WORLD JOURNAL OF PHARMACEUTICAL RESEARCH
SJIF Impact Factor 8.453
Volume 13, Issue 8, 21-75. Review Article ISSN 2277–7105

RHAMNACEAE TREES OF ISRAEL AND PALESTINE – NUTRITION, MEDICINE AND CHEMISTRY

Abdullatif Azab*

Eastern Plants Company, Box 868, Arara, Israel.

Article Received on
29 February 2024,

Revised on 20 March 2024,
Accepted on 10 April 2024

DOI: 10.20959/wjpr20248-32021

***Corresponding Author**
Dr. Abdullatif Azab
Eastern Plants Company,
Box 868, Arara, Israel.

ABSTRACT

The trees of the Rhamnaceae family are part of sights of Eastern Mediterranean region and have been used by inhabitants of today's Israel and Palestine since ancient times. In this review article we will introduce the taxonomical affiliations of this family and its genera, as well as the ethnomedicinal and nutritional uses of the nine species that naturally grow in this region. The main part of this article will be briefly listing the findings of modern research of the medicinal, biological and nutritional properties of these trees, and extensive discussion will follow these findings. Structures of active phytochemicals will be presented in figures. It can be concluded here that there are significant differences in the number of published studies related to each one of the species. Finally, even though it is considered a domesticated species, selected activities of *Ziziphus jujuba* will be introduced for comparison and completion of this presentation.

KEYWORDS: Chemical composition, Plant extract, Antimicrobial, Antioxidant, nutrition, Anti-inflammatory, Growth conditions, Phytoremediation, Ethnomedicine, Nanoparticles.

1. INTRODUCTION

Rhamnaceae (Buckthorns in English, النبقيات Arabic, אשחריים Hebrew) is one of the largest plant families and it is mainly consisted of trees, as in our reviewed region, Israel and Palestine, where nine tree species are found in the wild. The Rhamnaceae has worldwide distribution, excluding both poles and Asian and African central deserts, and include 54 genera and 900 species.[1] But these numbers are debated: 50 and 900,[2] 55 and 950,[3] and other reported estimations.

Among the nine wild Rhamnaceae species found in the reviewed region, *Ziziphus spina-christi* is the most widespread and most used by humans since antiquity. Remains of its fruits were found in two temples in Sudan, dating back to 1500-1480 BC,[4] in Kuwait from a vast era of Bronze and Hellenistic ages,[5] and wood in a boat that belonged to King Khufu of ancient Egypt (reigned 2589-2566 BC).[6] Other archeological studies revealed even greater importance of this tree for ancient Egyptians. Some scholars found that it was named *Nebes* and its first mention was on a wall writing that shows food offering in the fifth dynasty, 2494-2345 BC.[7] In this publication, O. Kadioglu ahc (see list of abbreviations after **Table 1**) listed five papyri that mentioned *Z. spina-christi* for its medicinal uses, dating from 1900 to 300 BC. Most of these uses were based of consumption of fruits bread and mainly treated general weaknesses. R. Elshiwy concluded that *Z. spina-christi* was named *Nbs* in ancients Egypt and lists many uses of this tree at that time, wood, food and several herbal medicines.[8]

Moving from ancient times to more recent ethnomedicine reports, *Rhamnus alaternus* is used for treatment of jaundice and liver diseases, while *Ziziphus nummularia* is used to treat diarrhea, lung inflammation, congestion[9] and astringent.[10]

Of all the nine wild Rhamnaceae species found in Israel and Palestine, *Ziziphus spina-christi* is the most reported for use in traditional medicines and beyond that. A. Dafni ahc list more than thirty traditional medicine uses of this tree, as well as its social and religious importance for peoples of the Middle East.[11] M. Abou Auda listed this tree as an important plant for treatment of skin disorders,[12] A. Aati ahc considered it “vital” and it has decorative and shade benefits, in addition to having emotional, religious importance.[13] They mentioned large number (18) of ethnomedicinal uses of this tree, mainly in the Middle East, but also in other regions of the world. N. Jaradat and A. Zaid reported that flowers decoction of *Z. spina-christi* treats male infertility.[14] D.H. Feyssa ahc consider this tree essential for “people’s resilience to adapt to changing environment” in Ethiopia, due to its many uses of wood, nutrition and medicine, for humans and their livestock.[15]

Finally, the Rhamnaceae trees of Israel and Palestine are *Paliurus spina-christi*, *Rhamnus alaternus*, *Rhamnus disperma*, *Rhamnus libanotica*, *Rhamnus lycioides*, *Rhamnus punctata*, *Ziziphus lotus*, *Ziziphus nummularia* and *Ziziphus spina-christi*.

2. Selected published activities of rhamnaceae trees of Israel and Palestine

The biological-medicinal activities of the nine Rhamnaceae trees of Israel and Palestine are notably diverse. It is also notable that some species were extensively studied and published, while for others, a few publications can be found, if any. These properties and activities are summarized in **Table 1**.

Table 1: Selected published activities of rhamnaceae trees of Israel and Palestine.

Testing Method, Results and Reference/s
Paliurus spina-christi
Leaves and flowers were separately extracted with ethanol, and both extracts were moderately active against MCF-7 and MDA-MB-231 breast cancer cells, tested in various time periods and concentrations (total of 12 tests). The chemical compositions of the extracts were analyzed (GC-MS) and reported, and this part of the publication includes many mistakes. See section 3, **Discussion**.[16]
Fruits methanolic and ethanolic extracts were active against STZ-induced diabetes in rats. Chemical compositions of the extracts were determined by LC-MS and the major components were: rutin, catechin, hesperidin, quinic acid and malic acid.[17]
Fruits 70% aqueous methanolic extract was prepared and fractionized with *n*-hexane, chloroform, ethyl acetate and *n*-butanol. All extracts were tested for α-amylase and α-glucosidase inhibition, but only the *n*-hexane fraction had significant activity. The chemical composition of this fraction was analyzed and the main components were betulin, betulinic acid, lupeol and β-sitosterol (**Figure 1**. Figures mentioned in **Table 1** appear after **Abbreviations**). All four compounds inhibited the enzymes, especially betulinic acid. Acarbose was reference in this study.[18]
Aerial parts were extracted with 70% aqueous methanol and the extract was fractionized with petroleum ether, chloroform, ethyl acetate, and methanol. All products were tested for insulin activation in HepG2 insulin-resistant cells. Both crude extract and methanolic fraction were active, indicated by several biomarkers. Metformin was reference.[19]
Fruits water extract was prepared and analyzed for phenolic compounds. It had significant *in vitro* antioxidant activity (ABTS, CUPRAC, DPPH, FRAP methods) and *in vivo* measured by several biomarkers. It also had activity in STZ-induced diabetic rats.[20]
Fruits 70% aqueous methanolic extract was prepared and fractionized with *n*-hexane, ethyl acetate and *n*-butanol. Several phenolics were isolated from the ethyl acetate and *n*-butanol fractions, and these had antigenotoxicity V79 cell lines.[21]
Fruits aqueous extracts had lipid lowering activity in high cholesterol-fed STZ-induced diabetic rats.[22]
Fruits, leaves and branches were separately extracted with ethanol, and each extract was fractionized with *n*-hexane, chloroform, and ethyl acetate extract and 60% aqueous ethanol (total 15 extracts). All extracts except the *n*-hexane fractions had significant antioxidant activity (ABTS, DPPH methods), and most of them had anti-inflammatory activity measured by 5-LOX inhibition.[23]
Bark, flowers, fruits, leaves and roots were separately extracted with 90% aqueous ethanol, and from the leaves extract, a flavonoid-rich fraction was prepared. All six extracts were active against 6 bacteria species. Oxytetracycline was reference.[24]
Stems methanolic extract was prepared and found active against *Trichophyton*

mentagrophytes fungus. It was analyzed for chemical composition, compounds* are listed but no concentrations or percentages are provided.[25]
Leaves methanolic extract had notable antioxidant activity (CUPRAC, DPPH, FRAP methods) and its TFC and TPC were determined. It had weak to moderate activities against 11 bacteria species, but strong activity against *Candida albicans*.[26]
Fruits and leaves were separately extracted with ethanol and water, and the four extracts had notable antioxidant activity (ABTS, CUPRAC, DPPH methods). BHT and Trolox were references. The had weak to moderate activities against 8 bacteria species and *Candida albicans*, with penicillin as a reference.[27]
Aerial parts 80% aqueous methanolic extract had moderate antioxidant activity measured with DPPH method.[28]
Flowers aqueous decoction had moderate antioxidant activity (ABTS, FRAP, Fe^{+2} chelating methods).[29]
Fruits, leaves and stems were separately extracted with *n*-hexane, ethyl acetate, dichloromethane, methanol and water (15 extracts). The phenolic compositions of all extracts were analyzed and a detailed table is provided. The antioxidant activity of the extracts was tested with six methods (ABTS, CUPRAC, DPPH, FRAP, PBD and metal chelating methods) and found notable. They also had significant enzyme inhibition activity (acetylcholinesterase, butyrylcholinesterase, tyrosinase, amylase, and glucosidase).[30]
Fruits and leaves were separately extracted with methanol and both extracts had high antioxidant activity tested by DPPH and β-carotene bleaching method. Both extracts had significant pancreatic lipase inhibition activity. Extracts were analyzed for phenolic compounds and molecular docking was performed for enzyme inhibition by major components: rutin, quercitrin, quercetin, kaempferol and kaempferol 3-O-glucoside-7-O-rhamnoside.[31]
Isolation of three known phenolic compounds from fruits aqueous extract.[32]
* The listed compounds in this research are products of silylation. This process was not described in the article and was not even mentioned. In addition, the plant name is mistakenly written in the title as *PALIURUS SPINA-CHRISTII* instead of *Paliurus spina-christi*.

Rhamnus alaternus
Leaves ethanolic extract and two of its major components, emodin and kaempferol (**Figure 2**), were active against methicillin-resistant *Staphylococcus aureus*. *R. alaternus* was more active than 14 other plants used in this research.[33]
Aerial parts were extracted with petroleum ether, chloroform, ethyl acetate, methanol and water. In addition, three flavonoid-rich fractions were prepared. All eight products were tested for activity against K562 leukemia cells and five bacteria species. Ethyl acetate and one of the fractions were most active.[34]
Aerial parts 70% aqueous ethanolic extract was prepared and fractionized with petroleum ether, ethyl acetate and *n*-butanol. Extract and fractions were tested for antioxidant activity (DPPH, FRAP, hydroxyl radical scavenging, TAC methods), antibacterial (5 bacteria species) and hemolytic activity (human blood). Positive results were observed in all tests ranging from weak to strong activities. Seven active known compounds were isolated.[35]
Bark was successively extracted with methanol and ethyl acetate and the extract had notable antioxidant (DPPH, β-carotene bleaching, FRAP, Fe^{+2} chelating methods), antimicrobial (3 bacteria and 3 fungi species) activities. Extract was analyzed for anthraquinone content resulting the presence of emodin, aloe-emodin, rhein, chrysophanol and physcion (**Figure 2**). Three other *Rhamnus* species were studied in

this research.[36]
Leaves, pods and roots were combinedly extracted with three natural deep eutectic solvents (choline chloride and glycerol/ethylene glycol/urea) resulting phenolics-rich extracts. These were tested for antioxidant (ABTS, DPPH, Fe^{+2} chelating methods) and antibacterial (5 species) activities. Moderate to high activities were observed. Chemical compositions of extracts contained many compounds including aloesin, aloesol and piperonylidene acetone (**Figure 2**).[37]
Leaves EO (hydrodistillation) had activity against *E. coli*, *S. typhimurium* and *P. aeroginosa*. The major component of this EO were (%): camphene 17.63, linalool 16.13, pulegone 15.01 and naphthalene 14.66 %.[38]
Leaves were separately extracted with petroleum ether, chloroform, ethyl acetate, methanol and 67% aqueous acetone (flavonoid-rich). All extracts had antioxidant (DPPH) and antibacterial (*S. typhimurium*) and antimutagenic (*S. typhimurium*) activities. General chemical compositions (compound families) were determined.[39]
Leaves were defatted with petroleum ether then extracted with methanol. The extract had antioxidant (DPPH, β-carotene bleaching methods) and antimutagenic (*Allium cepa* assay) activities. TFC and TPC were also determined.[40]
Leaves and root bark were separately extracted with methanol, and the leaves extract was used to obtain a phenolics-rich extract by using water-saturated-*n*-butanol. The original extracts were tested for antioxidant (DPPH, xanthine oxidase methods), antimutagenic (*S. typhimurium*) and antiproliferative (K562 leukemia cells) activities. General chemical composition of phenolics-rich extract was determined.[41]
Kaempferol 3-*O*-β-isorhamninoside and rhamnocitrin 3-*O*-β-isorhamninoside were isolated from leaves (several extraction steps), and they were found antioxidant (ABTS method) and antigenotoxic (in *E. coli*).[42]
Bark methanolic and aqueous extracts were prepared and had antioxidant (ABTS, DPPH, FRAP, ORAC methods) and anticancer (U937 leukemia cells) activities. Flavonoid content and compositions were determined.[43]
Leaves 80% aqueous acetone extract had activity against B16F10 cancer cells. The chemical composition of this extract included nine major phenolics.[44]
A follow up of previous study.[45]
Leaves methanolic extract had no significant effect in alloxan-induced diabetic rats.[46]
Leaves aqueous extract was prepared and fractionized with several solvents to determine the chemical (phenolic) compositions. The crude extract had activity against Triton-induced hyperlipidemia in rats and human HepG2 cells.[47]
Leaves aqueous extract had notable blood glucose lowering activity in STZ-induced diabetic rats. General chemical composition is provided.[48]
Bark and leaves were separately extracted with 70% aqueous methanol. Methanol was evaporated from this crude extract to obtain aqueous extract, which was fractionized with *n*-hexane, chloroform and ethyl acetate, yielding a total of ten extracts. These showed clear activity against *A. niger* and *C. albicans* fungi, with three reference drugs.[49]
Bark and leaves were separately extracted with 70% aqueous ethanol. Extracts had significant antioxidant (ABTS, DPPH, FRAP methods) and antihemolytic (AAPH method) activities. General chemical compositions are listed.[50]
Ethanolic leaves extract was chromatographed to obtain 12 fractions. Crude extract and mixtures of the fractions were tested for antioxidant activity (DPPH method), and most active components were determined: emodin and kaempferol.[51]
A follow up of previously cited studies, especially,[41] and this study focused on the antioxidant (DPPH, superoxide anions and inhibition H_2O_2-induced lipid peroxidation

in K562 cells) activity of three known, single compounds: kaempferol 3-*O*-isorhamninoside, rhamnocitrin 3-*O*-isorhamninoside and rhamnetin-3-*O*-isorhamninoside.[52] Leaves aqueous and methanolic extracts were prepared and had significant antioxidant activity (DPPH and β-carotene bleaching methods). Four known major phenolic compounds were identified in these extracts.[53] Leaves methanolic extract was defatted and fractionized with several solvents and several steps. Crude extract and fractions were tested for antioxidant activity (DPPH method), their phenolic contents were determined and analyzed for major compounds (6).[54] Bark and leaves were separately extracted with methanol-acetone 3:2 (v/v). Extracts were tested for antioxidant activity (DPPH, FRAP methods) with BHA as reference, showing notably higher activity of leaves extract. Hemolysis activity was measured by direct effect of extracts on human blood, showing maximum (weak) effect of 2%.[55] One of the first reports of anthraquinones isolation from this plant. See **Figure 2**.[56] Analysis of fruits methanolic extract afforded the six major anthocyanins shown in **Figure 2**.[57] Leaves aqueous extract was administered (250 mg/kg/day, 9 days) to rats with CCl_4-induced hepatotoxicity, resulting ameliorative effect. Silymarin was reference in this study.[58] Leaves aqueous extract had nephroprotective (plasma electrolyte concentrations) in high salt and high fat-fed rats.[59] Aerial parts aqueous extract had antioxidant activity (DPPH, FRAP, β-carotene bleaching methods), and hepatoprotective (plasma hepatic biomarkers) against $AlCl_3$-induced hepatotoxicity in rats.[60] Case report of poisoning from Tunisia, as a result of daily drinking roots tea six months, by a person who considered this tea a herbal medicine against type II diabetes.[61]
Rhamnus disperma Roots ethanolic extract was prepared, fractionized with several solvents and the ethyl acetate fraction was chromatographed yielding several phenolics, four of them are methoxylated flavonoids (**Figure 3**). These compounds had significant activity against MCF7, A2780 and HT29 cancer cell lines.[62] Same extraction, isolation and purification as in previous cited study (study[63] is 6 years earlier). Extract had amelioration effect on dinitrochlorobenzene-induced eczema in rats (1.0% w/w alcoholic extract ointment in Vaseline, 15 days). Reference was 0.1% w/w betamethazone (**Figure 3**) ointment.[63] Roots were extracted with 70% aqueous ethanol and extract was fractionized with petroleum ether, ethyl acetate and *n*-butanol. The ethyl acetate fraction chromatography afforded four known phenolic compounds (rhamnocitrin 3-*O*-*α*-L-rhamnopyranoside, quercetin 7-*O*-*α*-L-rhamnopyranoside, kaempferol 3,7-di-*O*-*α*-L-rhamnopyranoside and quercetin 3,4'-di-*O*-*α*-L-rhamnopyranoside). These compounds had antioxidant activity measured by DPPH method.[64] First isolation of quercetin 3,4'-di-*O*-*α*-L-rhamnopyranoside (**Figure 3**) with other known phenolics from 80% aqueous ethanol aerial parts extract. The known compounds included these mentioned in the previous citation[64],[65]
Rhamnus libanotica Bark methanolic extract was fractionized with several solvents and fractions were analyzed affording new derivative of physcion (**Figure 2**) along with other previously known compounds. The structure of the new compound is shown in **Figure 4**.[66]

Rhamnus lycioides Leaves were extracted with several solvents, and extracts were tested for antioxidant (DPPH, FRAP, Fe^{+2} chelating methods) and acetylcholinesterase inhibition activities. Three of the extracts were analyzed for chemical composition: ethyl acetate, methanolic and anthraquinone-rich. All reported compounds are previously known.[67] Leaves 70% aqueous methanolic extract was prepared, methanol was evaporated, and the aqueous phase was fractionized with chloroform, ethyl acetate and *n*-butanol. Crude extract and fractions were analyzed for chemical compositions where major seven compounds were obtained, including rhamnazin, rhamnocitrin and taxifolin (**Figure 5**).[68] Aerial parts 70% aqueous methanolic extract was prepared, methanol was evaporated, and the aqueous phase was fractionized with chloroform, ethyl acetate and *n*-butanol. All materials were tested for hypotensive activity in rats.[69] A follow up of previous study about the hypotensive activity of the plant, revealed a major active component (**Figure 5**).[70]
Rhamnus punctata **No published medicinal-biological activities**
Ziziphus lotus Fruits and leaves aqueous extracts were separately prepare and analyzed for phenolic compositions. Both extracts had significant antioxidant (ABTS, DPPH, FRAP methods, Trolox and ascorbic acid were references), antidiabetic (α-amylase and α-glucosidase inhibition) and dermatoprotective (tyrosinase inhibition) activities.[71] Fruits flavonoid-rich aqueous extract was analyzed for TFC and TPC. It had notable antioxidant (DPPH, β-carotene bleaching methods, BHA was the reference) and antihyperlipidemic (high fat-fed mice, blood cholesterol, triglycerides and glucose were measured) activities.[72] Fruits were successively extracted with petroleum ether, dichloromethane and methanol, and each extract was analyzed for TFC, TPC and tannins content. The extracts were active against eight bacteria (control: amoxicillin[a]) and four fungi species (control: difenoconazole).[73] Leaves, roots and seeds were separately extracted with several solvents, but only the 50% aqueous ethanolic extract[b] was used for antifungal activity *Aspergillus flavus-parasiticus* and *Aspergillus ochraceus*, showing notable activity. General chemical composition is presented.[74] Honey of bees that was naturally fed by the tree flowers, was analyzed for TFC and TPC, and was active against three bacterial strains.[75] Leaves 80% aqueous methanolic extract was prepared, analyzed for TFC and TPC, and major phenolic ingredients. It was active against 7 bacteria species and *C. albicans*. The inhibition kinetics is presented.[76] Leaves methanolic extract was analyzed for general chemical composition and tested for antibacterial (5 species)[c].[77] Leaves methanolic extract was analyzed for general phenolic composition, had significant antioxidant (DPPH method) and antimicrobial (*E. coli*, *S. aureus*, *K. pneumoniea* and *F. culmorum*, *F. solani*, *B. cinerea*)[d] activities. In this research, *Ziziphus jujuba* was also studied.[78] Seeds were separately extracted with ethanol, methanol and water. Each extract was analyzed for TPC and TFC, had significant antioxidant (DPPH method) and antibacterial (*E. coli*, *P. aeruginosa*, *E. faecalis*, *S. aureus*, *C. tropicalis*) activities.[79] Fruits were separately extracted with ethanol, methanol and water. Each extract was analyzed for TPC and TFC and wide range of compound families. All extracts had

significant antioxidant (DPPH, TAC methods) and antibacterial (seven bacteria species and *C. tropicalis*) activities.[80]

Leaves methanolic extract was fractionized by several solvents and each fraction was tested for antimicrobial (2 bacteria and a fungi species), antileishmanial (2 species) and antioxidant (DPPH, FRAP methods). In the biological tests, the dichloromethane fraction had the highest activity, while in the antioxidant tests, the *n*-butanol fraction had the highest activity.[81]

Fruits, leaves and seeds were separately extracted with methanol and each extract had notable antioxidant (DPPH, TAC methods) and antibacterial (4 strains) activities. The extracts were analyzed for TFC and TPC, as well as single compounds. Major compounds were quinic acid, rutin, quercitrin and naringin. In this research *Ziziphus mauritiana* (nonnative of the reviewed region) was also studied.[82]

Methanolic extracts of fruits and leaves were prepared. The fatty acids composition of fruit extract included 13 compounds, including the isomers C18:1 *cis* (oleic acid, 88.1%) and C18:1 *trans* (elaidic acid, 7.9%). Leaves extract had higher phenolic, stronger antioxidant (ABTS, DPPH methods) and stronger antimicrobial (seven bacteria and three fungi species) activities.[83]

Fruits from 11 different locations in Morocco were analyzed for mineral content, extracted with *n*-hexane for EO, and this EO was analyzed for fatty acids composition. Separately, fruits were successively extracted with 70% aqueous acetone, ethanol, methanol and with water. The general composition of the combined extracts was determined and their antioxidant activity was tested with DPPH, FRAP and TEAC methods, showing significant results.[84]

Follow up of previous study, by the same group, focusing on nutritional properties.[85]

Methanolic extract was analyzed for phenolics and fatty acids compositions. It had notable antioxidant (DPPH, FRAP methods) activity, and protective effect (against oxidation) of corn oil during frying. *Moringa oleifera* was also studied in this research.[86]

Fruits leaves and roots were separately extracted with five solvents (15 extracts). They had notable antioxidant (ABTS, DPPH, FRAP methods) and cytotoxic (against SH-SY5Y cell line) activities. Extracts were separately analyzed for TFC, TPC and tannins content, and combinedly for chemical composition, revealing many major compounds where 13-epimanool (**Figure 6**) had one of the highest concentrations. Drying process of plant materials effect on the tested properties was also studied.[87]

Fruits without seeds were dried, analyzed for phenolic content and tested for antioxidant activity (DPPH method). The powder was added to cakes, resulting improvement of their taste, nutritional value and sensory quality.[88]

Honey of bees that was naturally fed by the tree flowers, had healing effect on hard palate ulcers (mechanical cut) in rats.[89]

Fruits aqueous extract had antiurolithiatic effect in ethylene glycol-induced lithiasis in rats (150 mg/kg/day, 14 days), indicated by several biomarkers, mainly Ca^{+2} and $C_2O_4^{-2}$ concentrations.[90]

Leaves were successively extracted with petroleum ether, dichloromethane, ethyl acetate, *n*-butanol and water distilled. The combined extracts were tested *in vitro* for prevention of the formation of calcium oxalate after the mixing of $CaCl_{2\ (aq)}$ and $Na_2C_2O_{4\ (aq)}$.[91]

Aerial parts were specially extracted for alkaloids (NH_4OH-CH_3OH-C_6H_6 1:1:98), resulting the isolation of five 14-membered frangulanine-type cyclopeptide alkaloids. Two of these alkaloids were new (**Figure 6**).[92]

Leaves were defatted with *n*-hexane and chloroform, then extracted with methanol.

