified Eagle Media (DMEM) (2mM L-glutamine, 45 g/l glucose, 1 mM sodium pyruvate, 2g /l sodium bicarbonate and 10% fetal bovine serum). Monolayers of the cells (5 × 10 3 /100 l) were grown in 96-well microtitre plates and exposed to two-fold serial dilution of the extracts from 200 g to 3.1 g/100 l. After 3 days incubation at 37°C, the cytotoxicity of extract was determined by using MTT assay according to Ahmad et al. (2005). Tamoxifen, which is known as an anticancer drug was used as a positive control in the present study. [5]

4.5 **Antifungal activities**:
The plant pathogenic fungi including C. coccode, P. ultimum, P. capsici, R. solani, B. oryzae and F. fujikuroi were received as a gift from Pakistan Agricultural Research Council (PARC), Islamabad, for research purpose only [6]
The antifungal activities of J. curcas de-oiled seed cake extracts and seed oil were carried out using microdilution method according to guidelines of National Clinical and Laboratory Standard Institute (Clinical and Institute 2002) with some modifications. An aliquot (100 µL) of spore suspension (2× 106 spores/mL in Sabouraud dextrose broth) of each fungus was dispensed in separate wells comprising 100 µL of different dilutions of J. curcas seed oil or de-oiled seed cake extracts (aqueous, methanolic or n-hexane) with final concentrations of 25, 12.5, 6.25, 3.12 and 1.56 mg/mL of DMSO and incubated at 30 °C for 72 h [6]

4.6 Anti-inflammatory activity of Jatropha curcas
Anti-inflammatory activity of topical application of Jatropha curcas L. root powder in paste form in TPA-induced ear inflammation was confirmed in albino mice and successive solvent extraction of these roots was carried out by ether and methanol. The methanol extract exhibited systemic and important anti-inflammatory activity in acute carrageenan induced rat paw edema. It also showed activity against formalin-induced rat paw edema, turpentine-induced exudative changes and cotton pellet-induced granular tissue construction after oral treatment for 7 days in albino rats. Thus, resultant anti-inflammatory activity might be due to effects on several mediators [12]

4.7 Antimetastatic effects of curcusone-B, a diterpene
A new approach to cancer therapy in recent years has been to target the metastatic process. The antimetastatic potential of curcusone B, a diterpene isolated from J. curcas Linn., was investigated against 4 human cancer cell lines. Treatment with non-cytotoxic doses of curcusone-B resulted in a strong decrease of invitro invasion, motility [12]

4.8 Antitumor effects of curcin from seeds
Antitumor activity of curcin was tested by MTT assay. The N-glycosidase activity of curcin was determined by characterization of R-fragment in gel. A cell-free system, rabbit reticulocyte lysate, was announced to quantify the inhibitory activity of curcin on protein biosynthesis. The curcin had a powerful inhibitory action upon protein synthesis in reticulocyte lysate with an IC50 (95 % confidence limits) value of 0.19 (0.11-0.27) nmol/L [12]

4.9 Coagulant and anticoagulant activities:
In latex J. curcas Linn. is traditionally used as a hemostatic. Investigation of the coagulant activity of the latex of J. curcas showed that whole latex significantly, however, prolonged the clotting time: at high dilutions, the blood did not clot at all. This indicates that J. curcas latex possesses both coagulant and anticoagulant activities. Prothrombin time (PT) and activated partial thromboplastin time (APTT) tests on plasma confirm these observation [12]

4.10 Disinfectant/antiparasitic activity
Bacteriological and parasitological tests were carried out on laboratory bench surface using the sap and crushed leaves of J. curcas. Observation showed that the sap exhibited germicidal actions on the growth of common bacteria of Staphylococcus, Bacillus and Micrococcus species on contact and retained such effect on treated laboratory bench surface for close to six hours after initial application [12]

4.11 Insecticidal properties:
Jatropha seed oil at various serial dilutions ranging from 0% to 2% (v/w) at 0.5% interval were evaluated for anti-ovipositional activity and long-term protective ability [12]

4.12 Pregnancy terminating effect:

The fertility regulatory effect of the fruit of J. curcas was investigated by oral administration of different extract to pregnant rats for varying periods of time. Fetal resorption was observed with methanol, petroleum ether and dichloromethane extracts indicating the abortifacient properties of the fruit. The results also suggest that the interruption of pregnancy occurred at an early stage after implantation [13,14,15,16,17]

CONCLUSION:

Jatropha curcas is a quick-growing and popular tree, It is a traditionally important medicinal plant and having numerous commercial applications. 1. Jatropha curcas having anti-inflammatory, anti-meta statics, anti-tumor, coagulant and anti-coagulant, disinfectant / anti-parasitic, wound healing, insecticidal, pregnancy dismissing activity and anti-diarrheal effect.

The main constituents are curcin, curcusone B, curcain, campesterol and curcacycline-A.

The plant having toxic potential, toxicity is due to curcin and tetramethylpyrazine. The seed oil contains phorbol esters, known to cause a large number of biological effects. However, the toxicity can be managed by deacidification and bleaching of phorbol esters. Now a day's plant has been used for numerous commercial applications such as oil production, schistosomiasis control, disinfection, prevention of malaria and fertilizer.

