Minireview Article

Antiviral activities of *Jatropha curcas* : A mini review

ABSTRACT

Background: The Plant of *Jatropha curcas* is known for their many biological activities including antiviral, antifungal and antibacterial.
Aim: To provide update knowledge on the phytochemistry, toxicology and antiviral activity of some medically interesting *Jatropha curcas*.
Study Design: Multidisciplinary advanced bibliographic surveys and dissemination of the resulted knowledge.
Results: The literature review shows that *Jatropha curcas* have antiviral properties on different types of viruses. Different parts of the plant such as leaves, roots, latex, seeds, fruits and other parts have been reported to have different compounds which have interesting bioactivities and antiviral properties.
Conclusion: The present mini-review can therefore help inform future scientific research towards the development of anti-Hepatitis B virus and antiCovid-19 herbal drugs of relevance as well as nutraceuticals from *J.curcas* for the improvement of human health and wellbeing using reverse pharmacology approach. Molecular docking of some naturally occurring isolate compounds against anti-Hepatitis B virus protease is in progress.

Keywords: Jatropha Curcas, *Antiviral activity,* Hepatitis *B virus, phytochemistry.*

1. INTRODUCTION

The human being and ther Animals depend on the plants for their daily life. The main source of drugs remains plants products since the ancient time. Tropical medicinal plant species are known for their richness in biologically active secondary metabolites of therapeutic relevance. These products are claimed to be safe, economic, effective and available. Because of these advantages the medicinal plants are widely used by the traditional healers in their day to day practice (Ngbolua et al., 2017).
The World Health Organization (WHO) recognizes that traditional and complementary medicines are a vital part of the global health care system. In Africa, it is estimated that over 80% of the population rely on medicinal plant species to meet their basic health care needs.
The Democratic Republic of the Congo (DRC) is one of the most plant diversity rich countries in Africa, and contains 47% plant diversity of the African rain forests (Ngbolua et al., 2016). Jatropha curcas Linn is a part this richful flora among which many pharmaceutical plants.
Jatropha curcas Linn., called Purghère, Médicinier de Barbades, Fève d'enfer, Gros pignon d'Inde in french, or in DRC languages Mukadi pemba, Nzo bamputu (Kiyanzi), Mpulungu (Kiyombe) Mpuluka (Kikongo), Lundimba, mutshi au mvidie (Tshiluba), Ngbozinga (Ngbaka), Kada (Mono, Ngbandi), Etiteza (Ngombe), Lubonobono, Lw'ebufuliro (Mashi), Lakya-akya (Bembe), Kivurahinda (Fuliro), Mutanzania (Nande) is a well known medicinal plant in DRC. Jatropha curcas Linn has some known medicinal properties include antiviral activities.
Viruses are a large group of submicroscopic infectious agents that can infect animals, plants, fungi and even bacteria. Once infected in living cell, it produces more viruses using host machinery. They consist of genetic material, RNA or DNA surrounded by a coat of protein,

lipid or glycoloipids. They are capable of growth and multiplication only in living cells and can cause various important diseases in humans, animals, and plants. Most Commonly Occurring Viral Diseases are AIDS, Hepatitis, Small Pox, Polio, Measles, Rubella, Severe Acute Respiratory Syndrome (SARS) etc. New Severe Acute Respiratory Syndrome caused by coronavirus was reported, in December 2019, in Wuhan, Hubei Province, China and became a global pandemic, killing millions of people (Abd El Hafez et al., 2022) .
The occurrence of the covid-19 pandemic has led many researchers to examine plants that may have activity on viruses. *Jatropha curcas* being a plant widely used against several diseases including hepatitis B in DRC, this mini review aims to review the antiviral activity of this multiple-use plant.

2. METHODOLOGY

A literature search was conducted to obtain updated information about the phytochemistry and virucidal activity of Jatropha *curcas* from various electronic databases like PubMed, Science Direct, Sci-hub and Google scholar. The scientific name of this plant was used as a keyword for the search, along with the terms biological activities, antiviral activities and phytochemistry, toxicology and virucidal/antiviral activity. We used "Mendeley" software for Bibliographical references.