Analysis of the extract afforded four new dammarane saponins (**Figure 6**).[93]
Fruits were defatted with *n*-hexane and separately extracted with 80% aqueous ethyl acetate and 80% aqueous methanol. Extracts were analyzed for chemical compositions and detailed results are presented. TFC, TPC, total anthocyanins and tannins contents were also determined. Testing antioxidant activity with DPPH showed significant results.[94]
EOs of aerial parts (not including fruits) and fruits were prepared by hydrodistillation and analyzed for chemical compositions: aerial parts EO contained much larger number of compounds.[95]
Fruits powder had excellent activity of Cr(VI) removal from aqueous solution. Kinetics, thermodynamics and the effect of various factors (pH, temperature, particle size) were studied.[96]
Leaves ethanolic extract had inhibition effect on corrosion of carbon steel under strong acidic conditions (1 M HC*l*).[97]
Activated carbon prepared from leaves had high capacity of methylene blue (decolorization) from textile wastewater. Kinetics, thermodynamics and the effect of various factors were studied.[98]
Cellulose was extracted from trunks with two methods (alkaline extraction then bleaching or vice versa), then it was carboxymethylated with α-chloroacetic acid. The product was used to prepare membranes that had significant activity of pollutants removal (decolorization) from aqueous solutions.[99]
Honey of bees that was naturally fed by the tree flowers was tested for color, pH, moisture, electrical conductivity, and various nutritional contents such water, protein, total and single carbohydrates, phenolics and minerals. It had high antioxidant activity measured by DPPH method.[100]
Honey of bees that was naturally fed by the tree flowers was tested for external properties resulting clear dependence of these on the source of pollen.[101]
Aqueous extract of fruits pulp had modulatory effect on the humoral immune response in mice, antibacterial activity against *S. aureus* and antioxidant activity tested with DPPH method. It had hemolytic activity in low concentrations and antihemolytic activity in high concentrations .[e][102]
Fruits powder had high capacity of removing Pb^{+2} and Cd^{+2} from aqueous solution. The kinetics of the phytoremediation process was studies, as well as pH effect.[103]
a) Amoxicillin mistakenly written as amoxillin and difenoconazole mistakenly written as difenocazole.
b) This publication includes several mistakes. For example, under the title of "Extraction of flavonoids" it is written: "About 50 g powder of *Z. lotus* (seeds, roots, and leaves) were heated separately to 900°C under reflux in a mixture (distilled/ethanol water) (250 ml/250 ml) for 4 hrs".
c) Despite the fact that the title of this article is "Evaluation of antibacterial and antioxidant activities of *Artemisia campestris* (*Astraceae*) and *Ziziphus lotus* (*Rhamnacea*)", no tests of antioxidant activity were presented. In addition, plant family names should not be written in *italics*, and in this case, both names are misspelled: Astraceae should be Asteraceae and Rhamnacea should be Rhamnaceae.
d) The antimicrobial activity is presented in this article for "ethanolic" and "aqueous" extracts, but practically, these are solutions of the original methanolic extract.
e) This article has a mistake in the title, "Immunomosuppressive" instead of "Immunosuppressive". We did not correct it in the references list.

Ziziphus nummularia

Methanolic roots extract was fractionated with water, of n-hexane, chloroform, ethyl

acetate, and ethanol. The crude extract and fractions tested for four activities in mice. Sedative, by treatment with 50 or 100 mg/kg; hypnotic effect against phenobarbitone-induced sleep, with positive control of bromazepam; antipyretic effect in (yeast) *S. cerevisiae*-induced hyperthermia, with paracetamol as control; and acetic acid-induced inflammation, with diclofenac as control. In all tests positive effects were observed.[104]

Leaves ethanolic extract was administered (three doses) to rats with formaldehyde-induced arthritis, showing positive effect measured by several biomarkers, especially oxidative/antioxidative. Diclofenac as reference in this study.[105]

Leaves 70% aqueous ethanolic extract had activity against Capan-2 human pancreatic cancer cells. Various mechanistic pathways were tested and it was found that for example, activity has clear relation to downregulation of ERK1/2 and NF-κB signaling pathways, among other actions.[106]

Leaves 80% aqueous ethanolic extract had activity against MDA-MB-231 human breast cancer cells. Authors linked this activity to the high antioxidant capacity of this extract that was proved with DPPH method. Qualitative chemical composition analysis revealed that extract contains 81 compounds.[107]

Fruits and leaves were separately extracted with 70% aqueous ethanol, and both extracts had glucose diffusion inhibition activity. TPC of both extracts is reported.[108]

Leaves 90% aqueous ethanolic extract was used to prepare a topical gel (20 and 30%), that had anti-inflammatory (carrageenan-induced paw edema) and wound healing (mechanical cut) activities in rats.[109]

Root bark ethanolic extract had anti-inflammatory activity *in vitro* (RAW 264.7 cells) and *in vivo* (rats). Inflammations were induced by several agents: carrageenan, arachidonic acid, xylene and LPS. Authors report the active compound shown in **Figure 7**.[110]

Leaves 70% aqueous ethanolic extract attenuated TNF-*α*-induced phenotypic inflammation in human aortic smooth muscle cells.[111]

Leaves were successively extracted with petroleum ether, chloroform, ethyl acetate, ethanol and water. Each extract was tested for anti-inflammatory (inhibition of protein denaturation test) and antioxidant (DPPH, hydroxyl radical scavenging methods) activities.[112]

Root bark 70% aqueous ethanolic extract was chromatographed affording a novel cyclic peptide-alkaloid (**Figure 7**) with anti-inflammatory activity in LPS/IFN-γ stimulated RAW 264.7 cells (INF, interferons). Molecular docking study is reported.[113]

Fruits and leaves were separately extracted with water, methanol, ethanol and chloroform (8 extracts). Each extract was tested against *E. coli*, *P. aeruginosa*, *S. aureus*, *S. pyogenes*, *C. albicans*. Both alcoholic extracts had high activity and aqueous extract was weakest. TFC, TPC and alkaloid content were determined.[114]

Roots aqueous and ethanolic extracts had activity against several bacteria species. For some strains, ethanolic extract was more active, and vice versa. General chemical compositions of both extracts are presented.[115]

Leaves aqueous extract had antibacterial (against 6 species) and antioxidant (ABTS, DPPH, β-carotene bleaching methods) activities. TPC and general chemical compositions are reported.[116]

Fruits were extracted with chloroform-methanol (1:1, v/v) and this extract was active against four bacteria and two fungi species. It had antioxidant activity measured with DPPH method. Its general and detailed chemical compositions are presented with pyrogallol (**Figure 7**) as major component.[117]

Aerial parts methanolic extract antioxidant activity was tested with FRAP method.[118]

Fruits aqueous extracts was analyzed for nutritional and general compositions, and its

antioxidant activity was tested with DPPH, FRAP and Fe^{+2} chelating power.[119]
Fruits methanolic extract (100, 200, 400 mg/kg) had antiulcer (mechanical cut, pyloric ligation method) activity in rats, with omeprazole as a reference.[120]
Fruits ethanolic extract had cardioprotective activity in isoproterenol induced myocardial infarcted rats, indicated by activity of several cardiac enzymes.[121]
Similar isolation methods to ref. 92 and ref. 113 afforded 11 new cyclic peptide-alkaloid with structures like those shown in **Figure 6** and **Figure 7**.[122,123,124]
General chemical compositions of fruits and leaves 70% aqueous ethanolic extracts.[125]
Leaves 70% aqueous ethanolic extract was analyzed for general and detailed chemical compositions, resulting N-[3-methyl-2-butenylidene]methanamine as second major component, where the first is not specified ethyl glucose ether.[126]
Comparative chemical compositions (whole plant) analysis with *Z. jujuba* revealed many similarities and many differences. For example, jujuboside A and jujuboside B (**Figure 7**) are present in both species, but their concentrations in *Z. jujuba* are higher.[127]
Sieves were obtained by acidic hydrolysis of the tree wood and had high adsorption capacity of bromocresol green. The kinetics of the adsorption process was studied, including effects of pH, dye concentration, amount of adsorbent, size of adsorbent particles, and contact time on removal (decolorization).[128]
Activated carbon was prepared from fruit kernel and it had high erythrosine removal capacity. The kinetics and thermodynamics of the decolorization process are presented, with detailed effects of various factors as in the previous study.[129]
Adsorbent (pyrene) prepared from the plant waste had high erythrosine removal capacity. This study is a follow up of the study cited in reference 129, and it compares this adsorbent with another prepared from Sorghum.[130]
Seven months old infants and lambs were fed with the same amount and for the same time period, with fruits and a mineral food additive. Infants gained more nutritional benefits than lambs.[131]
Leaves polyphenol-rich extract was studied as part of feed block with *Vigna sinensis* and *Acacia nilotica*. The study tested *in vitro* rumen fermentation kinetics, methane production and digestibility.[132]
Leaves 80% aqueous ethanolic extract was tested for four activities: castor oil-induced diarrhea in mice, antisecretory activity in castor oil-induced fluid accumulation in mice, against potassium chloride-induced contractions in isolated rabbit jejunum tissues, and against ethanol-induced gastrointestinal ulcer in rats. In all tests positive effect was observed.[133]
Fruits, leaves and stems were separately powdered and these powders had significant metal ions* (Pb^{+2}, Cd^{+2}, As^{+5}, Hg^{+2}) accumulation from aqueous solutions.[134]
Similar isolation methods to ref. 92 and ref. 113 afforded two new cyclic peptide-alkaloid with structures like those shown in **Figure 6** and **Figure 7**, along with five previously known. In this research *Z. spina-christi* was studied.[135]
Fruits EO was obtained by headspace solid-phase micro extraction and it was analyzed, revealing 39 known compounds. In this research *Z. spina-christi* was studied.[136]
* In section 2.2 of this article it is written: "Prepare the standard solution [Lead, cadmium, Arsenic and Mercury] or as per the requirement containing the element of interest by the following method". Solutions can not contain these elements. They contain their ions.

Ziziphus spina-christi

Similar isolation methods to ref. 92 and ref. 113 afforded two new cyclic peptide-alkaloid with structures like those shown in **Figure 6** and **Figure 7**, along with five

previously known. In this research *Z. nummularia* was studied.[135]
Fruits EO was obtained by headspace solid-phase micro extraction and it was analyzed, revealing 41 known compounds. In this research *Z. nummularia* was studied.[136]
Leaves 70% aqueous ethanolic extract was used to prepare a topical solution with clindamycin to treat patients with mild to moderate acne, for six weeks. The results showed significant reduction.[137]
Molecular docking of anti-acne of christinins (A, B, C, D), natural products from the fruits of this tree. Their molecular structures are shown in **Figure 6** and **Figure 7**, taken from references 93 and 127.[138]
Leaves aqueous extract had allelopathic activity against *Triticum durum* and *Raphanus sativus* seeds.[139]
Leaves methanolic extract was analyzed for TPC and tannins content. It had antioxidant (DPPH method) and allelopathic (against *Trigonella foenum-graecum* and *Lens culinaris* seeds) activities.[140]
Root bark was extracted with *n*-hexane, chloroform, ethyl acetate and methanol. The methanolic extract was eluted with chloroform-methanol (7:3, v/v), and this fraction was the most active against pain (induced by acetic acid, formalin or hot plate) in rats, and had anti-inflammatory (egg-albumin-induced paw edema) in mice.[141]
Leaves were extracted with 80% aqueous ethanol yielding crude extract, which was eluted with ethanol-water gradient, resulting three more extracts: ethanolic, 50% aqueous-ethanolic and aqueous. The ethanolic extract had the highest activity against MCF-7 cancer cells.[142]
Leaves methanolic extract had strong anticancer (human rhabdomyosarcoma cell line) and antioxidant (DPPH method) activities.[143]
Leaves 70% aqueous ethanolic extract was fractionated with *n*-hexane, dichloromethane, ethyl acetate and *n*-butanol. The last fraction was analyzed affording christinin E and its two new derivatives (**Figure 8a**). These compounds had activity against lung cancer (A549), glioblastoma (U87), breast cancer (MDA-MB-231), and colorectal carcinoma (CT-26) cell lines.[144]
Leaves 70% methanolic extract had anticancer activity: *in vivo* against diethyl nitrosamine-induced hepatocarcinogenesis in rats, and *in vitro* against HepG2 cancer cell line. It had antioxidant activity measured by DPPH and hydroxyl radical scavenging methods. The chemical composition of this extract is presented.[145]
Leaves ethanolic extract was used to prepare five shampoos (5%) that had anti-dandruff (caused by *Malassezia furfur*) activity in human volunteers.[146]
Leaves 75% aqueous ethanolic extract had significant activity of blood glucose lowering and insulin upregulation in STZ-induced diabetic rats.[147]
Fruits were separately extracted with 80% aqueous ethanol and water, and both extracts had positive effect *in vivo* (alloxan-induced diabetic rats, measured by several biochemical parameters), and *in vitro* (inhibition of α-amylase and α-glucosidase).[148]
Leaves 50% aqueous ethanolic extract had notable ameliorating effect in alloxan-induced diabetic rats, indicated by several liver and kidney biomarkers.[149]
Fruits, leaves and seeds were separately extracted with ethanol, and these extract had positive effect (blood glucose lowering and insulin upregulation) in hyperglycemia induced by hyperlipidemic diet (no details) in albino rats.[150]
Leaves 80% aqueous methanolic extract was prepared and fractionated with ethyl acetate, *n*-butanol and water. All four materials had blood glucose lowering activity (and other biochemical indicators) in STZ-induced diabetic rats. It also had high antioxidant activity measured by ABTS and DPPH methods.[151]
A follow up of the previous study. Same extract was fractionized with *n*-hexane,

chloroform, ethyl acetate, *n*-butanol and water. These materials had hepatoprotective and nephroprotective effects in CCl_4-induced hepatotoxicity in rats, where both activities were measured by several biomarkers. These materials had significant α-amylase and α-glucosidase inhibition activity.[152]

Six extracts were prepared: seeds were separately extracted with dichloromethane, ethyl acetate and 80% aqueous methanol; leaves, roots and stems were separately extracted with 50% (v/v) methanolic dichloromethane. All materials were tested in two anti-inflammatory activity tests, and molecular docking was performed for epigallocatechin, gallocatechin, spinosin, 6'''-feruloyspinosin and 6'''-sinapoylspinosin (**Figure 8a**).[7]

Leaves hydroalcoholic extract (procedure is not specified) attenuated pentylenetetrazole-induced kindling in mice brain tissue, measured by several biochemical parameters.[153]

Seedless fruits and seeds were separately extracted with 70% aqueous ethanol. Antioxidant activity was determined with DPPH method and anti-inflammatory activity was determined with denaturation method.[154]

Leaves 80% aqueous methanolic extract reduced the concentration of Hg^{+2} ($HgCl_2$) in rats liver hepatotoxicity, and activated antioxidant enzymes: superoxide dismutase, catalase, glutathione peroxidase and glutathione reductase.[155]

Aerial parts were separately extracted with water, 95% aqueous ethanol, petroleum ether, and ethyl acetate, but only aqueous and aqueous-ethanolic extracts were tested against microbial strains of *S. aureus*, *E. coli*, *P. aeruginosa*, *P. vulgaris*, *K. pneumoniae* and *C. albicans*, showing significant activities.[156]

Leaves 80% aqueous ethanolic extract was active against bacterial strains of *S. typhi*, *P. mirabilis*, *S. dysenteriae*, *E. coli*, *K. pneumoniae*, *B. melitensis*, *B. bronchiseptica* and *P. aeruginosa*.[157]

Aerial parts ethanolic extract was prepared and fractionated with petroleum ether, ethyl acetate and methanol. All materials were active against bacterial strains: *S. aureus*, *B. subtilis*, *E. coli*, *P. vulgaris*, *P. aeruginosa*, *S. para typhi B*, and *K. pneumoniae*.[158]

Fruits, leaves, seeds and stems were separately and successively extracted with petroleum ether, chloroform, methanol and water. All 16 extracts were tested against six bacteria and two fungi species. The aqueous extract was not active, and all extracts had no activity against fungi, while against bacteria, organic extracts had moderate activities.[159]

Seeds EO was obtained by extraction with *n*-hexane and it was active against *S. aureus*, *E. coli*, *Shigella* ssp. and *P. aeruginosa*.[160]

Fruits 80% aqueous methanolic extract was active against six bacteria species.[161]

Bark, fruits, leaves, roots and seeds were separately extracted with ethanol and methanol (10 extracts), and these extracts were tested against *P. aeruginosa*, *E. cloacae*, *E. aerogenes*, *E. coli*, *K. pneumoniae*, *E. faecalis* and *S. aureus*. Notable activity was observed in most cases.[162]

Leaves aqueous and ethanolic extracts were mildly active against five bacterial strains. In this research *Ziziphus abyssinica* and *Ziziphus mauritiana* (nonnative to the reviewed region) were also studied.[163]

Leaves aqueous and ethanolic extracts were mildly active against three bacterial strains. In this research *Ziziphus jujuba* was also studied.[164]

Stem bark was separately extracted with petroleum ether, ethyl acetate, ethanol, water and methanol, in microwave-assisted method. Extracts were tested against four bacteria and a fungi species, showing moderate activities, except the petroleum ether extract that was inactive. General chemical compositions were presented.[165]

Leaves and stem bark aqueous extracts were separately and combinedly tested against

12 bacterial strains, resulting high activities.[166]
Leaves aqueous, 60% aqueous ethanolic and 60% aqueous methanolic extracts were prepared and found active against four bacterial isolates.[167]
Leaves 96% aqueous ethanolic extract tested against ten bacterial species and found active. This extract was analyzed and 30 compounds were identified, where the major three were (%): *cis*-9-hexadecenal 31.6, *n*-hexadecanoic acid 20.1, squalene 5.2. Theoretical analysis of antibacterial activity of all 30 compounds was performed.[168]
Leaves aqueous and ethanolic extracts were active against six bacteria and two fungi species.[169]
Leaves 70% aqueous ethanolic extract was active against *Streptococcus mitis*.[170]
Leaves 70% aqueous ethanolic extract was active against *Streptococcus oralis*.[171]
Leaves aqueous extract was active against *Streptococcus warneri*.[172]
Leaves aqueous and 96% aqueous ethanolic extracts were active against four bacterial strains.[173]
Leaves 70% aqueous ethanolic extracts was active against five bacteria species.[174]
Whole plants ethyl acetate extract had mild activity against four bacteria species, and moderate antioxidant activity, tested with DPPH method.[175]
Aerial parts EO (hydrodistillation) had high activity against *A. niger*, *P. digitatum* and *K. pneumonia*, and high antioxidant activity (DPPH method). The chemical composition of this EO was analyzed and the major components were (%): carotol 42.2, hexadecanoic acid 13.75%, linoleic acid 11.76, vetivenic (zizanoic) acid 9.56% and valeranone 7.06. The structures of carotol vetivenic acid, and valeranone are shown in **Figure 8a**.[176]
Leaves 70% aqueous ethanolic extract was active against two bacteria species and a fungus, and notable antioxidant (hydroxyl radical scavenging) activity.[177]
Fruits *n*-hexane extract had significant antibacterial (against *P. Carotovorum*, *D. solani*, *R. solanacearum*, *E. cloacae*, *B. pumilus*), and antioxidant (DPPH, β-carotene bleaching methods) activities. The chemical composition (GC-MS) of this extract included mainly phenyl long chain alkane derivatives.[178]
Leaves 70% aqueous methanolic extract was prepared from three different locations in Tunisia. It was active against three bacteria and three fungi species, had significant antioxidant (DPPH method) and insecticidal (against *Tribolium castaneum*) activities.[179]
Leaves ethanolic extract was active against three fungi species and had significant antioxidant (DPPH method) activity. The major volatile ingredient of this extract was $CH_3(CH_2)_{16}CO_2CH(CH_2OH)_2$ octadecanoic acid, 2-hydroxy-1-(hydroxymethyl)ethyl ester (18.8%).[180]
Leaves ethanolic and methanolic extracts had activity against COVID-19 virus. Analysis of extracts yielded christinin E (**Figure 8a**) as major active component.[181]
Stem bark ethanolic extract was fractionized with chloroform, diethyl ether and *n*-butanol, and all these four materials were tested against two fungal and three bacterial species. The *n*-butanol fraction was most active. The ethanolic was analyzed and authors link the antimicrobial activity to betulin and betulinic acid (**Figure 1**), and molecular docking was performed for these compounds. In total, 36 compounds were identified in the ethanolic extract and diethyl ether and *n*-butanol fractions, most were shown in **Figures 1-8a**.[182]
Fruits and leaves were separately extracted with methanol, and both extracts were found active against three fungi species: A. *alternata*, A. *citri*, and A. *radicina*. Fruits extract was more active. The chemical compositions of both extracts is presented, and the major compound in each extract is shown in **Figure 8a**.[183]

Aerial parts 90% aqueous ethanolic extract (crude) was prepared, dissolved in 50% aqueous ethanol, and this solution was fractionized with petroleum ether, chloroform, ethyl acetate and *n*-butanol. All fractions were tested for pancreatic lipase inhibition, where chloroform and *n*-butanol fractions were most active. The crude extract was analyzed for chemical composition, and the major components were tested for the same activity. The three most active compounds were christinin A, daphnoretin and daphnodorin (**Figure 8b**).[184]