The study was intended to explore the antimicrobial and Phytochemicals value of J. curcas extract and results revealed that the highest activity was measured against E. coli, Agrobacterium tumifaciens, Klebsiella pneumonia, Salmonella Typimuruim, Enterobacter cloacae and Proteous vulgar with different organic extracts

J. curcas Linn. leaf and latex extracts, contained appreciable amounts of phenolic and saponin compounds. These extract also showed good antioxidant activity toward DPPH and NO radical scavenging activity

References:

1. MUHAMMAD NISAR UL HAQ, SULTAN MEHMOOD WAZIR, FAIZAN ULLAH*, RAHMAT ALI KHAN, MIR SADIQ SHAH & ADNAN KHATAK, Phytochemical and Biological Evaluation of Defatted Seeds of Jatropha curcas, UKM JOURNAL ARTICLE REPOSITORY, Sains Malaysiana 45(10) (2016): 1435–1442
2. Amit Kumar Sharma1, Mayank Gangwar2, 3, Dharmendra Kumar2, Gopal Nath2, Akhoury Sudhir Kumar Sinha 4, Yamini Bhushan Tripathi1, Phytochemical characterization, antimicrobial activity and reducing potential of seed oil, latex, machine oil and press cake of Jatropha curcas, AVISENNA JOURNAL OF PHYTOMEDICONE, Vol. 6, No. 4, Jul-Aug 2016 PAGE NO. 366-375
3. Nisha Singh Tomar, R. M. Agarwal, Influence of Treatment of Jatropha curcas L. Leachates and Potassium on Growth and Phytochemical Constituents of Wheat (Triticum aestivum L.), American Journal of Plant Sciences, 2013, 4, 1134-1150 http://dx.doi.org/10.4236/ajps.2013.45140 Published Online May 2013 (http://www.scirp.org/journal/ajps) PAGE NO. 1135-1150
4. Muhammad Idrees Rahu a, Syed Habib Ahmed Naqvi a, Nazakat Hussain Memon b, e, ⇑, Muhammad Idrees b, Farhatullah Kandhro a, Navish Lodhi Pathan c, Md Nazirul Islam Sarker d, Muhammad Aqeel Bhutto a, Determination of antimicrobial and phytochemical compounds of Jatropha curcas plant, Saudi Journal of Biological Sciences 28 (2021) 2867–2876
5. Ehsan Oskoueian 1, Norhani Abdullah 2 *, Wan Zuhainis Saad 1, Abdul Rahman Omar 3, Syahida Ahmad 2, Wen Bin Kuan 2, Nor Azlina Zolkifli 2, Rudi Hendra 2 and Yin Wan Ho 3, Full Length Research Paper Antioxidant, anti-inflammatory and anticancer activities of methanolic extracts from Jatropha curcas Linn. Journal of Medicinal Plants Research Vol. 5(1), pp. 49-57, 4 January, 2011
6. Abdul Haq1 · Sama Mushtaq1 · Alam Khan1 · Arshad Islam2,3 · Haji Khan4 · Zulfiqar Ali Malik5 · Farhan Younas3 · Samiullah Khan1 · Aamer Ali Shah1 · Malik Badshah1, Evaluation of phytochemical, bioactive, and antifungal potential of Jatropha curcas seed oil and de-oiled seed cake extracts against phytopathogenic fungi, Journal of Plant Pathology
7. Constance C. Jide-Ojo1 *, Daniel T. Gungula2 and Opeolu O. Ojo1,2, Extracts of Jatropha curcas L. exhibit significant insecticidal and grain protectant effects against maize weevil, Sitophilus zeamais (Coleoptera: Curculionidae), ournal of Stored Products and Postharvest Research, page no 44-50
8. B.C. Ejelonu, R.A. Oderinde and S.A. Balogun 1 2 3, Chemical and Biological Properties of Jatropha curcas and Mucuna solan Seed and Seed Oil, Libyan Agriculture Research Center Journal Internation 1 (4): 263-268, 2010
9. https://images.app.goo.gl/fyqzxb39V1CihunA7
10. https://keyserver.lucidcentral.org/weeds/data/media/Images/jatropha_curcas/thumbs/jatrophacurcas1_sml.jpg
11. https://keyserver.lucidcentral.org/weeds/data/media/Html/jatropha_curcas.htm#:~:text=Jatropha%20curcas-,Scientific%20Name,covered%20in%20soft%20blunt%20spines%2C%20but%20are%20hairless%20(i.e.%20glabrous).,-Copyright%20%C2%A9%202016.%20All
12. Sumit N Laxane 1, Surendra Swarnkar 1, Mruthunjaya K2, Sachin B Zanwar 1 and Manjunath Setty M 1 *, Jatropha curcas: A Systemic Review on Pharmacological, Phytochemical, Toxicological Profiles and Commercial Applications, Research Journal of Pharmaceutical, Biological and Chemical Sciences, Volume 4 Issue 1 Page No. 990-1010
13. Osoniyi O, Onajobi F. J Ethnopharmacol 2003; 89(1): 101-105.
14. Fagbenro-Beyioku AF, Oyibo WA. East Afr Med J 1998; 75(9): 508-511. [12] Ahmed OM, Adam SE. Vet Pathol 1979; 16(4): 476-482.

15. Staubmann R, Ncube I, Gübitz GM, Steiner W, Read JS. J Biotechnol 1999; 75(2-3):117- 126. [14] Shetty S, Udupa SL, Udupa AL, Vollala VR. Saudi Med J. 2006; 27(10): 1473-1476.
16. Adedire CO, Adebowale KO, Dansu OM. J. Trop. Forest Products 2003; 9: 15-25.
17. Goonasekera MM, Gunawardana VK, Jayasena K, Mohammed SG, Balasubramaniam S. J Ethnopharmacololgy 1995; 47(3): 117-123.
18. https://images.app.goo.gl/JjrPGdJAs74kc11s7
19. https://images.app.goo.gl/Y9iqBngNGGZ6F2AcA
20. https://images.app.goo.gl/FtQeHXu43Dr267S38