3. RESULTS AND DISCUSSION

3.1.*Botany and propagation*

Jatropha curcus L. is large shrub of 3-4m high (Fig.1), formed by juicy multi-branched stem Leaves alternately arranged, 10-15cm x 7.5-12.5 cm, they are broadly ovate, conate, acute usually palmately 3 or 5 lobed, glabrous; flowers in loose panicles of the cymes, yellowish green, fruits are 2.5cm, long ovoid, black, seeds are ovoid – oblong, dull brownish black. The plant is monoecious and the terminal inflorescences contain unisexual flowers on the same inflorescence. The inflorescence is a panicle, with the female flowers (about 10–20%) at the apices of the main stem and branches of the inflorescence. Male flowers are more numerous (about 80–90%) and occupy subordinate positions on the inflorescence The period of the male inflorescence is 8-10 days for the male flowers while the female flowers take only 2-4 days. The continuous flowering results in a sequence of reproductive development stages from yellow mature fruits at the base of the branch, to green fruits in the middle, and flowers at the top. After pollination, the inflorescences form grapes of 10 green fruits, 2–3 cm long with an ovoid shape. Each fruit typically has three carpels and the potential for two seeds per carpel. The seed resembles castor seed in shape but are smaller in size and dark brown in color.
The plant root system proceeds through the development of a main taproot and four shallow lateral roots (Krishnan & Paramathma, 2009; van Peer Masc, 2010).
J curcas belongs to the Jatropha genus which is composed of 170 species. The genus Jatropha belongs to the tribe Jatropheae in the Euphorbiaceae family (Carels, 2009). The Euphorbiaceae family, composed of more than 8000 species, contains distinct representatives in commercial exploitation, such as the Hevea brasiliensis, Manihot esculenta (cassava) and Ricinus communis (castor oil).

Figure 1 : Jatropha curcas

Jatropha curcas can easily be propagated by both cuttings or seed. But the seed propagation is recommended for establishment of long-lived plantations. When J. curcas plants develop from cuttings, they may produce many branches but yield fewer seeds and do not have enough time to develop their taproot, which makes them sensitive to wind erosion. The seeds of J.curcas exhibit orthodox storage behaviour and under normal treatment and storage will maintain viability at high percentages for eight months to a year. Furthermore, propagation through seed or sexual propagation leads to a lot of genetic variability in terms of growth, biomass, seed yield and oil content

3.2 Ecological and Geographic Distribution

Jatropha curcas is native to Central America but now grows naturally in most tropical areas of the world (Fig.2) (Burkill, 1994; FAIRLESS D., 2007; Joachim Heller, 1996; Openshaw, 2000)). It is widely distributed in the wild and cultivated tropical areas of Central America, South America, Africa, India, South Eastern Asia, and Australia. Therefore, it typically grows between 15 and 40°C with rainfall between 250 and 3000 mm. The optimum water regime is around 700 mm/year.

Figure 2 : Jatropha distribution ((Formad, 2013))

Although is an open-field plant species, it requires intense sun such as found in the savanna or desert periphery. It is not adapted to grow under the shadow of forest canopy and does not compete with fast-growing species of the rain forest. It is well adapted to arid and semi-arid climates, and can resist to adverse environmental conditions. J. curcas can grow on a large range of soils provided they are well drained and aerated.

Uses of Jatrophas

Jatropha curcas is a multiple purpose plant (fig.3) . Apart from its medicinal uses, the most widespread use for which large plantations of J. curcas are made is the production of oil from its seeds. The oil content of the seeds varies from 20 to 30% and can even reach 80% depending on the type of extraction. On a hectare 400 to 600 liters of oil can be obtained for a soil of average quality J.curcas oil is not suitable for human consumption, it can induces diarrhea and vomiting. This oil can but uses directly as biofuel for combustion engines or may be subjected to transesterification to produce biodiesel. Several tests have also been carried out to use Jatropha oil in aviation as jet fuel mixed in different proportions. This is the case of Air New Zealand 50 :50 of Jatropha oil and A-1 fuel, Continental Airlines (USA) 50/50 mixture of algae/jatropha-oil-derived biofuel and Jet A and Indian airline SpiceJet (India) which used jatropha based biofuel in the ratio of conventional jet fuel to jatropha oil of 25:75(Jagriti Chandra, 2018; Murthy et al., 2019)