Leaves ethanolic extract had significant antioxidant activity, tested by DPPH and hydroxyl radical scavenging methods. In this research *Ziziphus mauritiana* was also studied.[185]

Fruits 80% aqueous ethanolic extract had notable antioxidant activity, measured by DPPH, hydroxyl radical scavenging, FRAP, TRPA and Fe(II) chelating.[186]

Leaves methanolic extract had notable antioxidant activity tested by DPPH method.[187]

Fruits powder or its 80% ethanolic extract, were separately, combinedly or in combination with zinc, fed to rats that were poisoned with sodium fluoride. The poisoning increased the total oxidant status in the kidneys and liver, and the intervention ameliorated that. Analysis of the extract revealed that its major component is nimbolide (**Figure 8b**).[188]

Fruits and leaves were separately extracted with 80% aqueous ethanol, and the extracts had significant antioxidant activity tested by DPPH and FRAP methods.[189]

Acetic acid-induced ulcerative colitis in rats was treated with 80% aqueous methanolic fruits extract, by suppressing oxidative stress biomarkers.[190]

Aqueous, ethanolic and methanolic leaves extracts had significant antioxidant activity tested with DPPH (methanolic was highest) and FRAP (ethanolic) methods.[191]

The effect of natural fermentation on general chemical compositions, TFC and TPC, was separately studied for whole fruits. This effect was also studied on the positive antioxidant activities using DPPH, FRAP, TRPA and hydroxyl scavenging methods.[192]

Mice were infected with *Schistosoma mansoni* and were supplemented with 70% aqueous ethanolic root bark extract. This resulted in amelioration of oxidative stress, measured by five oxidative/antioxidative biomarkers, and activities of seven hepatic enzymes.[193]

Mice were infected with Bilharzia (schistosomiasis) and were supplemented with ethanolic root bark extract. This intervention reduced hepatic worm burden and glaucoma, and increased ova count.[194]

Follow up of the study cited in reference 193 with three differences: leaves extract not roots, the major tested biomarkers were liver granuloma and fibrosis, and a mechanism of action is proposed in this study: downregulation of fibrinogenic signaling.[195]

Ethanolic leaves extract was fractionized to achieve saponin-rich extract, which was tested against B16F10 (melanoma) and L929 (fibroblasts) cell lines, resulting high activity against the first.[196]

Seedless fruits were defatted with petroleum ether and analyzed for fatty acids, protein, sugars and unsaponifiable fractions. The petroleum ether, fatty acids and unsaponifiable fractions were tested against three bacteria and three fungi species, showing significant activity against bacteria and no activity against fungi.[197]

Seeds methanolic extract had genotoxicity against *Biomphalaria alexandrina* (snails), with control of *Daphnia magna* (plankton), where the extract had very low toxicity.[198]

Leaves aqueous extract used for treatment of *Enterobiasis vermicularis*-infected children in Egypt, separately or in combination with mebendazole, a standard antiparasitic drug.[199]

Molecular docking work of pentacyclic peptides contained in this plant (see **Figures 6** and **7**) against SARS-COVID-2 main protease enzyme.[200]
Leaves 70% aqueous ethanolic extract had activity against scopolamine-induced anxiety in rats, measured by rotarod task method, with diazepam as a reference. The extract antioxidant activity was determined with DPPH method.[201]
Leaves 70% methanolic extract had ameliorative effect on mice sepsis induced by cecal ligation and puncture (CLP). This effect was measured by the activity of antioxidant and anti-inflammatory biomarkers in heart and kidneys. The extract was analyzed by GC-MS where squalene and piperidine were the major components.[202]
Aerial parts general chemical composition is presented.[203]
Leaves were extracted with 35% ethyl acetate in ethanol, and extract was fractionized and analyzed for chemical composition. Twenty-two compounds were isolated and characterized, including christinin-like (10) and phenolics (12).[204]
Isolation of betulinic acid* from stem bark 95% aqueous ethanolic extract.[205]
Ethanolic stem bark extract was fractionized with diethyl ether, chloroform, ethyl acetate and *n*-butanol. GC-MS analysis revealed that the major components were (%): ethyl palmitate 18.94 in diethyl ether, betulin 55.23 in chloroform, α-sitosterol 43.89 in ethyl acetate and 23.51 in *n*-butanol. In addition, compositions comparison is presented.[206]
Fruit pulp nutritional composition is presented.[207]
Leaves 95% aqueous ethanolic extract was supplemented to bulls in three dosages, 1, 3, and 5%, resulting increase of quantity and quality of the animals semen.[208]
Branches were added to lambs diet (10, 20, 30%) resulting higher digestibility and greater weigh gain compared with control group. *Z. mauritiana* was also studied.[209]
Fruits, pulp and aqueous extract (hot or cold) were used to produce jam.[210]
Leaves 70% aqueous methanolic extract attenuated liver and spleen *Plasmodium berghei*-induced injury in mice, by modulating antioxidant enzymes.[211]
Follow up of previous study with two differences. First, malaria was induced by *Plasmodium chabaudi*, and second, more biomarkers were tested in this research.[212]
Dynamics of nectar secretion from flowers, its sugar content and its potential for honey production.[213]
Honey of bees that naturally fed from the tree flowers was active against *S. aureus*, *L. monocytogenes*, *S. typhimurium* and *E. coli*.[214]
Honey of bees that naturally fed from the tree flowers was active against *B. cereus*, *S. aureus*, *E. coli*, *S. enteritidis* and *T. mentagrophytes*. The activity was compared with two standard antibiotics, flucoral and mycosat.[215]
Honey of bees that naturally fed from the tree flowers was active against *S. aureus*, *S. aureus*, *E. coli*. Molecular docking found that some of the active compounds were isopropyl 2-furoate, (S)-5-(2-methylpropyl)-2,4-imidazolidinedione, methyl-β-D-thiogalactoside and γ-sitosterol (**Figure 8b**).[216]
Roots were separately extracted with acetone, ethanol, methanol and water, and these extract were analyzed TPC, and tested for antioxidant activity (ABTS, DPPH, Fe^{+2} chelating methods). Extracts tests for insecticidal activity against cigarette beetle (*Lasioderma serricorne*). In all these tests, ethanolic extract was most active.[217]
Roots aqueous extract had positive effect on central nervous system of mice, tested with exploratory behaviour pattern, spontaneous motor activity, motor coordination (rotarod) and pentobarbital-induced hypnosis.[218]
Leaves 80% aqueous methanolic extract attenuated $HgCl_2$-induced hepatotoxicity in rats, measured by decreased Hg concentration, lipid peroxidation, and nitric oxide, increased glutathione, superoxide dismutase, catalase, peroxidase and reductase, and

upregulated nuclear factor-erythroid 2-related factor 2.[219]
Same extract was used by the same group of previous research to ameliorate $HgCl_2$-induced brain toxicity in rats, mainly by lowering Hg(II) concentration in the cortex and regulation of oxidant/antioxidant biomarkers.[220]
Biosorbent prepared from seeds (stones) was efficient for removal of Zn(II) and Cd(II) from their aqueous solutions.[221]
Follow up of the previous study with two differences. First, Pb(II) was added, and second, the metal ions were in wastewater, not prepared aqueous solutions.[222]
Young trees grown in Cu(II) contaminated soil showed accumulative activity.[223]
Leaves 70% aqueous ethanolic extract was used to prepare shampoos with 5, 10 or 20%. These were tested for physical appearance, pH value, surface tension, wetting time, rheological property, dirt dispersion, foam volume and stability, detergency, eye irritation, skin sensitization and overall stability.[224]
Leaves aqueous extract with extracts of another four plants were used, in various proportions, to prepare shampoos, and these were compared for different properties with two commercial shampoos.[225]
Leaves 70% methanolic extract was used to prepare a shampoo with similar extracts of *Salix babylonica* leaves and *Glycyrrhiza glabra* rhizomes. In addition to some listed above shampoo properties, its antioxidant (DPPH method) and antimicrobial (against *S. aureus*, *B. cereus*, *Proteus* spp., *E. coli* and *C. albicans*) activities were tested.[226]
Wet leaves powder was very efficient in disappearance of severe rash that was caused by erlotinib cancer treatment.[227]
* Mistakenly written in the title and 6 other mentions as “betunilic acid”.

Abbreviations: AAPH 2,2′-azobis(amidinopropane) dihydrochloride, ABTS 2,2'-azino-bis(3-ethylbenzothiazoline-6-sulfonic acid), ahc and her/his colleagues, BHA butylated hydroxyanisole, BHT butylhydroxytoluene, CUPRAC cupric reducing antioxidant capacity, DPPH 2,2-Diphenyl-1-picrylhydrazyl, EO essential oil, FRAP ferric reducing activity power, GC-MS gas chromatography mass spectrometry, LC-MS liquid chromatography mass spectrometry, LPS lipopolysaccharide, LOX lipoxygenase, ORAC oxygen radical absorbance capacity, PBD phosphomolybdenum (assay), STZ streptozotocin, TAC total antioxidant capacity, TEAC Trolox equivalent antioxidant capacity, TFC total flavonoid content, TPC total phenolic content, TRPA total reducing power ability.

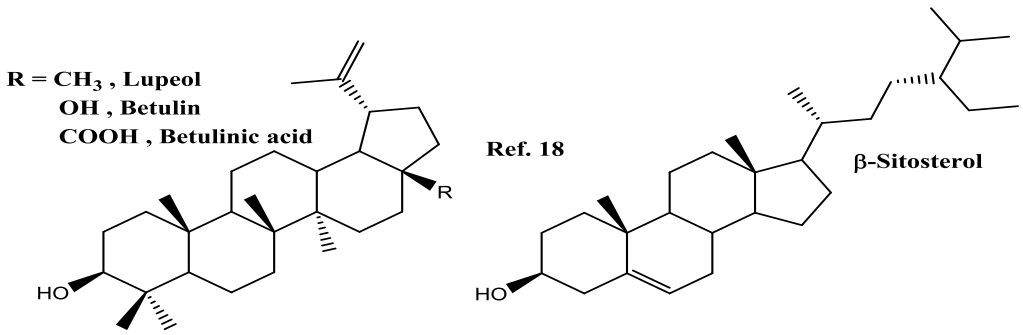


Figure 1: Natural products isolated from *Paliurus spina-christi*.

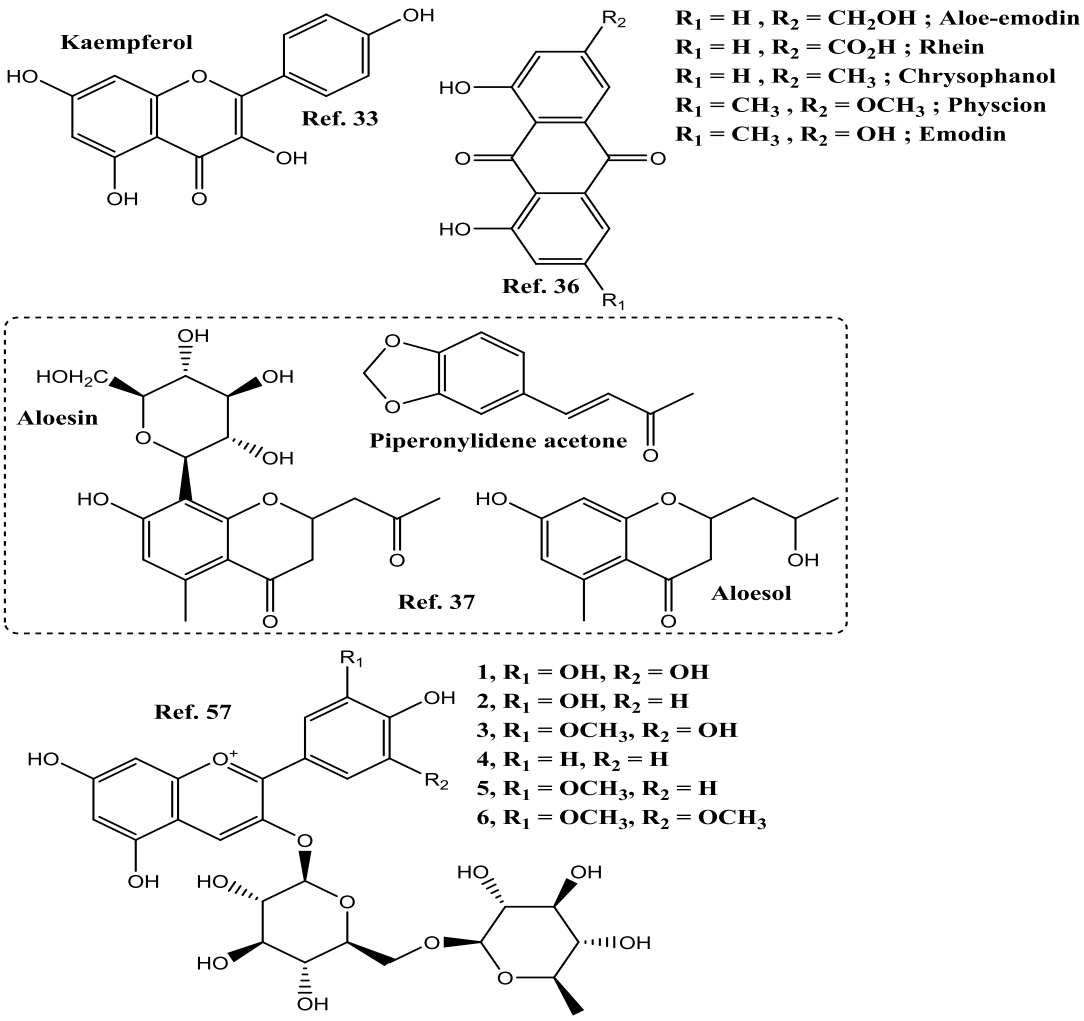


Figure 2: Natural products isolated from *Rhamnus alaternus.*

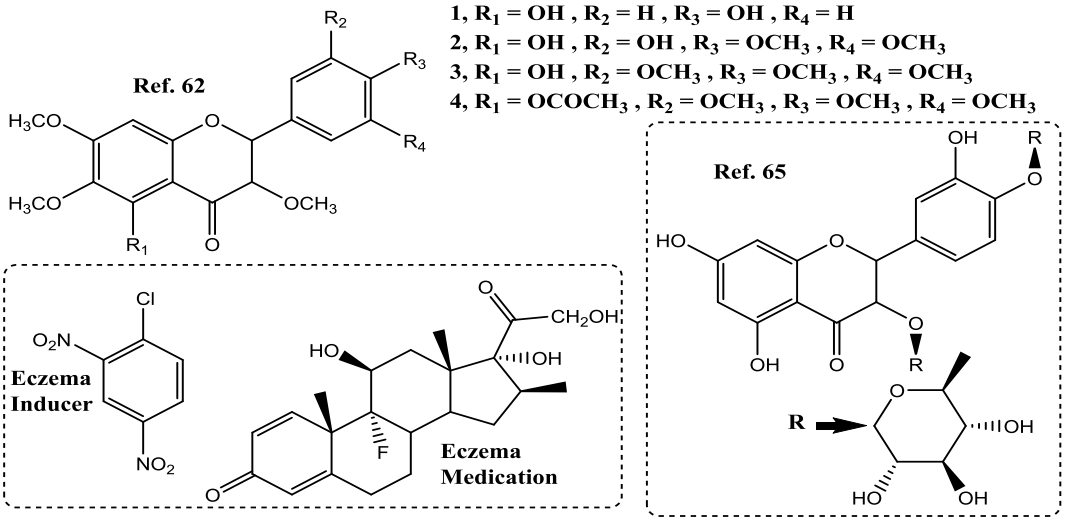


Figure 3: Natural products isolated from *Rhamnus disperma.*

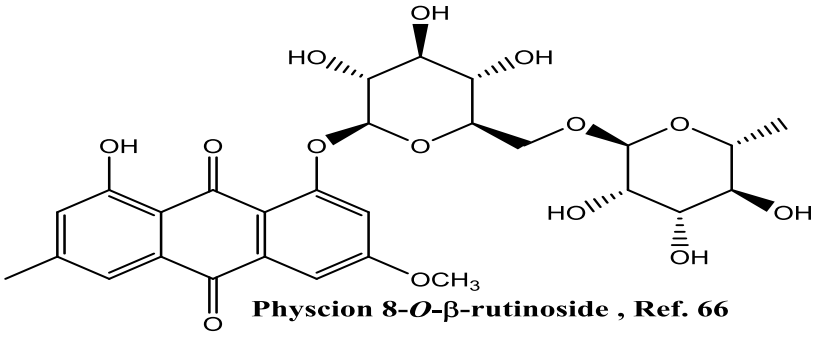


Figure 4: Natural products isolated from *Rhamnus libanotica.*

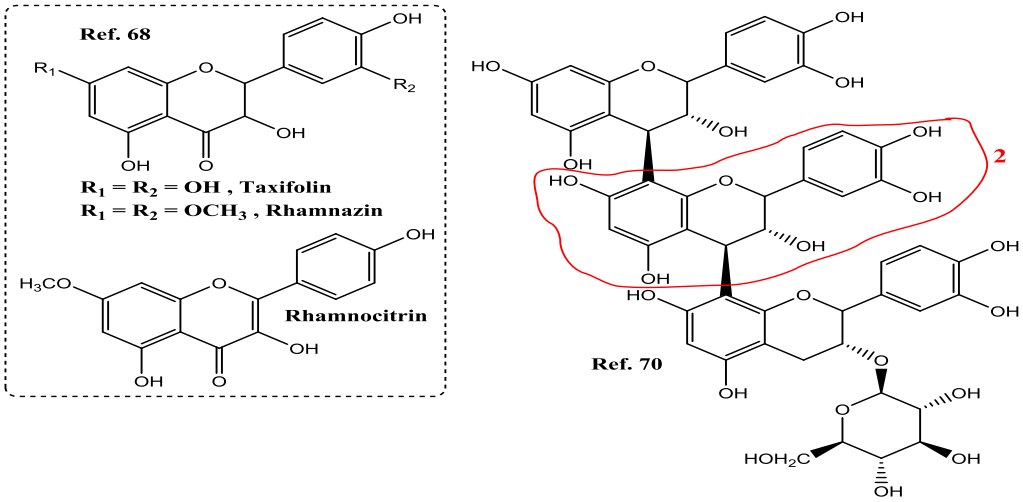


Figure 5: Natural products isolated from *Rhamnus lycioides.*

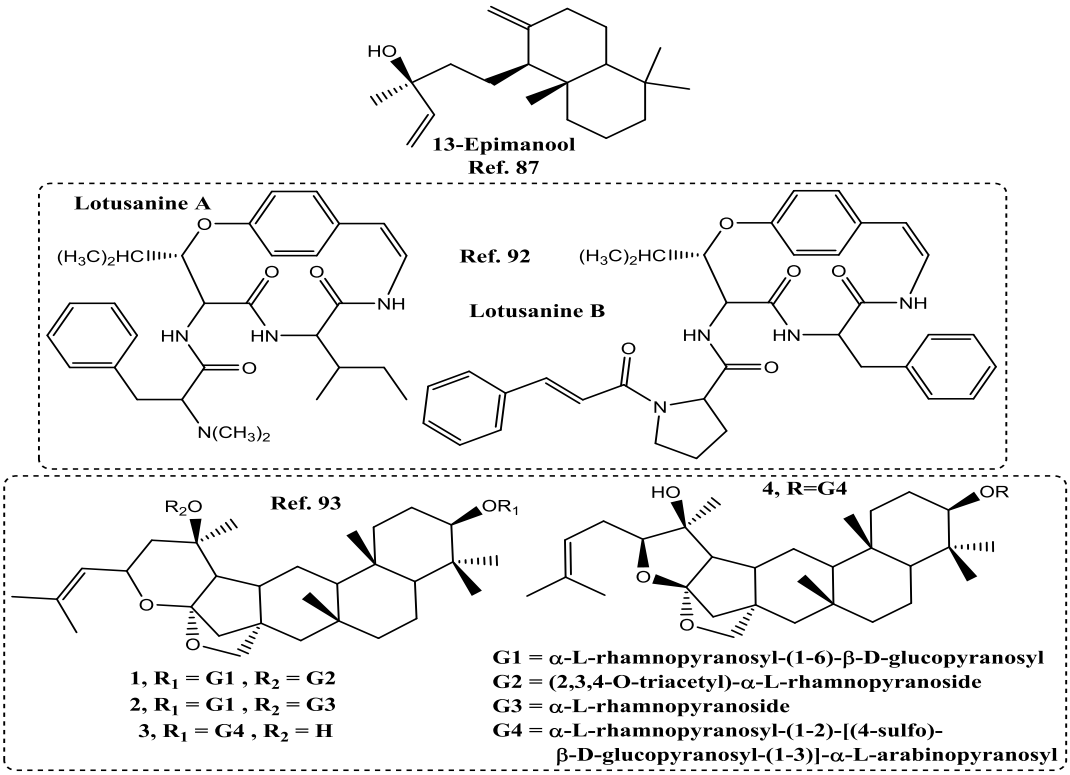
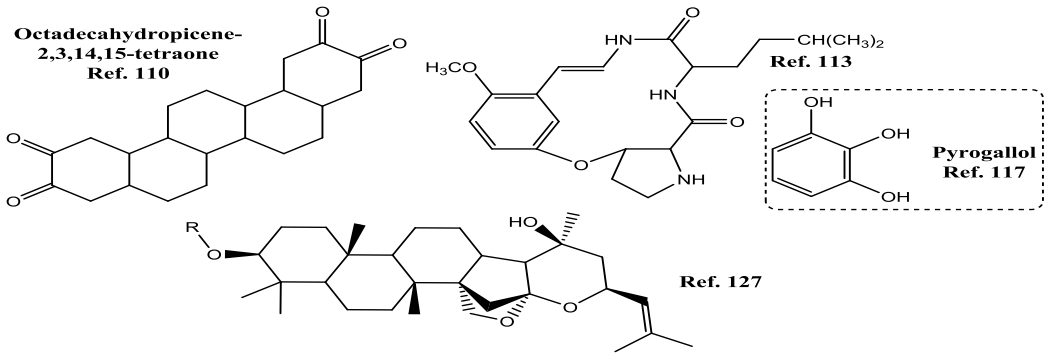


Figure 6: Natural products isolated from *Ziziphus lotus.*



Jujuboside A , R = 6-deoxy-α-L-mannopyranosyl-(1-2)-O0[O-β-D-glucopyranosyl-(1-6)-O-[β-D-xylopyranosyl-(1-2)-β-D-glucopyranosyl-(1-3)]-α-L-arabinopyranoside

Jujuboside B , R = 6-deoxy-α-L-mannopyranosyl-(1-2)-O-[O-β-D-xylopyranosyl-(1-2) -β-D-glucopyranosyl-(1-3)-α-L-arabinopyranoside

Figure 7: Natural products isolated from *Ziziphus nummularia.*

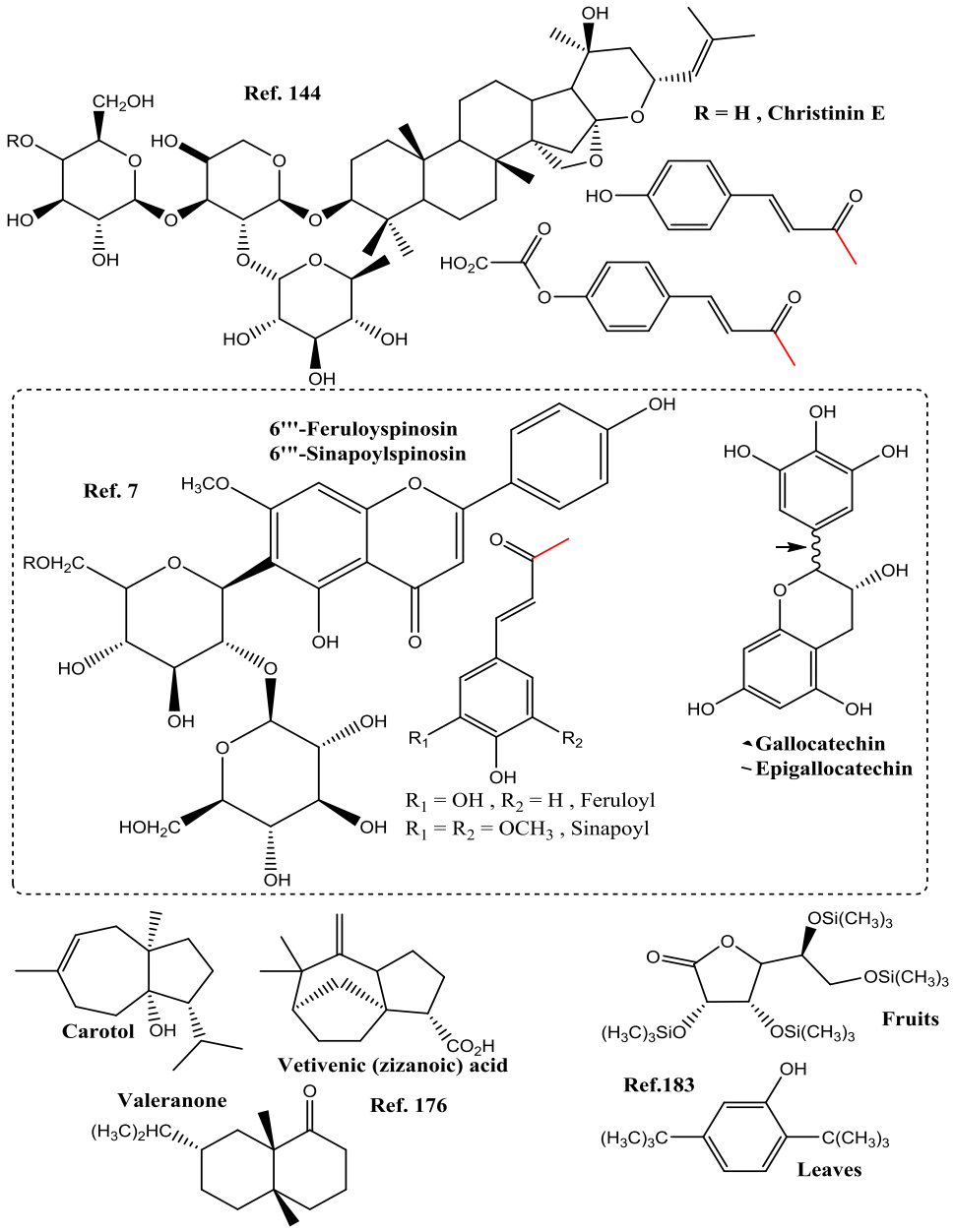


Figure 8a: Natural products isolated from *Ziziphus spina-christi.*

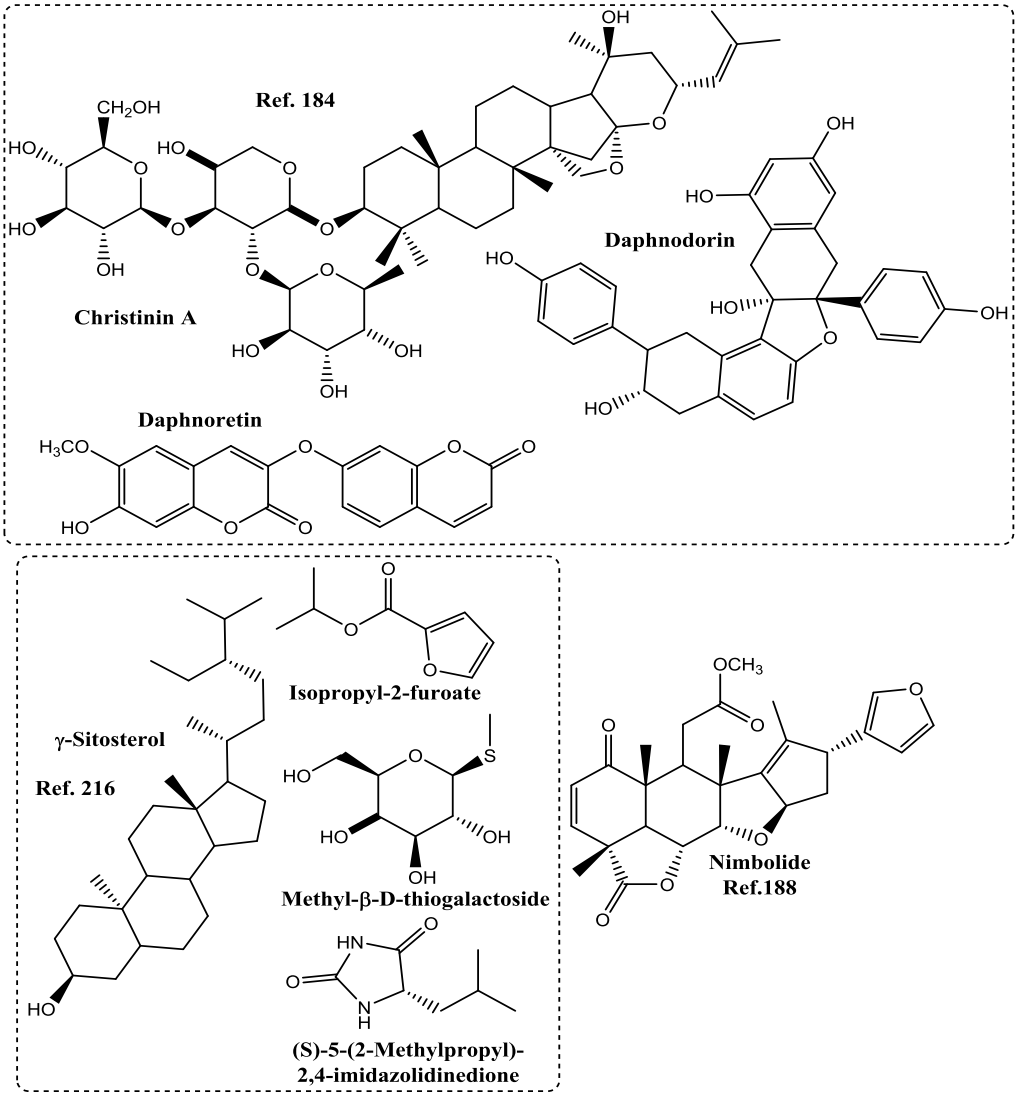


Figure 8b: Natural products isolated from *Ziziphus spina-christi.*

3. DISCUSSION

The trees of the Rhamnaceae family growing between the Jordan river and the Mediterranean sea are very important part of the flora of this region. Traditionally, they were used for a variety of purposes, such as shade, medicine, wood and above all, nutrition. In fact, in more arid regions in Western Asia and North Africa, they are major source of income.[228]

As we mentioned several times in previous publications, accurate reporting is vital for the progress of science. With this obvious foundation of science, we found the publication of F., Oguz,[16] very inaccurate and misleading. Our statement refers to the chemical compositions listed in the article (table 1 and table 2, there). There are many examples but we will present only two. First, “2-decanal”. This compound cannot exist since aldehyde group cannot be second carbon. Same mistake applies for “2-undecenal”. In addition, for both compounds, the

presented molecular formulas are wrong: decanal should be $C_{10}H_{20}O$, not $C_{10}H_{18}O$, and undecanal should be $C_{11}H_{20}O$, not $C_{13}H_{18}O_2$. Even the formulas of simpler compounds such as cyclohexanone are mistakenly reported: $C_{10}H_{14}O$ instead of $C_6H_{10}O$. Second, authors reported the presence of "squalane" in the text (page 359 there) but in table 1 there, the compound is "squalene", with molecular formula of $C_{30}H_{50}$, which is correct. These mistakes and many others, severely limit the reliability of this publication.

Interesting findings were reported by S. Aichour ahc about hemolytic activity of *Rhamnus alaternus* extracts,[35] while S. Kherbachi ahc reported antihemolytic activity.[50] These seemingly contradicting results are practically not. Plant parts are different (aerial parts, bark and leaves, respectively), extraction solvent (petroleum ether, 70% aqueous ethanol) and method of testing (direct effect on human blood, against AAPH-induced hemolysis). These differences can also explain the great gap in the results of S. Aichour ahc that reported 90% hemolysis, and T.M. Chaouche ahc,[55] who used the same method and same concentration, but different plant part (bark and leaves) and different extraction solvent (methanol-acetone 3:2, v/v). They reported 2% hemolysis. It can be concluded that more polar solvents, yield higher phenolic content, lower hemolytic and higher antihemolytic activities.

Following the reports cited in the two paragraphs above, the work of A.H. Brantner and Z. Males has special importance: they presented a method of quality assessment and assurance for *Paliurus spina-christi* extracts.[229] Their work focused on phenolic glycosides, their extraction from different plant parts, chromatography and use of standards. And S. Guesmi ahc extracted these active polyphenolic compounds from the leaves of *Rhamnus lycioides* and studied their capacity as radiation (^{60}Co, 0-30 kGy) bio-dosimeter.[230]

Several works were published about the influence of extraction conditions of *Ziziphus lotus* on the results of the extraction, especially on the chemical compositions of the extracts. E. El Maaiden ahc used a multi-step extraction process, that was presented with a comprehensive flowchart, where they extracted four plant parts, with several solvent, *Ziziphus lotus* and *Ziziphus spina-christi*.[231] They determined the general chemical composition of each species, and the effect of the different extraction path is clearly evident. T. Letaief ahc studied the results and the kinetics of enzymatic extraction of *Z. lotus* fruit and syrup compared with traditional extraction process.[232] They used pectinase and cellulase and report that this method has higher yield and efficiency. M. Ouhammou ahc dried leaves of *Z. lotus* with temperatures ranging from room conditions to 90 °C.[233] Expectedly, they found out notable

differences in the chemical compositions of the resulting extracts (acetone) and their antioxidant activity, tested by DPPH method. F. Dahlia ahc studied the influence of locations with different environments, on the chemical composition of several extracts (leaves, pulp, seeds) of this tree.[234] They found clear differences in compound families content, as well as β-carotene, lycopene, chlorophyll a and chlorophyll b.

Green nanoparticles have high importance in medicine, catalysis, environmental protection and many other applications.[235] Consequently, several publications reported uses of two *Ziziphus* species aqueous extracts for synthesis of green nanoparticles. A summary of these publications is shown in **Table 2**.

Table 2: Green Nanoparticles (NPs) Prepared with *Ziziphus* species and Their Activities.

Species	NPs	Activities/Reference
Ziziphus nummularia	AgNPs	Antimicrobial, antioxidant[236]
Ziziphus nummularia	AgNPs	Antimicrobial[237]
Ziziphus nummularia	AgNPs	Antimicrobial, antioxidant, cytotoxic, genotoxic[238]
Ziziphus nummularia	AgNPs	Antimicrobial, antioxidant (encapsulated)[239]
Ziziphus nummularia	AgNPs	Antimicrobial, hair growth promoter[240]
Ziziphus nummularia	AgNPs	Antimicrobial[241]
Ziziphus nummularia	AgNPs AuNPs	Antimicrobial, antioxidant[242]
Ziziphus spina-christi	AgNPs	Antimicrobial[243]
Ziziphus spina-christi	AgNPs	Antimicrobial, neurotoxic[244]
Ziziphus spina-christi	AgNPs	Antimicrobial (Extract loaded)[245]
Ziziphus spina-christi	AgNPs	Antimicrobial (Antifungal)[246]
Ziziphus spina-christi	ZnONPs	Antimicrobial, Antioxidant[247]

In addition to nanoparticles, *Ziziphus spina-christi* products were published for use in preparations of other modern applications. M. Safian-Boldaji used leaves EO (hydrodistillation) as a natural surfactant based on its hydrophobic nature and lipophilic components (%): geranyl acetone 14, methyl hexadecanoate 10, methyl octadecanoate 9.9, farnesyl acetone 9.9, hexadecanol 9.7 and ethyl octadecanoate 8.[248] S. Emadi also used leaves EO that was prepared with same method to prepare a surfactant, exploiting this property of saponins contained in this EO.[249] They explain the surfactant property of the saponin by the hydrophobic nature of the steroid part and the hydrophilic nature of the glycoside moiety. E.M. Abdel Bary ahc used cellulose that was obtained from the stem bark fibers, to produce a superabsorbent membranes after modifying with polyvinyl alcohol.[250]

Leaves aqueous extracts of various concentrations were used by A. Mahmoud ahc to reduce graphene oxide.[251] The reduced form had decolorization (aqueous methylene blue), antioxidant (DPPH method) and antibacterial (*E. coli*, *K. pneumonia*, *B. subtilis*, *S. aureus*) activities. M.A. El Hamd ahc hydrothermal method to prepare carbon dots from the powdered leaves and concentrated phosphoric acid.[252] These were used as a green fluorometric biosensor for the assessment of rifaximin (antibiotic). To conclude this part, it is highly important to re-indicate the critical effect of the extraction method on the outcome of the extraction. In this context, M. Mohaddes-Kamranshahi ahc developed saponin green extraction method from the leaves of this tree, using hydrothermal, microwave and Bain-Marie water bath heating.[253] By this, they managed to isolate a structurally interesting saponin-alkaloid shown in **Figure 9**, which they mistakenly state that in it contains amide group, where it is actually amine group.

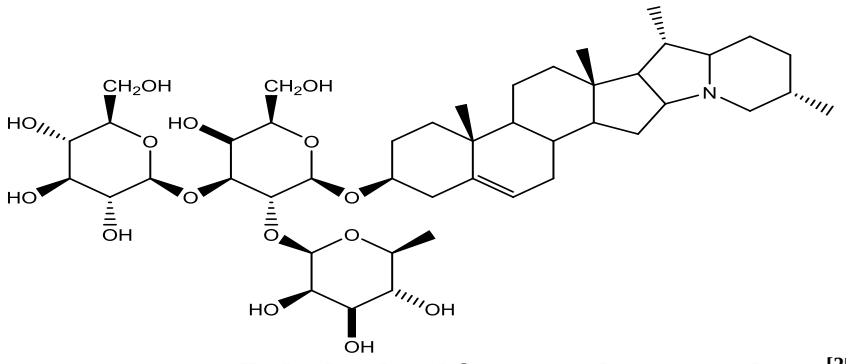


Figure 9: Saponin-alkaloid isolated from *Ziziphus spina-christi*.[253]

Ziziphus spina-christi can tolerate almost all types of climate and other conditions in Western Asia and North Africa. M. Sohail ahc studied the salinity tolerance of this tree by using sodium chloride solution and discovered that it can tolerate low to medium salinity.[254] They concluded that based on the mineral composition of the fruits that was not affected, and they suggest using *Ziziphus spina-christi* for re-vegetation of lands with these degrees of salinity. S. Naghmouchi and M. Alsubeie reported that this species is highly tolerant towards drought, and they concluded that after testing growth, biomass and proline content, compared with control trees.[255] Y. Zait ahc conducted experiments that included an exposure of young trees to salinity, drought and high temperatures, and they discovered that the trees tolerated all these stressful conditions.[256]

So, although *Ziziphus spina-christi* is very tolerant to external harsh conditions, its content and the consequential properties are clearly dependent on maturity stage, as in all other

plants. A.R. Aldhanhani ahc tested several properties of the fruits in three maturity stages: unripe, half-ripe and fully ripe.[257] In addition to morphological characteristics and general compositions, they found out clear differences: TFC, TPC, antioxidant activity (ABTS, DPPH methods) and antibacterial activity (four species). Very significant differences in the compounds content of the fruits in these stages were reported. First example is gallic acid (µg/g of fruit, unripe, half-ripe, fully-ripe): 5.8, 2.22, 7.27. And in the second example of catechol, the amounts are 0.76, 3.36 and 5.95, which means that the amount of this compound in the fully-ripe fruits is around 783% of that in unripe fruits. That is a very large difference. In this research *Z. mauritiana* was also studied. And as in numerous published works, storage conditions have a key role in the quality and the contents of plant material, M.S. AL-Saikhan reports that fruits storage with calcium chloride increased the preservation of the fruits and their contents.[258] These findings are consistent with many other results such as those of D.R. Katuwal ahc that studied the effect of calcium chloride on tomato fruits shelf life.[259]

Finally, these trees can have a key role in environmental protection for the benefit of humans. N. Al-Naimi ahc compared the contents of the fruits of *Ziziphus spina-christi* on roadsides and rural areas in Qatar.[260] They found clear differences in fruit contents, such as ascorbic acid. These differences are indicative for air quality, and this authors report, is consistent with findings in other countries like Saudi Arabia and Iraq.

4. Selected activities of *ziziphus jujuba*

Ziziphus jujuba is a very widespread domestic trees in the reviewed region between the Jordan river and the Mediterranean sea. Most scholars agree that it was domesticated in China, although its domestication date is debated. Recent scientific estimates this time about 6200 years before present.[261] It is mainly used for food consumption but its medicinal activities and chemical composition were extensively studied and published.[262] Since it is closely related and sometimes confused with other *Ziziphus* trees in this region, we will cite some selected articles about its medicinal activities. This summary is shown in **Table 3**.

Table 3: Selected published activities of *ziziphus jujube.*

Activity, Testing Method, Results and Reference
Alzheimer's disease Fruits 70% aqueous ethanolic extract had significant ameliorating effect in amyloid β_{25-35}-induced Alzheimer's disease. Activity was observed by behavioral three tests and measured with four biomarkers.[263]
Anti-inflammatory

Fruits 95% aqueous ethanolic extract had notable activity against *E. coli*-induced diarrhea and against carrageenan-induced paw edema in rats.[264]
Antioxidant Fruits from eight locations in five maturation stages, were extracted with water. The obtained extracts were analyzed for TFC, TPC, ascorbic acid, and tested for antioxidant activity by ABTS and DPPH, showing high results.[265]
Cardioprotective Fruits 80% aqueous ethanolic extract had attenuative effect in isoprenaline-induced myocardial infarction in rats, with or without aerobic training. In both groups positive effect was observed and in the trained group it was higher.[266]
Gastroprotective Dried fruit juice was supplemented to ethanol-induced ulcerative rats, positive effect measured by three biomarkers. Phenolic composition was determined and antioxidant activity was measured with ABTS and CUPRAC methods.[267]
Hepatoprotective Fruits 70% aqueous ethanolic extract had ameliorative effect against acetaminophen-induced hepatic toxicity in rats. Effect was measured by concentrations of alanine aminotransferase and aspartate aminotransferase.[268]

5. CONCLUSIONS

1) Trees of Rhamnaceae family growing in the reviewed region have great nutrition, economic and environmental potentials.
2) The published data of these trees has vast range of medicinal and nutritional activities.
3) These species are highly tolerant towards stressful conditions so they can be used for vegetation of landscapes with such conditions.
4) These plants contain natural products with unique structures and substructures that can be very useful in drug development and discovery.
5) Some of the species were not or very limitedly published, and this can open future research horizons and opportunities.