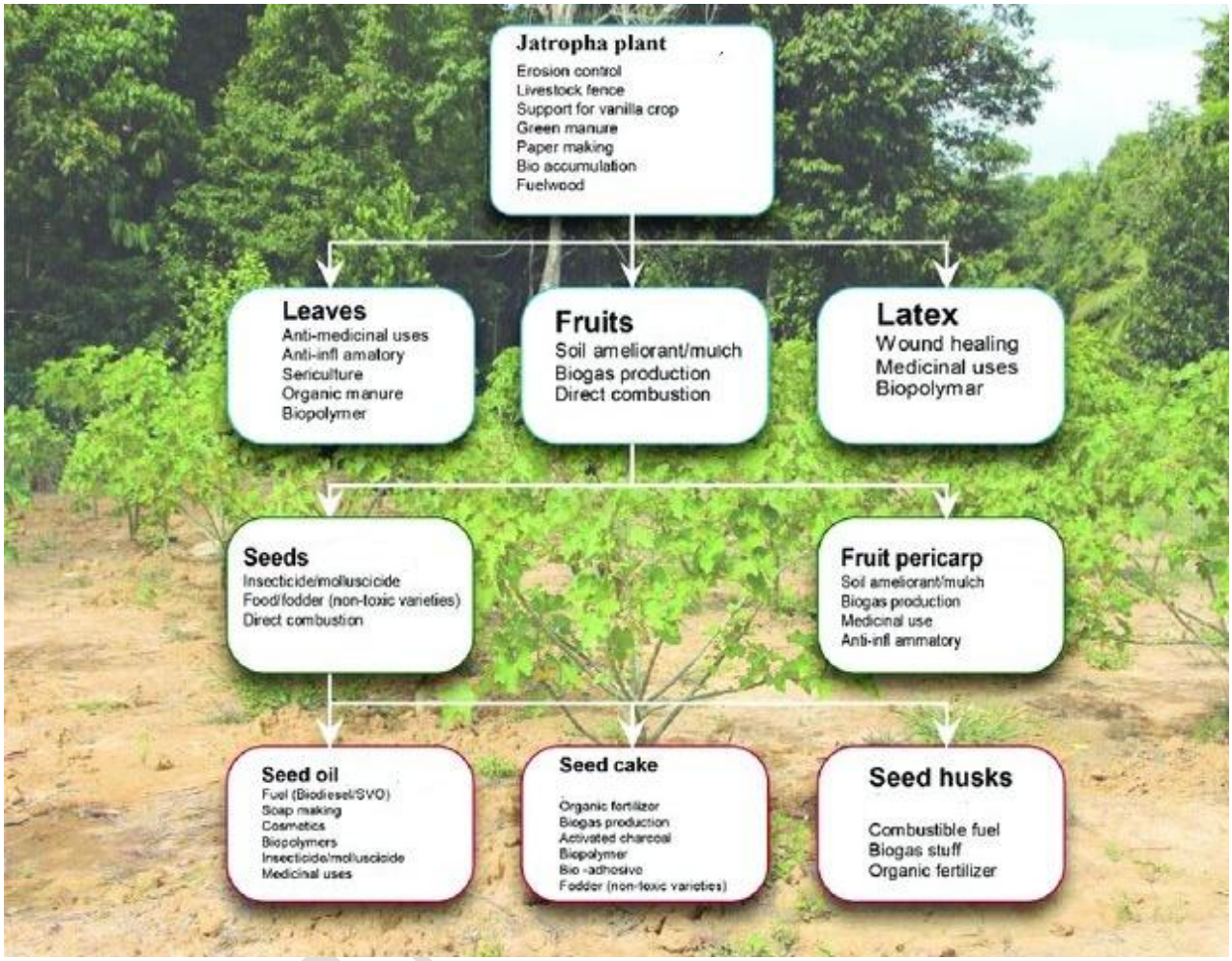

Figure 3 : Uses of Jatropha curcas (Moniruzzaman et al., 2017)

Jatropha curcas is also an important plant in relation to climate change and sustainability. It has also been reported that it contributes to carbon sequestration. This plant of Jatropha genus is very resistant to aridity so it can be planted in hot and dry land in soil unsuitable for food production. This plant can also be used in erosion control, soil stabilization and water saving.