6. REFERENCES

1. Jud, N.A., Gandolfo, M.A., Iglesias, A., Wilf, P., Flowering after disaster: Early Danian buckthorn (Rhamnaceae) flowers and leaves from Patagonia. *PLoS ONE*, 2017; *12*: e0176164. DOI: 10.1371/journal.pone.0176164
2. Richardson, J.E., Fay, M.F., Cronk, Q.C., Chase, M.W., A Revision of the Tribal Classification of Rhamnaceae. *Kew Bull*, 2000; *55*: 311-340. DOI: 10.2307/4115645
3. Christenhusz, M.J., Byng, J.W., The number of known plants species in the world and its annual increase. *Phytotaxa*, 2016; *261*: 201-217. DOI: 10.11646/phytotaxa.261.3.1
4. van Zeista, W., Fruits in foundation deposits of two temples. *J. Archaeol. Sci*, 1983; *10*: 351-354. DOI: 10.1016/0305-4403(83)90072-9

5. Willcox, G., The plant remains from Hellenistic and Bronze Age levels at Failaka, Kuwait. A preliminary report. *MOM Édit*, 1990; *18*: 43-50. [Google Scholar]
6. Abdrabou, A., Zidan, E., Nishisaka, A., Kurokochi, H., Yoshimura, S., King Khufu's Second Boat: Scientific Identification of Wood Species for Deckhouse, Canopy, and Forecastle. *Forests*, 2022; 13: 2118. DOI: 10.3390/f13122118
7. Kadioglu, O., Jacob, S., Bohnert, S., Naß, J., Saeed, M.E., Khalid, H., Merfort, I., Thines, E., Pommerening, T., Efferth, T., Evaluating ancient Egyptian prescriptions today: Anti-inflammatory activity of *Ziziphus spina-christi*. *Phytomedicine*, 2016; *23*: 293-306. DOI: 10.1016/j.phymed.2016.01.004
8. Elshiwy, R., The *Nbs* - Tree in Ancient Egypt: Significance and Uses. *JFTH*, 2023; *20*: 1-24. [Google Scholar]
9. Azaizeh, H., Saad, B., Khalil, K., Said, O., The state of the art of traditional Arab herbal medicine in the eastern region of the mMediterranean: a review. *Evid. Based Complement. Alternat. Med*, 2006; *3*: 229-235. DOI: 10.1093/ecam/nel034
10. Kumar, M., Rawat, S., Nagar, B., Kumar, A., Pala, N.A., Bhat, J.A., Bussmann, R.W., Cabral-Pinto, M., Kunwar, R., Implementation of the Use of Ethnomedicinal Plants for Curing Diseases in the Indian Himalayas and Its Role in Sustainability of Livelihoods and Socioeconomic Development. *Int. J. Environ. Res. Public Health*, 2021; *18*: 1509. DOI: 10.3390/ijerph1804150
11. Dafni, A., Levy, S., Lev, E., The ethnobotany of Christ's Thorn Jujube (*Ziziphus spina-christi*) in Israel. *J. Ethnobiol. Ethnomed*, 2005; *1*: 8. DOI:10.1186/1746-4269-1-8
12. Abou Auda, M., An Ethnobotanical uses of Plants in the Middle Area, Gaza Strip, Palestine. *Adv. Environ. Biol*, 2011; *5*: 3681-3687. [ResearchGate]
13. Aati, H., El-Gamal, A., Shaheen, H., Kayser, O., Traditional use of ethnomedicinal native plants in the Kingdom of Saudi Arabia. *J. Ethnobiol. Ethnomed*, 2019; *15*: 2. DOI: 10.1186/s13002-018-0263-2
14. Jaradat, N., Zaid, A.N., Herbal remedies used for the treatment of infertility in males and females by traditional healers in the rural areas of the West Bank/Palestine. *BMC Complement. Alternat. Med*, 2019; *19*:194. DOI: 10.1186/s12906-019-2617-2
15. Feyssa, D.H., Njoka, J.T., Asfaw, Z., Nyangito, M.M., Multiple uses of *Ziziphus spina-christi* (L.) Desf as an Agroforestry Species in the Northeastern rift Valley of Ethiopia: Contributions to People's Resilience to Adapt to Chaining Environment. *Ethiop. J. Appl. Sci. Technol*, 2015; *5*: 33-48. [Google Scholar]

16. Oguz, F., Pulat, C.C., Ilhan, S. Atmaca, H., GC-MS Analysis and Apoptotic Effect of Paliurus spina-christi Mill. Leaf and Flower Extracts against Breast Cancer Cells. *Sakarya Univ. J. Sci*, 2022; *26*: 357-364. DOI: 10.16984/saufenbilder.1029351
17. Takim, K., Bioactive component analysis and investigation of antidiabetic effect of Jerusalem thorn (*Paliurus spina-christi*) fruits in diabetic rats induced by streptozotocin. *J. Ethnopharmacol*, 2021; 264: 113263. DOI: 10.1016/j.jep.2020.113263
18. Yuca, H., Özbek, H., Ömür Demirezer, L., Güvenalp, Z., Assessment of the *α*-glucosidase and *α*-amylase inhibitory potential of *Paliurus spina-christi* Mill. and its terpenic compounds. *Med. Chem. Res*, 2022; *31*: 1393-1399. DOI: 10.1007/s00044-022-02921-y
19. Mousavi Esfahani1, S.M., Tarighi, P., Dianat, K., Ashour, T.M., Mottaghi-Dastjerdi, N., Aghsami, M., Sabernavaei, M., Montazeri, H., *Paliurus spina-christi* Mill fruit extracts improve glucose uptake and activate the insulin signaling pathways in HepG2 insulin-resistant cells. *BMC Complement. Med. Ther*, 2023; *23*: 151. DOI: 10.1186/s12906-023-03977-y
20. Takım, K., Işik, M., Phytochemical Analysis of *Paliurus spina-christi* Fruit and Its Effects on Oxidative Stress and Antioxidant Enzymes in Streptozotocin-Induced Diabetic Rats. *Appl. Biochem. Biotechnol*, 2020; *191*: 1353-1368. DOI: 10.1007/s12010-020-03287-w
21. Zor, M., Aydin, S., Güner, N.D., Başaran, N., Başaran, A.A., Antigenotoxic properties of *Paliurus spina christi* Mill fruits and their active compounds. *BMC Complement. Alternat. Med*, 2017; *17*: 229. DOI 10.1186/s12906-017-1732-1
22. Mosaddegh, M., Khoshnood, M.J., Kamalinejad, M., Alizadeh, E., Study on the Effect of *Paliurus spina-christi* on cholesterol, triglyceride and HDL Levels in diabetic male rats fed a high cholesterol diet. *Iran. J. Pharm. Res*, 2004; *3*: 51-54. [ResearchGate]
23. Şen A. Antioxidant and anti-inflammatory activity of fruit, leaf and branch extracts of *Paliurus spina-christi* P. Mill. *Marmara Pharm. J*, 2018; 22: 328-333. DOI: 10.12991/mpj.2018.71
24. Brantner, A., Males, Z., Pepeljnjak, S., Antolić A. Antimicrobial activity of *Paliurus spina-christi* Mill. (Christ's thorn). *J. Ethnopharmacol*, 1996; *52*: 119-122. DOI: 10.1016/0378-8741(96)01408-0
25. Ahmed, L.T., Al-Ani, N.K., Smariee, K.W., Chemical analysis and antifungal activity of *Paliurus spina-christii*. *Egypt. J. Exp. Biol*, 2012; *8*: 99-102. [Google Scholar]
26. Ceylan, Ş., Harşıt, B., Saral, Ö., Özcan, M., Demir, İ., Comparison of antioxidant and antimicrobial activities of plant extracts Centaury (*Hypericum montbretii* and *Hypericum*

bupleuroides) and Blackthorn (*Paliurus spina-christi* Mill) in Artvin, Giresun region of Turkey. *J. For. Fac*, 2020; *21*: 13-20. DOI: 10.17474/artvinofd.579494

27. Arsalan, L., Kaya, E., Investigation of Antimicrobial and Antioxidant Activities of *Paliurus spina-christi* Mill. In Kahramanmaras, Turkey. *KSU J. Agric. Nat*, 2021; *24*: 1161-1169. DOI: 10.18016/ksutarimdoga.vi.835763
28. Ahmed, L.T., Abood, K.W., Ghanim, Q., Ibrahim, N.K., Al-Naim, A.S., 2013. Anti oxidant activity of *Paliurus Spina-Christi* methanolic extract. *Int. J. Bio-Technol. Res*, 2013; *3*: 1-4. [Google Scholar]
29. Orhan, D.D., Coşkun, S.H., The Antioxidant Activities and Total Phenol Contents of Eleven Turkish Medicinal Plants. *J. Gazi Univ. Health Sci. Inst*, 2019; *1*: 1-9. [Google Scholar]
30. Zengin, G., Fernández-Ochoa, Á., Cádiz-Gurrea, M., Leyva-Jiménez, F.J., Segura-Carretero, A., Elbasan, F., Yildiztugay, E., Malik, S., Khalid, A., Abdalla, A.N., Mahomoodally, M.F., Phytochemical profile and biological activities of different extracts of three parts of *Paliurus spina-christi*: A linkage between structure and ability. *Antioxidants*, 2023; *12*: 255. DOI: 10.3390/antiox12020255
31. Grande, F., Marrelli, M., Amodeo, V., Occhiuzzi, M.A., Pinzaru, I., Fucile, M., Dehelean, C.A., Alexa, E., Conforti, F., Statti, G., Molecular Docking Studies and In Vitro Activity of *Paliurus spina-christi* Mill Extracts as Pancreatic Lipase Inhibitors. *Antioxidants*, 2024; *13*: 160. DOI: 10.3390/antiox13020160
32. Dalakishvili, T.M., Zurabishvili, T.S., Kemertelidze, E.P., Phytochemical investigation of *Paliurus spina-christi*. *Chem. Nat. Compd*, 1986; *22*: 602-603. DOI: 10.1007/BF00599276
33. Zeouk, I., Ouedrhiri,W., Sifaoui, I., Bazzocchi, I.L., Piñero, J.E., Jiménez, I.A., Lorenzo-Morales, J., Bekhti, K., Bioguided Isolation of Active Compounds from *Rhamnus alaternus* against Methicillin-Resistant *Staphylococcus aureus* (MRSA) and Panton-Valentine Leucocidin Positive Strains (MSSA-PVL). Molecules, 2021; *26*: 4352. DOI: 10.3390/molecules26144352
34. Ben Ammar, R., Kilani, S., Bouhlel, I., Skandrani, I., Naffeti, A., Boubaker, J., Ben Sghaier, M., Bhouri, W., Mahmoud, A., Chekir-Ghedira, L., Ghedira, K., Antibacterial and cytotoxic activities of extracts from (Tunisian) *Rhamnus alaternus* (Rhamnaceae). *Ann. Microbiol*, 2007; *57*: 453-460. DOI: 10.1007/BF03175089

35. Aichour, S., Mouffouk, S., Benkhaled, M., Haba, H., Phytochemical composition, antioxidant, cytotoxic, haemolytic and antibacterial activities of aerial parts of *Rhamnus alaternus*. *Herba Polon*, 2023; *69*: 15-28. DOI: 10.5604/01.3001.0053.8860
36. Kosalec, I., Kremer, D., Locatelli, M., Epifano, F., Genovese, S., Carlucci, G., Randić, M., Zovko Končić, M., Anthraquinone profile, antioxidant and antimicrobial activity of bark extracts of *Rhamnus alaternus, R. fallax, R. intermedia* and *R. pumila*. *Food Chem*, 2013; *136*: 335-341. DOI: 10.1016/j.foodchem.2012.08.026
37. Nekkaa, A., Benaissa, A., Dupire, F., Risler, A., Mutelet, F., Canabady-Rochelle, L., Green and innovative extraction of polyphenols from *Rhamnus alaternus* using natural deep eutectic solvents and evaluation of their bioactivities. *J. Appl. Res. Med. Aromat. Plants*, 2023; *35*: 100503. DOI: 10.1016/j.jarmap.2023.100503
38. Chouitah, O., Meddah, B., Aoues, A., Analysis of the Chemical Composition and Antimicrobial Activity of the Essential Oil from *Rhamnus alaternus*. *J. Biol. Act. Prod. Nat*, 2012; *2*: 302-306, DOI: 10.1080/22311866.2012.10719138
39. Ammar, R.B., Kilani, S., Abdelwahed, A., Hayder, N., Mahmoud, A., Chibani, J., Chekir-Ghedira, L. Ghedira, K., *In vitro* mutagenicity, antimutagenicity and free radical scavenging activities of *Rhamnus alaternus* L. (Rhamnaceae) extracts. *Pak. J. Biol. Sci*, 2005; *8*: 439-445. DOI: 10.3923/pjbs.2005.439.445
40. Gadouche, L., Zerrouki, K., Zidane, A., Ababou, A., Elazaar, I.B., Merabet, D., Henniche, W. and Ikhlef, S., Genoprotective, antimutagenic, and antioxidant effect of methanolic leaf extract of *Rhamnus alaternus* L. from the Bissa mountains in Algeria. *Foods Raw Mater*, 2022; *10*: 196-205. DOI: 10.21603/2308-4057-2022-2-530
41. Ben Ammar, R., Kilani, S., Bouhlel, I., Ezzi, L., Skandrani, I., Boubaker, J., Ben Sghaier, M., Naffeti, A., Mahmoud, A., Chekir-Ghedira, L., Ghedira, K., Antiproliferative, antioxidant, and antimutagenic activities of flavonoid-enriched extracts from (Tunisian) *Rhamnus alaternus* L.: Combination with the phytochemical composition. *Drug Chem. Toxicol*, 2008; *31*: 61-80. DOI: 10.1080/01480540701688725
42. Bhouri, W., Sghaier, M.B., Kilani, S., Bouhlel, I., Dijoux-Franca, M.G., Ghedira, K., Ghedira, L.C., Evaluation of antioxidant and antigenotoxic activity of two flavonoids from *Rhamnus alaternus* L. (Rhamnaceae): Kaempferol 3-O-β-isorhamninoside and rhamnocitrin 3-O-β-isorhamninoside. *Food Chem. Toxicol*, 2011; *49*: 1167-1173. DOI: 10.1016/j.fct.2011.02.011
43. Boussahel, S., Speciale, A., Dahamna, S., Amar, Y., Bonaccorsi, I., Cacciola, F., Cimino, F., Donato, P., Ferlazzo, G., Harzallah, D., Cristani, M., Flavonoid profile, antioxidant and

cytotoxic activity of different extracts from Algerian Rhamnus alaternus L. Bark. *Pharmacogn. Mag*, 2015; *11*: S102-S109. DOI: 10.4103/0973-1296.157707

44. Bouhlel Chatti, I., Ben Toumia, I., Krichen, Y., Maatouk, M., Chekir Ghedira, L., Krifa, M., Assessment of *Rhamnus alaternus* Leaves Extract: Phytochemical Characterization and Antimelanoma Activity. *J. Med. Food*, 2022; *25*: 910-917. DOI: 10.1089/jmf.2020.0170
45. Bouhlel Chatti, I., Krichen, Y., Maatouk, M., Lahmar, A., Ghoul Mazgar, S., Kammoun, R., Safta Skhiri, S., Chekir Ghedira, L., Krifa, M., Evaluation of Anticancer Potential of Flavones from *Rhamnus alaternus* against B16F10 Melanoma Cells. *Nutr. Cancer*, 2022; *74*: 2265-2275. DOI: 10.1080/01635581.2021.2004171
46. Ouchtati, S., Seridi, R., El-Shora, H.M., Influence of *Rhamnus alaternus* L leaf extract on normal and alloxan-induced Diabetic rats. *Biosci. Res*, 2019; *16*: 2009-2016. [ResearchGate]
47. Tacherfiout, M., Petrov, P.D., Mattonai, M., Ribechini, E., Ribot, J., Bonet, M.L. Khettal, B., Antihyperlipidemic effect of a *Rhamnus alaternus* leaf extract in Triton-induced hyperlipidemic rats and human HepG2 cells. *Biomed. Pharmacother*, 2018; *101*: 501-509. DOI: 10.1016/j.biopha.2018.02.106
48. Amtaghri, S., Farid, O., Lahrach, N., Slaoui, M., Eddouksm M., Antihyperglycemic Effect of *Rhamnus alaternus* L. Aqueous Extract in Streptozotocin-induced Diabetic Rats. *Cardiovasc. Hematol. Disord. Drug Targets*, 2023; *22*: 245-255. DOI: 10.2174/1871529X23666230123123317
49. Benchiha, W., Mahroug, S., Bouterfas, K., Moulessehoul, Y.I., In Vitro Antifungal Activity of The Flavonoid extracts from *Rhamnus alaternus* L. (Rhamnaceae). *Egypt. Acad. J. Biol. Sci*, 2022; *14*: 43-52. DOI: 10.21608/EAJBSC.2022.256738
50. Kherbachi, S., Kheniche, M., Tacherfiout, M., Antihemolytic activity of hydroalcoholic leaves and bark extracts from *Rhamnus alaternus* against AAPH induced hemolysis on human erythrocytes. *Int. J. Plant Based Pharm*, 2022; *2*: 210-219. DOI: 10.29228/ijpbp.3
51. Zeouk, I., Ouedrhiri, W., Jiménez, I.A., Lorenzo-Morales, J., Bazzocchi, I.L., Bekhti, K., Intra-combined antioxidant activity and chemical characterization of three fractions from *Rhamnus alaternus* extract: Mixture design. *Ind. Crops Prod*, 2020; *144*: 112054. DOI: 10.1016/j.indcrop.2019.112054
52. Ben Ammar, R., Bhouri, W., Sghaier, M.B., Boubaker, J., Skandrani, I., Neffati, A., Bouhlel, I., Kilani, S., Mariotte, A.M., Chekir-Ghedira, L., Dijoux-Franca, M.G., Ghedira, K., Antioxidant and free radical-scavenging properties of three flavonoids isolated from

the leaves of *Rhamnus alaternus* L. (Rhamnaceae): A structure-activity relationship study. *Food Chem*, 2009; *116*: 258-264. DOI: 10.1016/j.foodchem.2009.02.043

53. Boussahel, S., Dahamna, S., Ruberto, G., Siracusa, L., Harzallah, D., Phytochemical study and antioxidant activities of leaves extracts from *Rhamnus alaternus* L. *Pharmacogn. Commun*, 2013; *3*: 46-53. DOI: 10.5530/pc.2013.1.10
54. Moussi, K., Nayak, B., Perkins, L.B., Dahmoune, F., Madani, K., Chibane, M., HPLC-DAD profile of phenolic compounds and antioxidant activity of leaves extract of *Rhamnus alaternus* L. *Ind. Crops Prod*, 2015; *74*: 858-866. DOI: 10.1016/j.indcrop.2015.06.015
55. Chaouche, T.M., Haddouchi, F., Boudjemai, O., Ghellai, I., Antioxidant and hemolytic activity of *Ziziphus jujuba* Mill and *Rhamnus alaternus* L (Rhamnaceae) extracts from Algeria. *Bull. Soc. R. Sci Liège*, 2020; *89*: 1-14. [ResearchGate]
56. Briggs, L.H., Jacombs, F.E., Nicholls, G.A., The colouring matters of the bark of *Rhamnus alaternus* L. *J. Chem. Soc*, 1953; 3069-3072. DOI: 10.1039/JR9530003069
57. Longo, L., Vasapollo, G., Rescio, L. Identification of anthocyanins in *Rhamnus alaternus* L. berries. *J. Agric. Food Chem*, 2005; *53*: 1723-1727. DOI: 10.1021/jf048253p
58. Benchiha, W., Mahroug, S., Aoued, L., Bouterfas, K., Antihepatoxic activity of *Rhamnus alaternus* L.(Rhamnaceae) leaves extracts. *Phytothérapie*, 2017; *15*: 10-15. DOI: 10.1007/s10298-015-1012-5
59. Halzoune, H., Saiah, W., Tabani, K., Lahfa, F., Koceir, E.A., Omari, N., Therapeutic effects of *Rhamnus alaternus* on the nephroangiosclerosis in wistar rats. *Pak. J. Pharm. Sci*, 2020; *33*: 721-731. DOI: 10.36721/PJPS.2020.33.2.REG.721-731.1
60. Benzaid, C., Tichati, L., Trea, F., Rouabhia, M., Ouali, K., *Rhamnus alaternus* aqueous extract enhances the capacity of system redox defence and protects hepatocytes against aluminum chloride toxicity in rats. *Clin. Phytosci*, 2021; *7*: 67. DOI: 10.1186/s40816-021-00302-3
61. Ben Ghezala, H., Chaouali, N., Gana, I., Snouda, S., Nouioui, A., Belwaer, I., Ouali, J., Kaddour, M., Masri, W., Ben Salah, D., Amira, D., Ghorbal, H., Hedhili, A., Toxic effects of *Rhamnus alaternus*: a rare case report. *Case Rep. Emerg. Med*, 2015; 182951. DOI: 10.1155/2015/182951
62. Mohammed, H.A., Abd El-Wahab, M.F., Shaheen, U., Mohammed, A.I., Abdalla, A.N., Ragab, E.A. Isolation, Characterization, Complete Structural Assignment, and Anticancer Activities of the Methoxylated Flavonoids from *Rhamnus disperma* Roots. *Molecules*, 2021; *26*: 5827. DOI: 10.3390/molecules26195827

63. Ragab, E.A., Highly methoxylated flavonoids and the anti-eczematous activity of *Rhamnus disperma* roots. *J. Pharmacogn. Phytochem*, 2015; *4*: 01-08. [Google Scholar]
64. Mohammed, H.A., Antioxidant flavonol rhamnosides from *Rhamnus disperma* roots. *Int. J. Pharm. Phytopharmacol. Res*, 2015; *5*: 55-60. [Google Scholar]
65. Marzouk, M.S., El-Toumy, S.A., Merfort, I., Nawwar, M.A., Polyphenolic metabolites of *Rhamnus disperma*. *Phytochemistry*, 1999; *52*: 943-946. DOI: 10.1016/S0031-9422(99)00262-9
66. Coskun, M., Toshiko, S., Hori, K., Saiki, Y., Tanker, M., Anthraquinone glycosides from *Rhamnus libanoticus*. *Phytochemistry*, 1990; *29*: 2018-2020. DOI: 10.1016/0031-9422(90)85060-S
67. Benamar, H., Rarivoson, E., Tomassini, L., Frezza, C., Marouf, A., Bennaceur, M., Nicoletti, M., Phytochemical profiles, antioxidant and anti-acetylcholinesterasic activities of the leaf extracts of *Rhamnus lycioides* subsp. *oleoides* (L.) Jahand. & Maire in different solvents. *Nat. Prod. Res*, 2019; *33*: 1456-1462. DOI: 10.1080/14786419.2017.1422182
68. Payá, M., Máñez, S., Villar, A., Flavonoid constituents of *Rhamnus lycioides* L. *Z. Naturforsch. C*, 1986; *41*: 976-978. DOI: 10.1515/znc-1986-11-1204
69. Villar, A., Terencio, M.C., Paya, M., Hypotensive effect of *Rhamnus lycioides* extracts. *J. Ethnopharmacol*, 1986; 16: 269-273. DOI: 10.1016/0378-8741(86)90093-0
70. Terencio, M.C., Sanz, M.J., Payá, M., A hypotensive procyanidin-glycoside from *Rhamnus lycioides* ssp. *lycioide*s. *J. Ethnopharmacol*, 1990; *30*: 205-214. DOI: 10.1016/0378-8741(90)90009-i
71. Marmouzi, I., Kharbach, M., El Jemli, M., Bouyahya, A., Cherrah, Y., Bouklouze, A., Vander Heyden, Y., Elabbes Faouzi, M., Antidiabetic, dermatoprotective, antioxidant and chemical functionalities in *Zizyphus lotus* leaves and fruits. *Ind. Crops Prod*, 2019; *132*: 134-139. DOI: 10.1016/j.indcrop.2019.02.007
72. Bencheikh, N., Bouhrim, M., Alami Merrouni, I., Boutahiri, S., Kharchoufa, L., Addi, M., Tungmunnithum, D., Hano, C., Eto, B., Legssyer, A., Elachouri, M., Antihyperlipidemic and Antioxidant Activities of Flavonoid-Rich Extract of *Ziziphus lotus* (L.) Lam. Fruits. *Appl. Sci*, 2021; *11*: 7788. DOI: 10.3390/app11177788
73. Rsaissi, N., Kamili, E.L., Bencharki, B., Hillali, L., Bouhache, M., Antimicrobial activity of fruits extracts of the wild jujube *Ziziphus Lotus* (L.) Desf. *Int. J. Sci. Eng. Res*, 2013; *4*: 34-38. [Google Scholar]
74. Slimani, A., Moussaoui, A., Laazouni, H., Phytochemical screening, contribution to the study of the antifungal effect of flavonoids from different parts of *Ziziphus lotus* of south-

west Algeria. *Asian J. Pharm. Clin. Res*, 2017; *10:* 13-16. DOI: 10.22159/ajpcr.2017.v10i2.14595

75. Haderbache, L., Annou, S., Mohammedi, A., Antimicrobial potential of Ziziphus and Euphorbia honeys harvested in semi-arid region of Algeria and their possible use in soft medicine. *J. Microbiol. Biotechnol. Food Sci*, 2020; *9*: 1114-1118. DOI: 10.15414/jmbfs.2020.9.6.1114-1118
76. Bekkar, N.E., Meddah, B., Cakmak, Y.S., Keskin, B., Sonnet, P., Phenolic Extracts of *Zizyphus lotus* L. (Rhamnaceae) and *Ruta chalepensis* L. (Rutaceae) as Alternatives to Antibiotics and their Antimicrobial Effects on Clinical Multidrug-Resistant Pathogens. *Eur. J. Biol*, 2022; *81*: 163-183. DOI: 10.26650/EurJBiol.2022.1129558
77. Naili, M.B., Alghazeer, R.O., Saleh, N.A., Al-Najjar, A.Y., Evaluation of antibacterial and antioxidant activities of *Artemisia campestris* (Astraceae) and *Ziziphus lotus* (Rhamnacea). *Arab. J. Chem*, 2010; *3*: 79-84. DOI: 10.1016/j.arabjc.2010.02.002
78. Elaloui, M., Ennajah, A., Ghazghazi, H., Youssef, I.B., Othman, N.B., Hajlaoui, M.R., Khouja, A., Laamouri, A., Quantification of total phenols, flavonoides and tannins from *Ziziphus jujuba* (mill.) and *Ziziphus lotus* (l.) (Desf). Leaf extracts and their effects on antioxidant and antibacterial activities. *Int. J. Sec. Metabolite*, 2017; *4*: 18-26. DOI: 10.21448/ijsm.275886
79. Rais, C., Benidir, M., Slimani, C., EL-Ouazna, B., Ettadili, H., ElHanafi, L., EL Ghadraoui, L., Benjelloun, M., Antimicrobial and radical scavenging activities of Moroccan *Ziziphus lotus* L. seeds. *J. Phytopharmacol*, 2019; *8*: 155-160. DOI: 10.31254/phyto.2019.8402
80. Rais, C., Driouch, A., Slimani, C., Bessi, A., Balouiri, M., El Ghadraoui, L., Lazraq, A., Al Figuigui, J., Antimicrobial and antioxidant activity of pulp extracts from three populations of *Ziziphus lotus* L. *Nutr. Food Sci*, 2019; *49*: 1014-1028. DOI: 10.1108/NFS-08-2018-0232
81. Hammi, K.M., Essid, R., Khadraoui, N., Ksouri, R., Majdoub, H., Tabbene, O., Antimicrobial, antioxidant and antileishmanial activities of *Ziziphus lotus* leaves. *Arch. Microbiol*, 2022; *204*: 119. DOI: 10.1007/s00203-021-02733-5
82. Yahia, Y., Benabderrahim, M.A., Tlili, N., Bagues, M., Nagaz, K., Bioactive compounds, antioxidant and antimicrobial activities of extracts from different plant parts of two *Ziziphus* Mill. species. PLoS ONE, 2020; *15:* 0232599. DOI: 10.1371/journal.pone.0232599

83. Ghazghazi, H., Aouadhi, C., Riahi, L., Maaroufi, A., Hasnaoui, B., Fatty acids composition of Tunisian *Ziziphus lotus* L. (Desf.) fruits and variation in biological activities between leaf and fruit extracts, *Nat. Prod. Res*, 2014; *28*: 1106-1110, DOI: 10.1080/14786419.2014.913244
84. Ait Bouzid, H., Sakar, E.H., Bijla, L., Ibourki, M., Zeroual, A., Gagour, J., Koubachi, J., Majourhat, K., Gharby, S., Physical fruit traits, proximate composition, antioxidant activity, and profiling of fatty acids and minerals of wild Jujube (*Ziziphus lotus* L.(Desf.)) fruits from eleven Moroccan origins. *J. Food Qual*, 2022; 9362366. DOI: 10.1155/2022/9362366
85. Ait Bouzid, H., Bijla, L., Ibourki, M., Oubannin, S., Elgadi, S., Koubachi, J., Sakar, E.H., Gharby, S., *Ziziphus lotus* (L.) Lam. almonds nutritional potential: Evidence from proximate composition, mineral, antioxidant activity, and lipid profiling reveals a great potential for valorization. *Biomass Conv. Bioref*, 2023; 1-15. DOI: 10.1007/s13399-023-03984-6
86. Dhibi, M., Amri, Z., Mnari Bhouri, A., Hammami, S., Hammami, M., Comparative study of the phenolic profile and antioxidant activities of Moringa (*Moringa oleifera Lam* .) and Jujube (*Ziziphus Lotus Linn* .) leaf extracts and their protective effects in frying stability of corn oil. *Meas. Food*, 2022; *7:* 100045. DOI: 10.1016/j.meafoo.2022.100045
87. Letaief, T., Garzoli, S., Laghezza, Masci, V., Mejri, J., Abderrabba, M., Tiezzi, A., Ovidi, E., Chemical Composition and Biological Activities of Tunisian Ziziphus lotus Extracts: Evaluation of Drying Effect, Solvent Extraction, and Extracted. Plant Parts. Plants, 2021; *10*: 2651. DOI: 10.3390/plants10122651
88. Najjaa, H., Ben Arfa, A., Elfalleh, W., Zouari, N., Neffati, M., Jujube (*Zizyphus lotus* L.): Benefits and its effects on functional and sensory properties of sponge cake. PLoS ONE, 2020; *15:* e0227996. DOI: 10.1371/journal.pone.0227996
89. Golpasandhagh, L., Salehi, P., Karimi, B., Moghimipour, E., Therapeutic effect of *Ziziphus lotus* honey on hard palate ulcers in rats. *Med. Stud*, 2021; *37:* 58-64. DOI: 10.5114/ms.2021.105002
90. Chakit, M., Boussekkour, R., El Hessni, A., Bahbiti, Y., Nakache, R., El Mustaphi, H., Mesfioui, A., Antiurolithiatic Activity of Aqueous Extract of *Ziziphus lotus* on Ethylene Glycol-Induced Lithiasis in Rats. *Pharmacogn. J*, 2022; *14*: 596-602. DOI: 10.5530/pj.2022.14.141

91. Bensatal, A., *In-vitro* inhibition and dissolution of calcium oxalate stones by the fractions of the *Ziziphus lotus* L. leaves. *Int. J. Pharm. Sci. Res*, 2024; *15*: 844-53. DOI: 10.13040/IJPSR.0975-8232.15(3).844-53
92. Abu-Zarga, M., Sabri, S., Al-Aboudi, A., Ajaz, M.S., Sultana, N., Atta-Ur-Rahman., New cyclopeptide alkaloids from *Ziziphus lotus*. *J. Nat. Prod*, 1995; *58*: 504-511. DOI: 10.1021/np50118a004. PMID: 7623028
93. Maciuk, A., Lavaud, C., Thepenier, P., Jacquier, M-J., Ghedira, K., Zeches-Hanrot, M., Four New Dammarane Saponins from *Zizyphus lotus*. *J. Nat. Prod*, 2004; *67:* 1639-1643. DOI: 10.1021/np0499362
94. El Cadi, H., EL Bouzidi, H., Ginane, S., El Cadi, A., Ramdan, B., El Majdoub, Y.O., Alibrando, F., Dugo, P., Mondello, L., Lanjri, A.F., Brigui, J., Cacciola, F., Physico-Chemical and Phytochemical Characterization of Moroccan Wild Jujube "*Zizyphus lotus (L.)*" Fruit Crude Extract and Fractions. *Molecules*, 2020; *25*: 5237. DOI: 10.3390/molecules25225237
95. Letaief, T., Garzoli, S., Ovidi, E., Tiezzi, A., Jeribi, C., Abderrabba, M., Mejri, J., Organ Dependency Variation of the Chemical Composition of *Ziziphus Lotus* Volatile Fractions. *Eur. J. Biol. Res*, 2021; *11*: 501-508. DOI: 10.5281/zenodo.5552960
96. El Yakoubi, N., Nejjar El Ansari, Z., Ennami, M., El Kbiach, M.L., Bounab, L., El Bouzdoudi, B., Biosorption of Hexavalent Chromium onto *Ziziphus lotus* Fruits Powder: Kinetics, Equilibrium, and Thermodynamics. *J. Ecol. Eng*, 2024; *25*: 321-332. DOI: 10.12911/22998993/176571
97. Lahmady, S., Anor, O., Forsal, I., Mernari, B.,Hanin, H., Benbouya, K., Talfana, A., Investigation of *Ziziphus Lotus* Leaves Extract Corrosion Inhibitory Impact on Carbon Stee in a Molar Hydrochloric Acid Solution. *Port. Electrochim. Acta*, 2023; *41*: 135-149. DOI: 10.4152/pea.2023410203
98. Msaada, A., Belbahloul, M., El Hajjaji, S., Beakou, B.H., Houssaini, M.A., Belhajjia, C., Aassila, H., Zouhri, A., Anouar, A., Industrial wastewater decolorization by activated carbon from *Ziziphus lotus*. *Desalin. Water Treat*, 2018; *126:* 296-305. DOI: 10.2166/wst.2018.481
99. Saad, S., Dávila, I., Morales, A., Labidi, J., Moussaoui, Y., Cross-Linked Carboxymethylcellulose Adsorbtion Membranes from Ziziphus lotus for the Removal of Organic Dye Pollutants. *Materials*, 2022; 15: 8760. DOI: 10.3390/ma15248760

100. Zerrouk, S., Seijo, M.C., Olga Escuredo, O., Rodríguez-Flores, M.S., Characterization of *Ziziphus lotus* (jujube) honey produced in Algeria. J. *Apic. Res*, 2018; *57:* 166-174. DOI: 10.1080/00218839.2017.1399663
101. Mekious, S., Masseaux, C., Loucif-Ayad, W., Vercelli, M., Pollen quality and sensory attributes of Algerian jujube (*Ziziphus lotus* (L.) Lam.) honeys. *Acta Agric. Slov*, 2022; *118:* 1-7. DOI: 10.14720/aas.2022.118.3.2690
102. Bendiar, S., El-Faqer, O., Benjelloun, N., Hsseini, S., Bellaoui, H., Rais, S., Zaid, Y., Mtairag, E., Mounia Oudghiri, M., Immunomosuppressive Effect *of Ziziphus Lotus* L. (Desf.) Fruit's Extract on Neutrophil Bactericidal Activity and on in Vivo Humoral Immune Response in Mice. *Biomed. Pharmacol. J*, 2022; *15*: 2331-2341. DOI: 10.13005/bpj/2572
103. El Yakoubi, N., Ennami, M., El Ansari1, Z.N., Ait Lhaj, F., Bounab, L., El Kbiach, M.L., El Bouzdoudi, B., Utilization of *Ziziphus lotus* Fruit as a Potential Biosorbent for Lead(II) and Cadmium(II) Ion Removal from Aqueous Solution. *Ecol. Eng. Environ. Technol*, 2023; *24*: 135-146. DOI: 10.12912/27197050/159631
104. Rauf, A., Ali, J., Khan, H., Mubarak, M.S., Patel, S., Emerging CAM *Ziziphus nummularia* with in vivo sedative-hypnotic, antipyretic and analgesic attributes. *3 Biotech*, 2016; *6*: 11. DOI: 10.1007/s13205-015-0322-5
105. Carg, V., Malhotra, H., Singh, G., Ethanol extract of Ziziphus nummularia ameliorates formaldehyde induced arthritis in rats by regulating oxidative stress biomarkers and hematological profile. *Research Square*, 2023. DOI: 10.21203/rs.3.rs-3009388/v1
106. Mesmar, J., Fardoun, M.M., Abdallah, R., Al Dhaheri, Y., Yassine, H.M., Iratni, R., Badran, A., Eid, A.H., Baydoun, E. *Ziziphus nummularia* Attenuates the Malignant Phenotype of Human Pancreatic Cancer Cells: Role of ROS. *Molecules*, 2021; *26*: 4295. DOI: 10.3390/molecules26144295
107. Abdallah, R., Shaito, A.A., Badran, A., Baydoun, S., Sobeh, M., Ouchari, W., Sahri, N., Eid, A.H., Mesmar, J.E., Baydoun, E., Fractionation and phytochemical composition of an ethanolic extract of Ziziphus nummularia leaves: antioxidant and anticancerous properties in human triple negative breast cancer cells. *Front. Pharmacol*, 2024; *15*: 1331843. DOI: 10.3389/fphar.2024.1331843
108. Bagdi, P., Rathore, V., *In vitro* Anti-diabetic activity of Hydro-alcoholic Extracts of Leaves and Fruits of *Ziziphus nummularia* (Burm. F. Wight & Arn). *Pharm. Chem. J*, 2017; *4*: 88-93. [Journal Website]

109. Yusufoglu, H.S., Topical anti-inflammatory and wound healing activities of herbal gel of *Ziziphus nummularia* L.(F. Rhamnaceae) leaf extract. *Int. J. Pharmacol*, 2011; *7*: 862-867. DOI: 10.3923/ijp.2011.862.867
110. Ray, S.D., Ray, S., Zia-Ul-Haq, M., De Feo, V., Dewanjee, S., Pharmacological basis of the use of the root bark of *Zizyphus nummularia* Aubrev. (Rhamnaceae) as anti-inflammatory agent. *BMC Complement. Alternat. Med*, 2015; 15: 416. DOI: 10.1186/s12906-015-0942-7
111. Fardoun, M., Al-Shehabi, T., El-Yazbi, A., Issa, K., Zouein,, F., Maaliki, D., Iratni, R., Eid, A.H., *Ziziphus nummularia* Inhibits Inflammation-Induced Atherogenic Phenotype of Human Aortic Smooth Muscle Cells. *Oxid. Med. Cell. Longev*, 2017; 4134093. DOI: 10.1155/2017/4134093
112. Malhotra, H., Garg, V., Singh, G., *In-vitro* antioxidant and anti-inflammatory evaluation of successive extracts of *Ziziphus nummularia*. *Int. J. Pharm. Sci. Res*, 2023; *14*: 5354-5366. DOI: 10.13040/IJPSR.0975-8232.14(11).5354-66
113. Dey Ray, S., Dutta, S., Sengupta, P., Madhu, N. R., Das, N., Ray, S., Kolesarova, A., Roychoudhury, S. Elucidation of Anti-inflammatory Activity of a New Cyclic Alkaloid Compound from Root Bark of *Ziziphus nummularia* (Aubrev.): *In vitro*, *In silico* and *In vivo* studies. *J. Microbiol. Biotechnol. Food Sci*, 2024, *In Press*. DOI: 10.55251/jmbfs.10564
114. Azhar, M.F., Zubair, M., Evaluation of medicinal properties, phytochemical and nutritive attributes of different parts of wild *Ziziphus nummularia* (Burm. F.) from cholistan desert. *Int. J. Multidis. Res. Dev*, 2020; *7*: 71-74. [ResearchGate]
115. Bose, B., Kathirvel, V.V., Thirumaran, S., Ayyanar, T., Preliminary phytochemical screening and study of in vitro antibacterial activity on H37RV strain using roots of *Ziziphus nummularia*. *Res. J. Pharmacogn. Phytochem*, 2023; *15:* 198-202. DOI: 10.52711/0975-4385.2023.00030
116. Khalili, A., Barzegar, H., Behbahani, B.A., Noshad, M., In vitro evaluation of antioxidant and antimicrobial activity of *Ziziphus nummularia* leaf extract. *Iran. J. Infect. Dis*, 2022; *27*: 1-9. [Google Scholar]
117. Ahmadi, G., Khalifeh, T., Mobaraki, N., Mohebbi, G., Barmak, A.R., Evaluation of Some Phytochemical, Nutraceutical, and Antimicrobial Properties of *Ziziphus Nummularia* Fruit Extract. *Iran. South Med. J*, 2022; *25:* 130-155. [ResearchGate]
118. Dokhani, N., Nazer, M., Shokri, S., Darvishi, M., Determination and Evaluating the Antioxidant Properties of *Ziziphus nummularia* (Burm.f.) Wight & Arn., *Crataegus*

pontica K.Koch and *Scrophularia striata* Boiss. *Egypt. J. Vet. Sci*, 2022; *53:* 423-429. DOI: 10.21608/EJVS.2022.142449.1346

119. Gupta, D., Mann, S., Jain, I., Gupta, R.K., Phytochemical, Nutritional and Antioxidant Activity Evaluation Of Fruits Of *Ziziphus nummularia* Burm. F. *Int. J. Pharm. BioSci*, 2011; *2:* 629-638. [ResearchGate]
120. Thomas, S., Shrikumar, S., Velmurugan, C., Anitha, K.N., Ashok Kumar, B.S., Anti-Ulcer Activity of Fruit of *Zizyphus Nummularia* In Pyloric Ligation Method In Rats. *Int. J. Pharm. Chem. Sci*, 2016; *5*: 41-47. [Journal Website]
121. Tejaswi, A., Surapaneni, S., Manjunatha, P.M., Preventive effect of *Ziziphus nummularia* Burm on Cardiac Markers in Normal and Isoproterenol induced Myocardial Necrosis in Rats. *Res. Rev. Pharm. Pharm. Sci*, 2021; *10*: 19-29. [Journal Website]
122. Pandey, V.B., Singh, J.P., Seth, K.K., Shah, A.H., Eckhardt, G., Cyclopeptide alkaloids from *Zizyphus nummularia*. *Phytochemistry*. 1984, *23*, 2118-2120. DOI: 10.1016/S0031-9422(00)85003-7
123. Dwivedi, S.P., Pandey, V.B., Shah, A.H., Eckhardt, G., 1987. Cyclopeptide alkaloids from *Zizyphus nummularia*. *J. Nat. Prod*, 1987; *50*: 235-237. DOI: 10.1021/np50050a021
124. Singh, B., Pandey, V.B., An N-formyl cyclopeptide alkaloid from *Zizyphus nummularia* bark. *Phytochemistry*, 1995; *38*: 271-273. DOI: 10.1016/0031-9422(94)00548-8
125. Bagdi, P., Rathore, V., Phytochemical Investigation of Extracts of *Ziziphus nummularia* (Burm. F. Wight & Arn) Leaves and Fruits. *Pharm. Chem. J*, 2016; *3*: 220-226. [Google Scholar]
126. Prajapati, S., Singh, S., Singh, S.K., Phytoconstituents of *Ziziphus nummularia* (Burm. f.) Wight & Arn. Leaves Extracts Using GC-MS Spectroscopy. *Res. Rev. J. Life Sci*, 2019; *9:* 109-118. DOI: 10.37591.rrjols.v9i1.1331
127. Khan, M.N., Ul Haq, F., Rahman, S., Ali, A., Musharraf, S.G., Metabolite distribution and correlation studies of *Ziziphus jujuba* and *Ziziphus nummularia* using LC-ESI-MS/MS. *J. Pharm. Biomed. Anal*, 2020; *178*: 112918. DOI: 10.1016/j.jpba.2019.112918
128. Shokrollahi, A., Alizadeh, A., Malekhosseini, Z., Ranjbar, M., Removal of Bromocresol Green from Aqueous Solution via Adsorption on *Ziziphus nummularia* as a New, Natural, and Low-Cost Adsorbent: Kinetic and Thermodynamic Study of Removal Process. *J. Chem. Eng. Data*, 2011; *56*: 3738–3746. DOI: 10.1021/je200311y

129. Mohebbi, P., Parvini, M., Mousavi, H.Z., Removal of Erythrosine Dyes from Aquatic Environment Using *Ziziphus nummularia* Kernel. *Iran. J. Energy Environ*, 2014; *5*: 400-406. DOI: 10.5829/idosi.ijee.2014.05.04.08
130. Yahyaei, N., Mousavi, J., Parvini, M., Mohebbi, P., Comparison and analysis of two natural adsorbents of Sorghum and *Ziziphus nummularia* pyrene for the removal of erythrosine dye from aquatic environments. *Adv. Environ. Technol*, 2016; *2*: 71-76. DOI: 10.22104/aet.2016.381
131. Mali, P.C., Bedekar, A.R., Patnayak, B.C., Comparative growth and nutrient utilization in lambs and kids fed with Pala (*Ziziphus nummularia* leaves). *Ann. Arid Zone*, 1984; *23*: 243-248. [Google Scholar]
132. Aderao, G.N., Sahoo, A., Bhatt, R.S., Kumawat, P.K., Soni, L., In vitro rumen fermentation kinetics, metabolite production, methane and substrate degradability of polyphenol rich plant leaves and their component complete feed blocks. *J. Anim. Sci. Technol*, 2018; *60*: 26. DOI: 10.1186/s40781-018-0184-6
133. Hussain, S.M., Khan, A., Khan, A., Qazi, N.G., Ali, F., Pharmacological basis for medicinal use of *Ziziphus nummularia* (Rhamnaceae) leaves in gastrointestinal disorders. *Trop. J. Pharm. Res*, 2017; *16*, 2379-2385. DOI: 10.4314/tjpr.v16i10.10
134. Beg, M.A., Teotia, U.V., Farooq, S., Heavy metal analysis in *Ziziphus nummularia* leaf stem and fruit parts. *Int. J. Sci. Eng. Res*. 2017, *8*, 347-353. [Journal Website]
135. Tuenter, E., Foubert, K., Staerk, D., Apers, S., Pieters, L., Isolation and structure elucidation of cyclopeptide alkaloids from *Ziziphus nummularia* and *Ziziphus spina-christi* by HPLC-DAD-MS and HPLC-PDA-(HRMS)-SPE-NMR. *Phytochemistry*, 2017; *138:* 163-169. DOI: 10.1016/j.phytochem.2017.02.029
136. Bahmani, M., Jalilian, A., Salimikia, I., Shahsavari, S., Abbasi, N., Phytochemical screening of two Ilam native plants *Ziziphus nummularia* (Burm.f.) Wight & Arn. and *Ziziphus spina-christi* (Mill.) Georgi using HS-SPME and GC-MS spectroscopy. *Plant Sci. Today*, 2020; *7:* 275-280. DOI: 10.14719/pst.2020.7.2.714
137. Shakiba, R., Nilforoushzadeh, M.A., Hashem-Dabaghian, F., Minaii Zangii, B., Ghobadi, A., Shirbeigi, L., Aliasl, J., Shakiba, M., Ghods, R., Effect of Cedar (*Ziziphus spina-christi*) topical solution in mild to moderate acne vulgaris: a randomized clinical study. *J. Dermatol. Treat*, 2019; *32:* 197-202. DOI: 10.1080/09546634.2019.1692125
138. Darusman, F., Fakih, T.M., Comprehensive *In Silico* Analysis of Christinin Molecular Behaviour from *Ziziphus spina-christi* Leaves on *Propionibacterium acnes*. *Pharm. Sci. Res*, 2021; *8*: 55-64. DOI: 10.7454/PSR.V8I1.1112