3.3 Ethnnopharmacology

Different parts of *Jatropha curcas* (leaves, roots, fruits, latex, grains, whole young plants, oil ...) are used in traditional medicine across the tropics and in particular in Africa against various ailments. According to (Neuwinger HD, 1996) in some african countries a few drops of diluted water solution of twig sap are given by mouth to new-born babies affected by tetanus; leaves have been used as haemostatic agent when applied to cuts and bleeding wounds; seed oil has been used as ingredient in the treatment of rheumatism, seeds are chewed when in need of a laxative and used for treating ascites, gout, paralysis, skin diseases and as a purgative, anthelminthic and abortifacient; etc.

In DRC, decocted from the leaves, is used against malaria; decocted roots (as a gargle) against gingivitis and stomatitis; latex from leafy stem (in instillation ocular) against eye disorder (conjunctivitis, …), but also as remedies for several other ailments.
Table 1 summarizes the main biological activities of *Jatropha curcas*

Bioactivity and ethopharmaceutical use	**Part of the plant**	**Form, extract or molecules**
Anti-bacterial activity	Leaves, roots	Terpenes
Antifungal activity	Various plant parts	Various extracts
Antiinflamatory activity	roots	Methanolic extract
Antidiabetic activity	leaves	Ethanolic extract
Anthelmintic activity	leaves	Aqueous extract
Antidiarrea activity	roots	Methanolic extract
Anticancer activity	leaves	Various extracts
Antiulcer activity	leaves	Methanolic extract
larvidal and insecticidal activity	Various plant parts	Methanol and ethanol extracts
Antioxydant activity	shoots	Glutathione reductase, ascorbate peroxidase,guiacol peroxidase
Pregnancy terminating effect	Fruits, seeds	Methanol,petroleum ether, dichloromethane extract ; jatraphone
Wound healing activity	leaves	
Anti toothache effect	Tender stem	
Coagulant and anticoagulant activities	latex	Whole latex
Hepatoprotective effect	shrup	
Dermatomucosal effect	Latex	
Anti artritis effect	seeds	
Anti-jaundice and liver trouble effects	Seeds ; leaves	
Cytotixicity	Seeds,	Jatrapone
antimalarial	Young leaves	Aqueous infusion
Anti sickle cell disease		
Antihemorroids effect	Fresh leaves	Aqueous decoction
Antihypertension effect	leaves	
Antirheumatism effect	roots	Aqueous infusion
Anticonstipastion, laxative effect	Friut powder	Aqueous infusion
Anticonvulsant activity	Aeral parts	Ethanol/water (1 :1) extract
Analgesic activity	leaves	Ethanolic and aqueous extracts

(Abdelgadir & van Staden, 2013) and (Sharma & Singh, 2012)

Several scientific studies have confirmed the different pharmacological activities which would be responsible for the effects observed in traditional medicine.

For instance Acetone, chloroform, ethanol and methanol extracts of root bark of this plant has been reported to inhibit the growth of both gram-positive (*Staphylococcus aureus*) and gram negative bacteria like *Salmonella typhimurium , Pseudomonas aeruginosa*, *Escherichia coli and Klebsiella pneumonia* (Muanza et al., 1991; Naqvi et al., 1991; Sundari et al., 2011; Tona et al., 1999)

Various plant parts of *J. curcas* have shown antifungal activity against *Candida albicans , Bacillus subtillis , Aspergillus fumigatus*, *Aspergillus flavus*, *Aspergillus niger*, *Phymatotrichopsis omnivora*, etc (Hu et al., 2011; Kubmarawa et al., 2007; Muanza et al., 1991; Naqvi et al., 1991; Sundari et al., 2011) Application of *Jatropha curcas* root powder in paste form in mice and rats has been reported to possess anti-inflammatory activity (Mujumdar & Misar, 2004) . Root bark extract showed also a very good scavenging activity when compared with acorbic acid (Sundari et al., 2011). The polar (using methanol) and non-polar (using petroleum ether) extracts of *J. curcas* roots have shown antidiarrea activity in various species of albino mice (Mujumdar et al., 2000) Various plant parts of *J. curcas* have been reported to possess insecticidal and larvicidal and anthelmintic activity etc (Akilesh Kumar, 2015).

3.4. Phytochemistry

Due to their medical value, Diterpenes have been dominating the research area in J. curcas. Diterpenes have a range of in vitro biological activities such as antihypertensive, anticancer, antiretroviral, anti-inflammatory, analgesic, antimicrobial, insecticidal and molluscicidal activities (Devappa et al., 2011) (Abdelgadir & van Staden, 2013)

On the below table 2, we have noted chemicals compounds reported by (Devappa et al., 2010a, 2010b; Insanu & Kayser, 2014; Ravindranath et al., 2004; Subramanian et al., 1971) as identified in J. curcas

Table 2: Chemicals Compounds

No	Chemical compounds	Type	Sources
1	2α-hydroxy-epiisojatrogrossidione	Diterpenes	Aerial part
2	Spirocurcasone	Diterpenes	Root
3	Curculathyrane-A	Diterpenes	Root
4	Curculathyrane-B	Diterpenes	Root
5	Curcusone-A	Diterpenes	Root
6	Curcusone-B	Diterpenes	Root
7	Curcusone-C	Diterpenes	Root
8	Curcusone-D	Diterpenes	Root
9	Curcusone-E	Diterpenes	Root
10	Jatrophone	Diterpenes	Root
11	Jatrophalactam	Diterpenes	Root
12	Palmarumycin CP1	Diterpenes	Stem
13	Palmarumycin JC1	Diterpenes	Stem
14	Palmarumycin JC2	Diterpenes	Stem

15	5-OH-pyrrolidin-2-one	Alkaloid	Leaf
16	Pyrimidine-2,4-dione	Alkaloid	Leaf
17	2-methylanthraquinone	Antraquinone	Aerial part
18	Marmesin	Coumarin	Root
19	Tomentin	Coumarin	Root
20	Propacin	Coumarino-Lignane	Root
21	Jatrophin	Coumarino-lignane	Root
22	Curcacyline-A	Cyclic peptide	Latex
23	Curcacycline-B	Cyclic peptide	Latex
24	4E)-15-O-Acetyl-15-epijatrogrossidentadione	Diterpenes	Aerialpart
25	(14E)-14-O-Acetyl-5,6-epoxygrossidentadione	Diterpenes	Aerial part
26	(4E)-15-epijatrogrossidentadione	Diterpenes	Aerialpart
27	3β-acetoxy-12-methoxy-13-methylpodocarpa-8,11,13-trien-7-one	Diterpenes	Aerial part
28	3β, 12-Dihydroxy-13-methylpodocarpane 8,10,13-triene	Diterpenes	Aerialpart
29	Heudelotinone	Diterpenes	Aerial part
30	Epi-isojatrogrossidione	Diterpenes	Aerial part
31	Apigenin	Flavonoid	Leaf
32	Vitexin	Flavonoid	Leaf
33	Isovitexin	Flavonoid	Leaf
34	Curcin	Lectin	Seed
35	Tetradecyl-E-ferulate	Lignane	Aerial part
36	12-deoxy-16-hydroxy phorbol-C13-C16 diesters	Phorbol ester	Seed
37	Factor 1	Phorbol ester	Seed
38	Factor 2	Phorbol ester	Seed
39	Factor 3	Phorbol ester	Seed
40	Factor 4	Phorbol ester	Seed
41	Factor 5	Phorbol ester	Seed
42	Factor 6	Phorbol ester	Seed
43	B-sitosterol	Phytosterol	
44	Curcain	Protease	
45	Stigmasterol	Triterpenes	Leaf
46	3-O-(Z)-coumaroyl oleanolic acid	Triterpenes	Aerial part
47	Acetoxyjatropholone	Diterpenes	Root
48	Multidione	Diterpenes	Root
49	Myristic acid	Fatty acid	Seed

A part from which roles habe been enlighten above, (Q. Huang et al., 2014) noted that flavonoids from *J. curcas* have antioxidant activities. (Ebuehi & Okorie, 2010) pointed out the role in the free radical scavaging after he quantified various flavonoids of the leaf extract.