139. Elaloui, M., Soltani, I., Laamouri, A., Ennajah, A., Houcine, S., Allelopathic activity of extracts from leaves of *Ziziphus spina-christi* collected in five Tunisian ecotypes. *Int. J. Innov. Sci. Res*, 2016; *20:* 333-342. [ResearchGate]
140. Elaloui, M., Ghazghazi, H., Ennajah, A., Manaa, S., Guezmir, W., Karray, N.B., Laamouri, A., Phenolic profile, antioxidant capacity of five *Ziziphus spina-christi* (L.) Willd provenances and their allelopathic effects on *Trigonella foenum-graecum* L. and *Lens culinaris* L. seeds. Nat. *Prod. Res*, 2017; *31:* 1209-1213. DOI: 10.1080/14786419.2016.1226830
141. Adzu, B., Haruna, A.K., Studies on the use of *Zizyphus spina-christi* against pain in rats and mice. *Afr. J. Biotechnol*, 2007; *6*: 1317-1324. [ResearchGate]
142. Farmani, F., Moein, M., Amanzadeh, A., Mostafapour Kandelous, H., Ehsanpour, Z., Salimi, M., Antiproliferative Evaluation and Apoptosis Induction in MCF- 7 Cells by *Ziziphus spina christi* Leaf Extracts. *Asian Pac. J. Cancer Pre*, 2016; *17:* 315-321. DOI: 10.7314/APJCP.2016.17.1.315
143. Abu-Raghif, A.R., Jasim, G.A., Hanoon, M.M., Antiproliferative activity of *Zizyphus spina christi* leaves methanol extract against rhabdomyosarcoma (RD) cell line. *Int. J. Pharm. Pharm. Sci*, 2017; *9*(2): 279-282. DOI: 10.22159/ijpps.2017v9i2.15013
144. Elmaidomy, A.H., El Zawily, A., Salem, A.K., Altemani, F.H. Algehainy, N.A., Altemani, A.H., Rateb, M.E., Abdelmohsen, U.R., Shady, N.H., New cytotoxic dammarane type saponins from *Ziziphus spina-christi*. *Sci. Rep*, 2023; *13:* 20612. DOI: 10.1038/s41598-023-46841-2
145. Salah El-Din, M., Taha, A.M., Sayed, A.A., Salem, A.M., *Ziziphus spina-christi* leaves methanolic extract alleviates diethylnitrosamine-induced hepatocellular carcinoma in rats. *Biochem. Cell Biol*, 2019; *97*: 437-445. DOI: 10.1139/bcb-2018-0318
146. Alzomor, A.K., Al-Madhagi, W.M., Sallam, N.M., Mojamel, H., Alawar, M.M., Al-Hetari, A.G., Subacute Toxicity Study and Clinical Trials for *Ziziphus spina-christi* Leaves Extract as an Anti-dandruff Shampoo. *Thai J. Pharm. Sci*, 2021; *45*: 126-136. [ResearchGate]
147. Khaleel, A.M., Almuhur, R.A., Al-Deeb, T.M., Jaran, A.S., Al-Jamal, A.A., Antidiabetic and hypolipidemic effects of ethanolic leaf extract of *Ziziphus spina-christi* on normal and streptozotocin-induced diabetic rats. *Eurasia. J. Biosci*, 2020; *14:* 5865-5870. [ResearchGate]

148. Nuru, K.A., Garkuwa, U.A., Yusuf, H., Tijjani, H., Kura, A.U., Hypoglycaemic Potential of *Ziziphus Spina-Christi* Fruit on Alloxan Induced Hyperglycaemic Rats. *J. Bioeq. Stud*, 2022; *8*: 102. [Journal Website]
149. Mohammed, A., Abdulrasak, M.A., Ladidi Musa, A., Liman, J.H., Israel, E., Harry, U., Ozisalami, I., Usman, D., Dickson, O., Anti-hyperglycaemic and selected organ protective effects of *Ziziphus spina-christi* hydroethanol leaf extract in alloxan induced diabetic rats. *Gadau J. Pure Allied Sci*, 2023; *2:* 146-155. DOI: 10.54117/gjpas.v2i2.102
150. Al-Ameri1, D.A., Al-Hegami, M.A., Al-Shaibani, E.A. The effect of *Zizyphus spina-christi* extracts on hyperglycemia induced by hyperlipidemic diet in Albino rats. *Sana'a Univ. J. Appl. Sci. Technol*, 2024; *2*: 1-6. DOI: 10.59628/jast.v2i1.649
151. Al-Ghamdi, A.A., Shahat, A.A., Antioxidant, hypoglycemic and anti-diabetic activities of *Ziziphus spina-christi* (L) Willd (Rhamnacae) leaf extract. *Trop. J. Pharm. Res*, 2017; *16*: 2601-2626. DOI: 10.4314/tjpr.v16i11.5
152. Al-Ghamdi, A.A., El-Zohri, M., Shahat, A.A., Hepatoprotective, nephroprotective, anti-amylase, and anti-glucosidase effects of *Ziziphus spina-christi* (L.) against carbon tetrachloride-induced toxicity in rats. *Trop. J. Pharm. Res*, 2019; *18:* 781-790. DOI: 10.4314/tjpr.v18i4.1
153. Al-Humaidhi, A.M., Abd, A.H., Ghazi, H.F., Hydro-alcoholic Extract of *Ziziphus spina christi* Attenuates Pentylenetetrazole-induced Kindling in Male Mice. *Sys. Rev. Pharm*, 2021; *12*: 314-317. [ResearchGate]
154. Alhakmani, F., Khan, S.A., Aftab, A., Determination of total phenol, in-vitro antioxidant and anti-inflammatory activity of seeds and fruits of *Zizyphus spina-christi* grown in Oman. *Asian Pac. J. Trop. Biomed*, 2014; *4:* S656-S660. DOI: 10.12980/APJTB.4.2014APJTB-2014-0273
155. Almeer, R.S., Albasher, G., Alotibi, F., Alarifi, S., Ali, D., Alkahtani, S., *Ziziphus spina-christi* Leaf Extract Suppressed Mercury Chloride-Induced Nephrotoxicity via Nrf2-Antioxidant Pathway Activation and Inhibition of Inflammatory and Apoptotic Signaling. *Oxid. Med. Cell. Longev*, 2019; 5634685. DOI: 10.1155/2019/5634685
156. Ali-Shtayeh, M.S., Yaghmour, R.M., Faidi, Y.R., Salem, K., Al-Nuri, M.A., Antimicrobial activity of 20 plants used in folkloric medicine in the Palestinian area. *J. Ethnopharmacol*, 1998; *60*: 265-271. DOI: 10.1016/s0378-8741(97)00153-0

157. Motamedi, H., Safary, A., Maleki, S., Seyyednejad, S.M., *Ziziphus spina-christi*, a native plant from Khuzestan, Iran, as a potential source for discovery new antimicrobial agents. *Asian J. Plant Sci*, 2009; *8:* 187-190. DOI: 10.3923/ajps.2009.187.190
158. El-Kamali, H.H., Mahjoub, S.A.T, 2009. Antibacterial activity of Francoeuria crispa, Pulicaria undulata, *Ziziphus spina-christi* and Cucurbita pepo against seven standard pathogenic bacteria. *Ethnobot. Leaflets*, 2009; 6. [ResearchGate]
159. Ali, A.B., Almagboul, A.Z., Mohammed, O.M., Antimicrobial activity of fruits, leaves, seeds and stems extracts of *Ziziphus spina-christi*. *Arabian J. Med. Aromat. Plants*, 2015; *1*: 94-107. [Google Scholar]
160. Bukar, A.M., Kyari, M.Z., Gwaski, P.A., Gudusu, M., Kuburi, F.S., Abadam, Y.I., Evaluation of phytochemical and potential antibacterial activity of *Ziziphus spina-christi* L. against some medically important pathogenic bacteria obtained from University of Maiduguri Teaching Hospital, Maiduguri, Borno State - Nigeria. *J. Pharmacog. Phytochem*, 2015; *3:* 98-101. [ResearchGate]
161. Abdallah, E.M., Antibacterial Activity of Fruit Methanol Extract of *Ziziphus spina-christi* from Sudan. *Int. J. Curr. Microbiol. Appl. Sci*, 2017; *6:* 38-44. DOI: 10.20546/ijcmas.2017.605.005
162. Temerk, H.A., Salem, W.M., Sayed, W.F., Hassan, F.S., Antibacterial Effect of Phytochemical Extracts from *Ziziphus-spina christi* against Some Pathogenic Bacteria. *Egypt. J. Bot*, 2017; *57*: 595-604. DOI: 10.21608/ejbo.2017.665.1035
163. Salih, R.R., Gibreel, H.H., Ahmed, D.M., Hammad, Z.M., Ahmed, A.I., Antimicrobial Effect of Aqueous and Ethanolic Leaves Extracts of *Ziziphus* Species against Animal Bacterial Pathogens. *Curr. Trends Forest Res*, 2019; *3*: 1036. DOI: 10.29011/2638-0013.101036
164. Alhassan, K.A., Indabawa, A.S., Shah, M.M., Phytochemical analysis, proximate composition and antibacterial activities of *Ziziphus* species (*Z. jujube* and *Z. spina-christi*). *J. Appl. Adv. Res*. 2019, *4*, 42-46. DOI: 10.21839/jaar.2019.v4i1.262
165. Makhawi, A.M., Mustafa, M.I., Uagoub, H.A., Phytochemical screening and antimicrobial activity of *Ziziphus spina-christi* stem barks. *bioRxiv*, 2020; 2020-02. DOI: 10.1101/2020.02.24.963157
166. Jebur, M.H., Kadhim Hindi, N.K., Hamza, H.J., Alkaim, A.F., The Activity of Aquatic Extract of *Ziziphus Spina-christi* against Bacteria, an in Vitro Study. *Int. J. Psychosoc. Rehab*, 2020; *24:* 1821-1827. DOI: 10.37200/I JPR/V24I5/PR201854

167. Al-Kaabi, H.K., Hmood, B.A., Jebur, L.S., Abdullah, S.M., AL-Qraghi, S.A., Determination of *Ziziphus spina-christi* leaves extracts antibacterial activity against some pathogenic bacteria. *Al-Kufa Univ. J. Biol*, 2021; *13*(1): 14-20. [Google Scholar]
168. Sarjito, S., Purnamayati, L., Riyadi, P.H., Desrina, D., Prayitno, S.B., Phytochemical Analysis and Antibacterial Activities of Sidr Leaf Extract (*Ziziphus spina-christi*) against Pathogenic Bacteria in Aquaculture. *Pertanika J. Trop. Agric. Sci*, 2021; *44*: 845-864. DOI: 10.47836/pjtas.44.4.08
169. Salih, R.R.., Gibreel, H.H., Daldoum, M.A., Hammad, Z.M., Ahmed, A.I., Antimicrobial Activity of Aqueous and Ethanolic Extraction of *Ziziphus spina-christi* (L.) Desf. Var. *Microphylla* Leaves Against Different Pathogens. *J. Bacteriol. Mycol*, 2021; 8: 1160. [Journal Website]
170. Obaid, Z.M., Ahmed, M.A., Anti-Bacterial Effects of *Commiphora Myrrha* and *Ziziphus Spina-Christ* Leaves Extracts Against *Streptococcus Mitis* (Primary Colonizer of Dental Plaque) *In vitro* Study. *J. Res. Med. Dent. Sci*, 2020; *8*: 57-64. [Journal Website]
171. Obaid, Z.M., Ahmed, M.A., Anti-Bacterial Effects of *Ziziphus Spina-Christi* and *Commiphora Myrrha* Leaves Extracts against *Streptococcus Oralis* (*In vitro Study*). *Teikyo Med. J*, 2022; *45*: 7041-7052. [Journal Website]
172. Neamah, B.A., Alquraishy, M.K., Almousawi, A.H., Chessab, R.M., Shaker, Z.B., Abed, H.A., Antibiofilm impact of *Ziziphus spina christi* on methicillin resistance of *Staphylococcus warneri*. *Int. J. Health Sci*, 2022; *6:* 5492–5499. DOI: 10.53730/ijhs.v6nS1.5651
173. Alamsjah, F., Agustien, A., Cantika, F., Antibacterial Test of *Ziziphus spina-christi* (L.) Desf. Leaves Extract Against gram-Positive Bacteria. *EKSAKTA*, 2023; *24:* 285-294. [Google Scholar]
174. Rante, H., Pabisa, M., Taebe, B., Antibacterial Activity of Ethanol Extract of Arabian Bidara Leaves *(Ziziphus spina-christi L)* and Bioautography TLC Analysis Against Pathogenic Bacteria. *J. Bionat*, 2023; *24:* 231-236. [Google Scholar]
175. Hamadnalla, H.M., Ali, M.A., Ahmed, A.A., Almakki, A.A., Anti-Microbial and Anti-Oxidant Activities of *Ziziphus Spina Christi*, Sudanese Medicinal Plant. *J. Biotechnol. Bioinform. Res*, 2020; SRC/JBBR-108. DOI: https://doi.org/10.47363/JBBR/2020(2)108
176. Fard, M.P., Ketabchi, S., Farjam, M.H., Chemical Composition, Antimicrobial and Antioxidant Potential of Essential Oil of *Ziziphus spina-christi* var. *aucheri* Grown

Wild in Iran. *J. Med. Plants By-prod*, 2020; *1:* 69-73. DOI: 10.22092/JMPB.2020.121752

177. Al-Azawi, K.F., Hussein, N.N., Majeed, R., Al, M.A., Evaluation the antimicrobial and antioxidant activities of the *Ziziphus spina-christi* plant leaves. In *AIP Conf. Proc*, 2022; *2437:* 020082. DOI: 10.1063/5.0092320
178. El-Hefny, M., Mohamed, A.A., Salem, M.Z., Abd El-Kareem, M.S., Ali, H.M., Chemical composition, antioxidant capacity and antibacterial activity against some potato bacterial pathogens of fruit extracts from *Phytolacca dioica* and *Ziziphus spina-christi* grown in Egypt. *Sci. Hortic*, 2018; *233:* 225-232. DOI: 10.1016/j.scienta.2018.01.046
179. Elaloui, M., Essghaier, B., Ghazghazi, H., Driouich Chaouachi, R., Bahri, S., Hamdi, S., Ben Nasr, R., Ben Jemaa, J., Ammari, Y., Laamouri, A., LC-MS Analysis and Biological Activities of *Ziziphus spina christi* L. (Christ's Thorn, Jujube) Leaves from Tunisia Oasis. *J. Explor. Res. Pharmacol*, 2022; *7:* 215-222. DOI: 10.14218/JERP.2022.00001
180. Bilel, H., Abdelzaher, H.M., Moustafa, S.M., Biochemical profile, antioxidant effect and antifungal activity of Saudi *Ziziphus spina-christi* L. for vaginal lotion formulation. *Plant Sci. Today*, 2023; *10:* 22–29. DOI: 10.14719/pst.1659
181. Taghipour, M.T., Nameni, R., Taghipour, M., Ghorat, F., Phytochemical Analysis and Antimicrobial Activity of *Ziziphus spina-christi* and *Tamarix aphylla* Leaves' Extracts as Effective Treatment for Coronavirus Disease 2019 (COVID-19). *Thrita*, 2020; *9:* e107776. DOI: 10.5812/thrita.107776
182. Ads, E.N., Hassan, S.I., Rajendrasozhan, S., Hetta, M.H., Aly, S.H., Ali, M.A. Isolation, Structure Elucidation and Antimicrobial Evaluation of Natural Pentacyclic Triterpenoids and Phytochemical Investigation of Different Fractions of *Ziziphus spina-christi* (L.) Stem Bark Using LCHRMS Analysis. *Molecules*, 2022; *27:* 1805. DOI: 10.3390/molecules27061805
183. El-Shahir, A.A., El-Wakil, D.A., Abdel Latef, A.A., Youssef, N.H. Bioactive Compounds and Antifungal Activity of Leaves and Fruits Methanolic Extracts of *Ziziphus spina-christi* L. *Plants*, 2022; *11:* 746. DOI: 10.3390/plants11060746
184. Abdallah, R.M., Hammoda, H.M., El-Gazzar, N.S., Ibrahim, R.S., Sallam, S.M., Exploring the anti-obesity bioactive compounds of *Thymelaea hirsuta* and *Ziziphus spina-christi* through integration of lipase inhibition screening and molecular docking analysis. *RSC Adv*, 2023; *13:* 27167–27173. DOI: 10.1039/d3ra05826c

185. Abalaka, M.E., Mann, A., Adeyemo, S.O., Studies on *in-vitro* antioxidant and free radical scavenging potential and phytochemical screening of leaves of *Ziziphus mauritiana* L. and *Ziziphus spina christi* L. compared with Ascorbic acid. *J. Med. Genet. Genom*, 2011; *3:* 28-34. [ResearchGate]
186. Singh, V., Guizani, N., Essa, M.M., Rahman, M.S., Selvaraju, S., *In vitro* antioxidant activities of *Ziziphus spina-christi* fruits (red date) grown in Oman. *Biotechnology*, 2012; *11*: 209-216. DOI: 10.3923/biotech.2012.209.216
187. Pambudi, D.B., Fajriyah, N.N., Shalekhah, V.R., Test on the Antioxidant Activities of Methanol Extract of Bidara Leaves (*Ziziphus spina-christi* L.) using the DPPH Radical Immersion Method. *Borneo J. Pharm*, 2020; *3:* 44-51. DOI: 10.33084/bjop.v3i1.1242
188. Awad, NY., Fakher Eldeen, R.S., Ameliorative Effects of Rhamnus Fruit (*Ziziphus spina-christi* L.) and Zinc on Sodium Fluoride-Induced Oxidative Stress in Rats. *Home Econ. J*, 2021; *37*: 125-156. [ResearchGate]
189. Zandiehvakili, G., Khadivi, A., Identification of the promising *Ziziphus spina-christi* (L.) Willd. genotypes using pomological and chemical proprieties. *Food Sci. Nutr*, 2021; 9: 5698-5711. DOI: 10.1002/fsn3.2535
190. Almeer, R.S., Mahmoud, S.M., Amin, H.K., Abdel Moneim, A.E., *Ziziphus spina-christi* fruit extract suppresses oxidative stress and p38 MAPK expression in ulcerative colitis in rats via induction of Nrf2 and HO-1 expression. *Food Chem. Toxicol*, 2018; *115*: 49-62. DOI: 10.1016/j.fct.2018.03.002
191. Khaleel, S.M., Jaran, A.S., Haddadin, M.S., Evaluation of total phenolic content and antioxidant activity of three leaf extracts of *Ziziphus spina-christi* (Sedr) grown in Jordan. *Br. J. Med. Med. Res*, 2016; *14*: 1-8. DOI: 10.9734/BJMMR/2016/24935
192. Hassan, A.B., Al Maiman, S.A., Mohammed, M.A., Alshammari, G.M., Alkhudhayri, D.A., Alhuthayli, H.F., Alfawaz, M.A., Osman, M.A. Effect of Natural Fermentation on the Chemical Composition, Mineral Content, Phytochemical Compounds, and Antioxidant Activity of *Ziziphus spina-christi* (L.) "Nabag" Seeds. *Processes*, 2021; *9*: 1228. DOI: 10.3390/pr9071228
193. El-Rigal, N.S., Aly, S.A., Rizk, M., Said, A., Effect of *Ailanthus altissima* and *Ziziphus spina christi* extracts on some hepatic marker enzymes and antioxidants in *Schistosoma mansoni* infected mice. *Pol. J. Food Nutr. Sci*, 2006; *2:* 199-206. [Google Scholar]
194. Aly, S.A., Hamed, M.H., 2006. Effect of *Ailanthus altissima* and *Zizyphus spina christi* on bilharzial infestation in mice: Histological and histopathological studies. *J Applied Sci*, 2006; *6*: 1437-1446. DOI: 10.3923/jas.2006.1437.1446

195. Almeer, R.S., El-Khadragy, M.F., Abdelhabib, S., Abdel Moneim, A.E., *Ziziphus spina-christi* leaf extract ameliorates schistosomiasis liver granuloma, fibrosis, and oxidative stress through downregulation of fibrinogenic signaling in mice. *PLoS ONE*, 2018; *13*: e0204923. DOI: 10.1371/journal.pone.0204923
196. Nazemoroaya, Z., Sarafbidabad, M., Mahdieh, A., Zeini, D., Nystrom, B., Use of Saponinosomes from *Ziziphus spina-christi* as Anticancer Drug Carriers. *ACS Omega*, 2022; *7*: 28421-28433. DOI: 10.1021/acsomega.2c03109
197. Nazif, N.M., Phytoconstituents of *Zizyphus spina-christi* L. fruits and their antimicrobial activity. *Food Chem*, 2002; *76*: 77-81. DOI: 10.1016/S0308-8146(01)00243-6
198. Ibrahim, A.M., Sayed, S.S., Assessment of the molluscicidal activity of the methanolic seed extracts of *Ziziphus spina-christi* and *Carica papaya* on immunological and molecular aspects of *Biomphalaria alexandrina* snails. *Aquacult. Res*, 2021; *52*: 2014-2024. DOI: 10.1111/are.15050
199. El Kutry, M.S., Sopeah, H.R., Impact of Intake a Sidr (*Zizyphus spina-christi* L.) Extract on *Enterobiasis vermicularis* Infection for Children. *Biomed. Pharmacol. J*, 2020; *13*: 359-366. DOI: 10.13005/bpj/1896
200. Fakih, T.M., Ramadhan, D.S., Darusman, F., In Silico Activity Identification of Cyclo Peptide Alkaloids from *Ziziphus spina-christi* Species against SARS-CoV-2 Main Protease. *J. Biodjati*, 2021; *6*: 71-81. DOI: 10.15575/biodjati.v6i1.10603
201. Setorki, M., Effect of hydro-alcoholic extract of *Ziziphus spina-christi* against scopolamine-induced anxiety in rats. *Bangladesh J. Pharmacol*, 2016; *11*: 421-427. DOI: 10.3329/bjp.v11i2.26505
202. Dkhil, M.A., Kassab, R.B., Al-Quraishy, S., Abdel-Daim, M.M., Zrieq, R., Abdel Moneim, A.E., *Ziziphus spina-christi* (L.) leaf extract alleviates myocardial and renal dysfunction associated with sepsis in mice. *Biomed. Pharmacother*, 2018; 102: 64-75. DOI: 10.1016/j.biopha.2018.03.032
203. Ermias, R., Tukue, M., Bahlbi, A., Phytochemical screening of *Ziziphus spina christi* and *Piper nigrum*. *Jamonline*, 2011; *1*: 41-47. [ResearchGate]
204. Bozicevic, A., De Mieri, M., Di Benedetto, A., Gafner, F., Hamburger, M., Dammarane-type saponins from leaves of *Ziziphus spina-christi*. *Phytochemistry*, 2017; *138*: 134-144. DOI: 10.1016/j.phytochem.2017.02.028
205. Garba, M.T., Yesufu, H.B., Salamatu, A., Abdulqadir, B.B., Mohammed, F.B., Milagawanda, H.H., Falmata, A.M., Isolation and Characterization of Betunilic Acid

from the Stem Bark of *Zizyphus Spina-Christi*. *Chem. Res. J*, 2018; *3*: 49-55. [Journal Website]