3.5. Antiviral activity

The water extract of the branches of J. curcas strongly inhibit the HIV-induced cytopathic effects with low cytotoxicity(Matsuse et al., 1999). Latex of J. curcas possesses inhibitory property against Water melon mosaic virus (Tewari & Shukla I.K., 1982).
The chromatography on Diaion HP-20 has been use to fraction the water extract of the branches of J, curcas (eluted with water and increasing concentrations of MeOH). The bioassay-guided fractionation afforded corilagin and ferulic acid from 50% MeOH-eluted fraction, and 5,7- dimethoxycoumarin and 6,7-dimethoxycoumarin from MeOH-eluted fraction. Comparing their 1 H and 13 CNMR data with those of authentic samples has conducted to the identification of the compounds. Of the compounds isolated, only 5,7-dimethoxycoumarin and 6,7-dimethoxycoumarin showed moderate inhibition on HIV-1-induced cytopathic effect but with considerable cytotoxicity.
Liver disease: Jatropha curcas L., Euphorbiaceae Piñon blanco (yura piñon), 033695 L The sap is expressed from the leave, then diluted in water and drunk 3 times a day, with dietary restrictions (Roumy et al., 2020).
It has been reported that a moderate cycloprotective activity against HIV in cultured human lymphoblastoid CEM-SS cells for the methanol extract from J. curcas (Muanza' et al., 1995).On the other side, (Matsuse et al., 1999) after investigation, mentionned the effects of aqueous and methanolic extracts from J. curcas branches for the inhibition of HIV-induced cytopathic effects in cultured cells, HIV reverse transcriptase and HIV-protease enzymes. The water extract of J. curcas branches showed potent inhibition (IC50 24 µg ml−1) of the HIV-induced cytopathic effects with low cytotoxicity (CC50 N 1000) and selectivity index CC50/IC50 (N41.7). (Wender et al., 2008) reported the possibility of synthesizing prostratin and DPP from phorbol esters from J. curcas. A high clinical candidates that could be used in the treatment of HIV has been identified after this synthesis.

A ribosome-inactivating protein (curcin 2) induced from Jatropha curcas can reduce viral and fungal infection in transgenic tobacco (M. X. Huang et al., 2008)

From various medicinal uses that known for J curcas, the antimicrobial, anti-cancer and anti-HIV activity has been well classified. Because of its broadspectrum activity, some investigations using aqueous and methanol leaf extracts for cytotoxicity and its potential to inhibit hemagglutinin protein of influenza virus. The bioactive compounds from leaf extracts were characterized by highperformance thinlayer chromatography which confirmed the presence of major phytochemicals groups including flavonoids, saponins and other tannins. The cytotoxic concentration 50 for aqueous and methanol extracts were determined using trypan blue dye exclusion assay. Inhibition of hemagglutinin protein was assessed using minimal cytotoxic concentrations of the extracts and 102.5 TCID50 (64 HA titre) of the Influenza A (H1N1) virus with different exposure studies using hemagglutination assay. Aqueous and methanol extracts were found to be non-toxic to Madin darby canine kidney cells below concentration of 15.57 and 33.62 mg/mL for respectively. Inhibition of hemagglutinin was studied using reducing hemagglutination titre which confirmed that the J. curcas extracts have direct effect on the process of virus adsorption leading to its inhibition. Results provide the information which shows the potential of Jatropha extracts in the treatment of influenza A (H1N1) virus infection. With an established reduced toxicity and prevention of infection by inhibiting hemagglutinin protein, these extracts and its derivatives may be further developed as broad-spectrum anti-influenza drugs for

prevention and treatment of infections by different types of influenza viruses with further mechanistic studies on antiinfluenza (Patil et al., 2013)),

Jatropha curcus activity against virus: Jatropha curcas is known for various medicinal uses. Its antimicrobial, anti-cancer and anti-HIV activity has been well recognized. Because of its broad-spectrum activity, investigation has been conducted on aqueous and methanol leaf extracts for cytotoxicity and its potential to inhibit hemagglutinin protein of influenza virus. The bioactive compounds from leaf extracts were characterized by high performance thin layer chromatography which revealed the presence of major phytochemicals including flavonoids, saponins and tannins. The cytotoxic concentration 50 for aqueous and methanol extracts were determined using trypan blue dye exclusion assay. Inhibition of hemagglutinin protein was assessed using minimal cytotoxic concentrations of the extracts and 102.5 TCID50 (64 HA titre) of the Influenza A (H1N1) virus with different exposure studies using hemagglutination assay. Aqueous and methanol extracts were found to be non-toxic to kidney cells below concentration of 15.57 and 33.62 mg/mL respectively. Inhibition of hemagglutinin was studied using reducing hemagglutination titre which confirmed that the J. curcas extracts have direct effect on the process of virus adsorption leading to its inhibition. The outcome provide insight which shows the potential of Jatropha extracts in the viruses infection treatment. With an established reduced toxicity and prevention of infection by inhibiting hemagglutinin protein, these extracts and its derivatives may be further developed as broad-spectrum anti-corona drugs for prevention and treatment of infections by different types of coronaviruses with further mechanistic studies on anti-corona (Dahake et al., 2013), and HIV (Agrawal et al., 2020) .

3.6. Toxicity studies

3.6.1 Toxic and antinutritional components

The major toxic and antinutritional components from J. curcas and their molecular mechanisms are in the Phorbol esters and curcin which are the most toxic phytochemicals of J. curcas ((Devappa et al., 2010a). Major toxic components as the phorbol esters, the antinutritional phytate and other trypsin inhibitor factors are contained in the seeds. As pointed out by (Devappa et al., 2010b) J. curcas kernels were separated into cotyledons, hypocotyls, kernel coat and endosperm to determine the location of the antinutrients. From this reseach, it has been proved that majority of phorbol esters (85.7%), phytate (96.5%) and trypsin inhibitor (95.3%) are localised in the endosperm.

3.6.2 Toxicological effects

In the in vitro and in vivo models J. curcas exhibited toxicity to a wide variety of species i.e., microorganisms, animals including humans. All parts of J. curcas are toxic and the degree of toxicity varies with the extract types, nature of test substances, dose, mode of administration, and sensitivity of the (Devappa et al., 2010a). The seeds are toxic to humans ((Joachim Heller, 1996); (Gandhi et al., 1995) with symptoms of giddiness, vomiting, delirium, muscle shock, decrease of visual capacity, high pulse rate and diarrhoea (Becker and Makkar, 1998; (Lakhanpal et al., 2008); (Singh et al., 2010)). In animals toxic symptoms were reported when raw or defatted seeds were force-fed to chicks (Amonoo-Kuofi et

al., 1995; Makkar & Becker, 2009), pigs (Chivandi et al., 2000), (Chivandi et al., 2006), sheep and goats ((Adam & Magzoub, 1975); (Ahmed & Adam, 1979)), rabbits ((Gandhi et al., 1995)), mice and rats (Liberalino et al., 1988; (Abdelgadir & van Staden, 2013); (Adam & Magzoub, 1975)), carp Cyprinus carpio ((Makkar et al., 1998)). In rabbits, (Gandhi et al., 1995) observed symptoms of diarrhoea, haemorrhagic eyes and inflammation of the g-intestinal tract at 6-, 9- and 13.5-ml kg−1 BW. In mice, (Horiuchi et al., 1987) reported induction of tumors by topical application of a methanol fraction from J. curcas oil with 36% of the animals having skin tumors in 30 weeks. Jing et al. (2005) reported toxicity for jatropherol-I (LD50 82.2 mg kg−1 BW) when administrated orally. (Li et al., 2010) reported toxic activity for phorbol esters (LD50 27.34 mg kg−1 BW) given by intragastric administration to Swiss Hauschka mice. A dead mice on which some histopathological studies on the organs were done showed prominent lesions mainly found in lungs and kidneys, with diffused haemorrhages in lung, and glomerular sclerosis and atrophy in kidney at doses 32.40 mg kg−1 BW. In rats, (Adolf et al., 1984) reported irritant activity from J. curcas seed oil (LD50 25 µg/ear), hydrophilic fraction (LD501.8 µg/ear) and the neutral fraction (LD501.5 µg/ear). For aniojane (Sutthivaiyakit et al., 2009) reported antiplasmodial activity against Plasmodium falciparum.

Jatropha curcas L. is known as two genotypes, the toxic and non-toxic. The presence of phorbol esters in the seed is making the difference between them. No differences were found in the level of amino acids, trypsin inhibitor, lectin, phytate curcin and saponin between these two genotypes

4.CONCLUSION

At the end of this work, which consisted in making an inventory of data on the phytochemistry or antiviral actions of *Jatropha curcas*. The large spectrum of biological activities and antiviral properties of this plant lead us to consider that it can play a role against viruses. Therefore *J.curcas* can be a good candidate to fight against Hepatitis B considering the importance of diterpenes and flavonoids in antiviral activities. This mini-review aims to guide and inform future scientific research towards the development of Hepatitis B herbal drugs of relevance as well as nutraceuticals from these three plant species for the improvement of human health. A molecular docking using components isolated from Jatropha curcas against Hepatitis B is ongoing.

COMPETING INTERESTS DISCLAIMER:

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

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