206. Ads, E.N., Rajendrasozhan, S., Hassan, S.I., Sharawy, S.M., Humaidi, J.R., Phytochemical screening of different organic crude extracts from the stem bark of *Ziziphus spina-christi* (L.). *Biomed. Res*, 2018; *29*: 1645-1652. DOI: 10.4066/biomedicalresearch.29-17-1668
207. Abubakar, Y.S., Proximate and Selected Mineral Elements Analysis of Nigerian *Ziziphus spina-christi* (L.) Willd Edible Fruit Pulp. *Earthline J. Chem. Sci*, 2021; *5*: 231-240. DOI: 10.34198/ejcs.5121.231240
208. Sahiruddin, S., Widjiati, W., Toleng, A.L., Yusuf, M., Masturi, M., Supplementation of Arabian jujube *(Ziziphus spina Christi)* leaf extracts as extender material on the quality of Bali bull semen. *IOP Conf. Ser. Earth Environ. Sci*, 2020; *492*: 012079. DOI: 10.1088/1755-1315/492/1/012079
209. Dashtizadeh, M., Kabirifard, A., Khaj, H., Kamali, A.A., Nutritive value of two species of *Ziziphus* (*Ziziphus spina-christi* and Ziziphus. mauritiana) tree branches in sheep nutrition. *J. Anim. Environ*, 2019; *11*: 69-76. [Google Scholar]
210. Altayp, A.A., Abdel-Rahman, N.A., Utilization of Sudanese *sidr* (*Ziziphus spina-christi* L) for jam manufacture. *IJRDO J. Health Sci. Nurs*, 2016; *1*: 1-14. [ResearchGate]
211. Hafiz, T.A., Mubaraki, M.A., The potential role of *Ziziphus spina-christi* leaf extracts against *Plasmodium berghei*-induced liver and spleen injury. *Biomed. Res*, 2016; *27*: 1027-1032. [ResearchGate]
212. Hafiz, T.A., Mubaraki, M.A., Diab, M.S., Dkhil, M.A., Al-Quraishy, S. Ameliorative role of *Ziziphus spina-christi* leaf extracts against hepatic injury induced by *Plasmodium chabaudi* infected erythrocytes. *Saudi J. Biol. Sci*, 2019; *26*: 490-494. DOI: 10.1016/j.sjbs.2017.10.012
213. Nuru, A., Awad, A.M., Al-Ghamdi, A.A., Alqarni, A.S., Radloff, S.E., Nectar of *Ziziphus spina-christi* (L.) Wild (Rhamnaceae): dynamics of secretion and potential for honey production. *J. Apicult. Sci*, 2012; *56*: 49-59. DOI: 10.2478/v10289-012-0023-9
214. Ekhtelat, M., Ravaji, K., Parvari, M., Effect of Iranian *Ziziphus* honey on growth of some foodborne pathogens. *J. Nat. Sci. Biol. Med*, 2016; *7*: 54-57. DOI: 10.4103/0976-9668.175069
215. Owayss, A.A., Elbanna, K., Iqbal, J., Abulreesh, H.H., Organji, S.R., Raweh, H.S., Alqarni, A.S., In vitro antimicrobial activities of Saudi honeys originating from

Ziziphus spina-christi L. and *Acacia gerrardii* Benth. trees. *Food Sci. Nutr*, 2020; *8*: 390–401. DOI: 10.1002/fsn3.1320

216. Bouali, N., Ahmad, I., Patel, H., Alhejaili, E.B., Hamadou, W.S., Badraoui, R., Hadj Lajimi, R., Alreshidi, M., Siddiqui, A.J., Adnan, M., Abdulhakeem, M.A., Bazaid, A.S., Patel, M., Saeed, M., Snoussi, M., Noumi, E., GC-MS screening of the phytochemical composition of *Ziziphus* honey: ADME properties and *in vitro*/*in silico* study of its antimicrobial activity. *J. Biomol. Struct. Dyn*, 2024; *42:* 1368-1380. DOI: 10.1080/07391102.2023.2205945
217. Elaloui, M., Hamdi, S.H., Ghazghazi, H., Nasr, R.B., Bouslih, E., Ammari, Y., Mediouni, J., Laamouri, A., Characterization of epicathechin contents in the *Ziziphus spina-christi* L. root extracts using LC-MS analyses and their insecticidal potential. *Plant Biosys*, 2020; *155*: 685-690. DOI: 10.1080/11263504.2020.1779837
218. Adzu, B., Amos, S., Dzarma, S., Wambebe, C., Gamaniel, K., Effect of *Zizyphus spina-christi* Willd aqueous extract on the central nervous system in mice. *J. Ethnopharmacol*, 2002; *79*: 13-16. DOI: 10.1016/s0378-8741(01)00348-8
219. Ramadan, S.S., Almeer, R.S., Alkahtani, S., Alarifi, S., Albasher, G., Abdel Moneim, A.E., *Ziziphus spina-christi* leaf extract attenuates mercuric chloride-induced liver injury in male rats via inhibition of oxidative damage. *Environ. Sci. Pollut. Res. Int*, 2021; *28*: 17482-17494. DOI: 10.1007/s11356-020-12160-6
220. Almeer, R.S., Alkahtani, S., Alarifi, S., Abdel Moneim, A.E., Abdi, S., Albasher, G., *Ziziphus spina christi* Leaf Extract Mitigates Mercuric Chloride-induced Cortical Damage in Rats. *Comb. Chem. High Throughput Screen*, 2022; *25*: 103-113. DOI: 10.2174/1386207323666201204124412
221. Assirey, E.A., Sirry, S.M., Burkani, H.A., Ibrahim, M., Biosorption of Zinc(II) and Cadmium(II) Using Ziziphus Spina Stones. *J. Comput. Theor. Nanosci*, 2018; *15*: 3102-3108. DOI:10.1166/jctn.2018.7676
222. Assirey, E.A., Sirry, S.M., Burkani, H.A., Ibrahim, M.A., Modified *Ziziphus spina*‑*christi* stones as green route for the removal of heavy metals. *Sci. Rep*, 2020; *10*: 20557. DOI: 10.1038/s41598-020-76810-y
223. Alotaibi, M.O., Mohammed, A.E., Almutairi, T., Shinwari, Z., Alaiya, A., Elobeid, M.M., Physio-Morphology and Proteomic Attitude of *Ziziphus Spina-Christi* in Copper-Contaminated Sites in Saudi Arabia: Is It a Candidate Bioremediator?. *Curr. Proteomics*, 2021; *18*: 279-292. DOI: 10.2174/1570164617999200612114626

224. Saad, A.H., Kadhim, R.B., Formulation and evaluation of herbal shampoo from *Ziziphus spina* leaves extract. *Int. J. Res. Ayurveda Pham*, 2011; *2:* 1802-1806. [ResearchGate]
225. Al Badi, K., Khan, S.A., Formulation, evaluation and comparison of the herbal shampoo with the commercial shampoos. *Beni-Suef Univ. J. Basic Appl. Sci*, 2014; *3*: 301-305. DOI: 10.1016/j.bjbas.2014.11.005
226. Bakr, R.O., Amer, R.I., Fayed, M.A. Ragab, T.I., A completely polyherbal conditioning and antioxidant shampoo: A phytochemical study and pharmaceutical evaluation. *J. Pharm. Bioallied Sci*, 2019; *11*: 105–115. DOI: 10.4103/jpbs.JPBS_214_18
227. Alzahrani, A.M., Alzahrani, A.A., Alsharm, A.A., The use of *Ziziphus spina-christi* extract in treating erlotinib (Tarceva®) associated rash: a case report. *Case Rep. Oncol*, 2019; *12*: 909-912. DOI: 10.1159/000504696
228. Adam, Y.O., Pretzsch, J., Contribution of local trade in *Ziziphus spina-christi* L. fruits to rural household's economy in Rashad Locality: Sudan. *For. Ideas*, 2010; *1*: 19-27. [ResearchGate]
229. Brantner, A.H., Males, Z., Quality assessment of *Paliurus spina-christi* extracts. *J. Ethnopharmacol*, 1999; *66*: 175-179. DOI: 10.1016/s0378-8741(98)00180-9
230. Guesmi, S., Raouafi, A., Amri, I., Hamzaoui, A.H., Boulila, A., Hosni, F., Sghaier, H., Polyphenolic extracts from the xerophyte *Rhamnus lycioides* as a radiation biodosimeter. *Environ. Sci. Pollut. Res. Int*, 2020; *27*: 5661-5669. DOI: 10.1007/s11356-018-3709-0
231. El Maaiden, E., El Kharrassi, Y., Moustaid, K., Essamadi, A.K., Nasser, B., Comparative study of phytochemical profile between *Ziziphus spina christi* and *Ziziphus lotus* from Morocco. *J. Food Meas. Charact*, 2019; *13:* 121-130. DOI: 10.1007/s11694-018-9925-y
232. Letaief, T., Mejri, J., Ressureição, S., Abderrabba, M., Costa, R., Extraction of *Ziziphus lotus* fruit syrups: effect of enzymatic extraction and temperature on their rheological and chemical properties. *Int. Agrophys*, 2021; *35*: 31-40. DOI: 10.31545/intagr/131801
233. Ouhammou, M., Nabil, B., Ouaabou, R., Elgadi, S., Hidar, N., Jaouad, Y., Jaouad, A., Mahrouz, M., The Impact of Drying Method on Bioactive Compounds and Microstructure of *Jujube Zizyphus Lotus* Leaves. *Herb. Med. J*, 2022; 7: 133-144. DOI: 10.22087/hmj.v7i4.872
234. Dahlia, F., Barouagui, S., Mahieddine, S., Salah, O., Drici, K., Attil, M., Heroual, M.A., Harrouche, I., Doukani, K., Change in the composition of primary metabolites, minerals

and secondary metabolites in natural *Ziziphus lotus* (L. Desf.) wild fruits under environmental variations. *Plant Genet. Resour*, 2023; *21*: 399-408. DOI: 10.1017/S1479262123000898

235. Malik, A.Q., Mir, T.U., Kumar, D., Mir, I.A., Rashid, A., Ayoub, M., Shukla, S., A review on the green synthesis of nanoparticles, their biological applications, and photocatalytic efficiency against environmental toxins. *Environ. Sci. Pollut. Res. Int*, 2023; *30*: 69796-69823. DOI: 10.1007/s11356-023-27437-9
236. Khan, F.A., Zahoor, M., Jalal, A., Ur Rahman, A., Green Synthesis of Silver Nanoparticles by Using *Ziziphus nummularia* Leaves Aqueous Extract and Their Biological Activities, 2016; 8026843. DOI: 10.1155/2016/8026843
237. Golla, N., Phytosynthesis and antimicrobial studies of silver nano particles using *Ziziphus nummularia* leave extracts. *MOJ Drug Des. Develop. Ther*, 2018; *2:* 261–264. DOI: 10.15406/mojddt.2018.02.00056
238. Padalia, H., Chanda, S., Synthesis of silver nanoparticles using *Ziziphus nummularia* leaf extract and evaluation of their antimicrobial, antioxidant, cytotoxic and genotoxic potential (4-in-1 system), *Artif. Cells Nanomed. Biotechnol*, 2021; *49*: 354-366. DOI: 10.1080/21691401.2021.1903478
239. Arodiya, F., Makvana, C., Parmar, K., Polymer Capped Silver Nanoparticles from *Ziziphus Nummularia* Leaves Extract: Potent Antibacterial and Antioxidant Activity. *Biosci. Biotechnol. Res. Asia*, 2021; *18:* 691-701. DOI: 10.13005/bbra/2952
240. Khalil, M.S., Shakeel, M., Gulfam, N., Ahmad, S.U., Aziz, A., Ahmad, J., Bibi, S., Chopra, H., Alhumaydhi, F.A., Idris, A.M., Khandaker, M.U., Hassan, M.E., Emran, T.B., Fabrication of silver nanoparticles from *Ziziphus nummularia* fruit extract: effect on hair growth rate and activity against selected bacterial and fungal strains. *J. Nanomater*, 2022; 3164951. DOI: 10.1155/2022/3164951
241. Kumar, V., Lakhawat, S.S., Kumar, S., Chaudhary, A.A., Rudayni, H.A., Al-Zahrani, M. Gilhotra, U.K., Rapid biogenic fabrication of silver nanoparticles using *Ziziphus nummularia* under optimised conditions and evaluation of their antimicrobial synergy. *Digest J. Nanomater. Biostruct*, 2022; *17:* 421-430. DOI: 10.15251/DJNB.2022.172.421
242. Parmar, K., Jangir, O.P., Phytochemical Screening, Antioxidant & Antibacterial Activity of Green Synthesized Silver & Gold Nanoparticles Using Leaf Extract of *Ziziphus nummularia* and Its Effectiveness Against Infected Dentine: An *in vitro* Study. *Int. J. Adv. Res*, 2017; *5*: 644-672. DOI: 10.21474/IJAR01/3556

243. Halawani, E.M., Rapid Biosynthesis Method and Characterization of Silver Nanoparticles Using *Zizyphus spina christi* Leaf Extract and Their Antibacterial Efficacy in Therapeutic Application. *J. Biomater. Nanobiotechnol*, 2017; *8*: 22-35. DOI: 10.4236/jbnb.2017.81002
244. El-Ansary, A., Warsy, A., Daghestani, M., Merghani, N.M., Al-Dbass, A., Bukhari, W., Al-Ojayan, B., Ibrahim, E.M., Al-Qahtani, A.M., Bhat, R.S., Characterization, antibacterial, and neurotoxic effect of green synthesized nanosilver using *Ziziphus spina christi* aqueous leaf extract collected from Riyadh, Saudi Arabia. *Mater. Res. Express*, 2018; *5*: 025033. DOI: 10.1088/2053-1591/aaaf5f
245. Hussein, N.N., Al-Azawi, K., Sulaiman, G.M., Albukhaty, S., Al-Majeed, R.M., Jabir, M., Al-Dulimi, A.G., Mohammed, H.A., Akhtar, N., Alawaji, R., Alshammari, A.A., Khan, R.A., Silver-cored *Ziziphus spina-christi* extract-loaded antimicrobial nanosuspension: overcoming multidrug resistance. *Nanomedicine*, 2023; *18*: 1839-1854. DOI: 10.2217/nnm-2023-0185
246. Abdelaziz, A.M., Elshaer, M.A., Abd-Elraheem, M.A., Ali, O.M.O.M., Haggag, M.I., El-Sayyad, G.S., Attia, M.S., *Ziziphus spina-christi* extract-stabilized novel silver nanoparticle synthesis for combating *Fusarium oxysporum*-causing pepper wilt disease: In vitro and in vivo studies. *Arch. Microbiol*, 2023; *205*: 69. DOI: 10.1007/s00203-023-03400-7
247. Shnawa, B.H., Jalil, P.J., Al-Ezzi, A., Mhamedsharif, R.M., Mohammed, D.A., Biro, D.M., Ahmed, M.H., Evaluation of antimicrobial and antioxidant activity of zinc oxide nanoparticles biosynthesized with *Ziziphus spina-christi* leaf extracts. *J. Environ. Sci. Health C Toxicol. Carcinog*, 2023; 1-16. DOI: 10.1080/26896583.2023.2293443
248. Safian-Boldaji, M., Pordel Shahri, M., Zargartalebi, M., Arabloo, M., New Surfactant Extracted from *Zizyphus Spina-Christi* for Enhanced Oil Recovery: Experimental Determination of Static Adsorption Isotherm. *J. Jpn. Petrol. Inst*, 2013; *56*: 142-149. DOI: 10.1627/jpi.56.142
249. Emadi, S., Shadizadeh, S.R., Manshad, A.K., Rahimi, A.M., Nowrouzi, I., Mohammadi, A.H., Effect of using *Zyziphus spina christi* or Cedr Extract (CE) as a natural surfactant on oil mobility control by foam flooding. *J. Mol. Liq*, 2019; *293:* 111573. DOI: 10.1016/j.molliq.2019.111573
250. Abdel Bary, E.M., Fekri, A., Soliman, Y.A., Harmal, A.N., Novel superabsorbent membranes made of PVA and *Ziziphus spina-christi* cellulose for agricultural and

horticultural applications. *New J. Chem*, 2017; *41*: 9688-9700. DOI: 10.1039/C7NJ01676J

251. Mahmoud, A., El‐Maghrabi, N., Hosny, M., Fawzy, M., Biogenic synthesis of reduced graphene oxide from *Ziziphus spina‐christi* (Christ's thorn jujube) extracts for catalytic, antimicrobial, and antioxidant potentialities. *Environ. Sci. Pollut. Res*, 2022; *29:* 89772-89787. DOI: 10.1007/s11356-022-21871-x
252. El Hamd, M.A., Albalawi, M.A., Gomaa, H., Mohammad, B.S., Abdul-Kareem, R.F., Obaydo, R.H., Alsaggaf, W.T., Saleh, S.F., Alossaimi, M.A., Abdel-Lateef, M.A. *Ziziphus spina-christi* Leaf-Derived Carbon Dots as a Fluorescence Nanosensor to Evaluate Rifaximin Antibacterial via Inner Filter Effect: Greenness and Whiteness Studies. *Chemosensors*, 2023; *11*: 275. DOI: 10.3390/chemosensors11050275
253. Mohaddes-Kamranshahi, M., Jafarizadeh-Malmiri, H., Simjoo, M., Jafarizad, A., Evaluation of the saponin green extraction from *Ziziphus spina-christi* leaves using hydrothermal, microwave and Bain-Marie water bath heating methods. *Green Process. Synth*, 2019; 8: 62-67. DOI: 10.1515/gps-2017-0185
254. Sohail, M., Saied, A.S., Gebauer, J., Buerkert, A., Effect of NaCl Salinity on Growth and Mineral Composition of *Ziziphus spina-christi* (L.) Willd. *J. Agric. Rural Dev. Trop. Subtrop*, 2009; *110*: 107-114. [ResearchGate]
255. Naghmouchi, S., Alsubeie, M., Ecological Diversity of *Ziziphus spina-christi* (L.) Willd. Of Four Provenances in Saudi Arabia: Differential Responses to Drought Stress and Characterization of Growth, Biomass and Proline Contents. *Ann. Bot*, 2021; *11*: 91-104. DOI: 10.13133/2239-3129/16937
256. Zait, Y., Shtein, I., Schwartz, A., Long-term acclimation to drought, salinity and temperature in the thermophilic tree *Ziziphus spina-christi*: revealing different tradeoffs between mesophyll and stomatal conductance. Tree Physiol, 2019; *39*: 701-716. DOI: 10.1093/treephys/tpy133
257. Aldhanhani, A.R., Ahmed, Z.F., Tzortzakis, N., Singh, Z., Maturity stage at harvest influences antioxidant phytochemicals and antibacterial activity of jujube fruit (*Ziziphus mauritiana* Lamk. and *Ziziphus spina-christi* L.). *Ann. Agric. Sci*, 2022; *67*: 196-203. DOI: 10.1016/j.aoas.2022.12.003
258. AL-Saikhan, M.S., Effect of calcium chloride dipping treatment on quality of *Ziziphus spina-christi* L. fruits during cold storage. *Afr. J. Agric. Res*, 2018; *13*: 866-871. DOI: 10.5897/AJAR2018.12976

259. Katuwal, D.R., Dhami, J.C., Awasthi, K.R., Dhami, Karan, S., Effect of Different Post-Harvest Treatments on Quality and Shelf Life of Tomato (*Lycopersicon esculentum* Mill.) Fruits During Storage. *Nepal. Hortic*, 2024; *17*: 41-48. DOI: 10.3126/nh.v17i1.60631
260. Al-Naimi, N., Abou Elezz, A., Al-Adba, M., Al-Saadi, H., Sorino, C., Hassan, H.
261. Assessing the Use of *Ziziphus spina-christi* as a Sustainable Solution for Biomonitoring of Urban Air Quality: A Case Study from Qatar. *Sustainability*, 2023; 15: 13590. DOI: 10.3390/su151813590
262. Li, Y., Zhou, X., Zhao, K., Liu, J., Chen, G., Zhang, Y., Ma, J., Sun, N., Li, X., Cultivation and morphology of jujube (*Ziziphus Jujuba* Mill.) in the Qi River Basin of Northern China during the Neolithic Period. *Sci. Rep*, 2024; *14*: 2305. DOI: 10.1038/s41598-024-52260-8
263. Lu, Y., Bao, T., Mo, J., Ni, J., Chen, W., Research advances in bioactive components and health benefits of jujube (*Ziziphus jujuba* Mill.) fruit. *J. Zhejiang Univ. Sci*. B, 2021; *22*: 431-449. DOI: 10.1631/jzus.B2000594
264. Kim, M.J., Jung, J.E., Lee, S., Cho, E.J., Kim, H.Y., Effects of the fermented *Zizyphus jujuba* in the amyloid β_{25-35}-induced Alzheimer's disease mouse model. *Nutr. Res. Pract*, 2021; *15*: 173-186. DOI: 10.4162/nrp.2021.15.2.173
265. Mesaik, A.M., Hiap, W.P., Bin, O.Y., Elawad, I., Alsayed, B., *In Vivo* Anti-Inflammatory, Anti-Bacterial and Anti-Diarrhoeal Activity of *Ziziphus Jujuba* Fruit Extract. *Maced. J. Med. Sci*, 2018; *6*: 757-766. DOI: 10.3889/oamjms.2018.168
266. Yan, M., Wang, Y., Watharkar, R.B., Pu, Y., Wu, C., Lin, M., Lu, D., Liu, M., Bao, J., Xia, Y., Physicochemical and antioxidant activity of fruit harvested from eight jujube (*Ziziphus jujuba Mill*.) cultivars at different development stages. *Sci. Rep*, 2022; *12*: 2272. DOI: 10.1038/s41598-022-06313-5
267. Hosseini, M., Bambaeichi, E., Sarir, H., Kargarfard, M., Effect of training with or without *Ziziphus jujuba* extract on cardiokines in heart tissue of myocardial infarcted rats. *Int. J. Prev. Med*, 2019; *10*: 103. DOI: 10.4103/ijpvm.IJPVM_367_18
268. Tanyeli, A., Guler, M.C., Eraslan, E., Bozhuyuk, M.R., Ekinci Akdemir, F.N., Toktay, E., Kurt, N., Ozkan, G., Capanoğlu Guven, E., Gastroprotective Effects of Jujuba (*Ziziphus jujuba*) Fruit Extract Against the Ethanol-Related Gastric Ulcer in Rats. *J. Contemp. Med*, 2023; *13*: 1046-1052. DOI:10.16899/jcm.1317273

269. Tedyanto, C.P., Wihanto, L., Hendrata, A.P., Hepatoprotective Effect of Dried Red Jujube Fruit Extract Against Acetaminophen-Induced Acute Hepatotoxicity. *Cureus*, 2023; *15*: e33272. DOI 10.7759/cureus.33272