

Herbal therapy with application of Brazilian peppertree and Cat's claw

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Abstract. Since ancient times, natural components considerably from plant origin, have routinely been a notable source of therapeutic agents. There are many endemic medicinal plants and herbs in South America, which is known as the region of biodiversity. Due to the lack of economic resources, and insufficient medical attention, application of medicinal herbs and plants in Latin America is a common practice. The systematic review of documents and manuscripts from clinical trials, and scientific societies has been carried out. The surveys of interest were indexed in “PubMed”, “Web of Science”, and “SciFinder”. Relevant literature has been obtained using the key-words “Antioxidant Activity”, “Antimicrobial Activity”, “Aroeira Fruit”, “Medicinal Plant”, “Mitraphylline”, “Brazilian Peppertree”, and “Cat’s claw”. The selection criterion was to include research papers on the most important topics, using *in vitro* or *in vivo* studies. Duplicate studies and those that do not fall with the scope of the search were excluded. The goal of this review article is a survey about the importance of Brazilian peppertree and cat’s claw. Brazilian peppertree (*Schinus terebinthifolia*) is an evergreen tree or shrub with wide-spreading horizontal branches. The most important phytochemicals of *Schinus terebinthifolia* fruit oil are β -pinene, α -pinene, δ -3-carene, α -phellandrene, limonene, *p*-cymene, β -phellandrene, and mono-alcohols, triterpene alcohols, terpinolene, ketones, and sesquiterpene hydrocarbons. Some of the most pharmacological properties of *Schinus terebinthifolia* are antioxidant, antimicrobial, antiinflammatory, anticancer, wound healing, and antidiabetic activity. Cat’s claw (*Uncaria tomentosa*) is an important medicinal plant endemic to the tropical forests of South and Central of America, which has been used in wound treatment in traditional medicine with high antibacterial activities. In traditional medicinal sciences in South America, its root and bark have been used for treatment of cancer, inflammation, and infections. It allegedly aids fight a range of ailments, including Alzheimer’s disease, arthritis, cancer, and infections. Although, many studies have evaluated the biological properties of these two medicinal plants in South America, little has been done to identify and characterize its chemical constituents, which is certainly a niche that needs to be further explored.

Keywords: antioxidant activity, antimicrobial activity, aroeira fruit, medicinal plant, mitraphylline

INTRODUCTION

The healing potential of many medicinal plants and herbs is because of bioactive components produced by the secondary metabolism of these plants (Sun et al., 2024a,b). The production of secondary metabolites is known as plants strategy for survival and defense. They acting basically in

the protection against pest attack, herbivory, negative effects of climatic conditions, ultraviolet radiation, oxidative stress and as signaling components to attract seed dispersants and pollinating insects. A wide range researches and studies have investigated plant extracts as sources of natural products that reduce the risk of toxicity and presents antimicrobial, antioxidant, anticancer, antibacterial, antiviral,



antifungal, antiinflammatory activities, etc. (Shahrajabian, Sun, 2024a,b). Medicinal herbs and plants have been recognized as veritable therapeutic agents since they contain secondary phytochemicals with vast medicinal advantages (Shahrajabian, Sun, 2024c,d,e).

Schinus terebinthifolia Raddi, commonly known as aroeira mansa, aroeira vermelha, Brazilian peppertree and pimento rosa has a variety of applications such as for food purposes and folk medicine (Lamboro et al., 2020), and in traditional medicine, it is used to prepare baths, teas, balms, soaps, and ointments (Linden et al., 2020; Sun et al., 2025a,b,c). It can be also used to treatment of different diseases due to it healing properties, antirheumatic, antimicrobial, and antiinflammatory effects (Oliveira et al., 2020a). It contains saponins, anthraquinones, triterpenes, steroids, flavonoids, and phenols (Rocha et al., 2020; Lima et al., 2022).

Cat's claw (*Uncaria tomentosa* DC.) belongs to Rubiaceae family which is rich in phytoconstituents such as anthoxanidins, phenols, sterols, anthocyanidins, glycosides, and indole alkaloids (Aldayel et al., 2021; Yepes-Perez et al., 2020) with various pharmacological properties such as immune booster, antiinflammatory, antiviral, antipyretic activities and wound healing agent (Bigliani et al., 2013; Kolodziejczyk-Czepas et al., 2021). In many researchers, it is reported that, the medicinal plant is mainly rich in oxindole and indole alkaloids, as well as triterpenoids derived from polyphenols and quinovic acid (Pavei et al., 2012; Montoro et al., 2004; Sheng et al., 2005). It has demonstrated anticancer activities, targeting melanoma cell lines and breast cancer (Zari et al., 2021).

This review aims at gathering the information undertaken till date on *Schinus terebinthifolia* (Brazilian peppertree), and *Uncaria tomentosa* (Cat's claw) in order to provide sufficient baseline information for future works and commercial exploitation.

BRAZILIAN PEPPERTREE (*SCHINUS TEREBINTHIFOLIA*)

Brazilian peppertree or aroeira (*Schinus terebinthifolia* Raddi; Anacardiaceae) is a plant native to South America. It is a tall shrub with several trunks and the leaflets are normally a deep glossy green color with reddish veins which grow opposite from each other with one leaflet at the tip. It possesses several characteristics such as rapid recovery after damage, high growth rates and seed production, tolerance of different environmental conditions, pollinated by insects and animal-dispersed seeds (Donnelly et al., 2008; Dlamini et al., 2018). Its fruits have a slight pepper, being extensively used as a culinary condiment (Manrique et al., 2009), a probable source of fatty acids, protein, and antioxidant compounds (Alvares-Carvalho et al., 2015; Tlili et al., 2018). It has antibacterial, antioxidative, antihyperlipidemic, antidiabetic, antihistaminic, antiinflammatory, anti-

hemolytic, and antiatherogenic properties (Dannenberg et al., 2016; Uliana et al., 2016; Da Silva et al., 2017; Feriani et al., 2020; Feriani et al., 2021). In traditional medicinal sciences, the medicinal plant uses for the treatment of diseases such as arthritis, diarrhea, tumors, ulcers, skin sores, respiratory and urinary tract infections as well as rheumatism (Zotti-Sperotto et al., 2021). Its fruits are usually used as spice, whereas its roots, leaves and bark are used in traditional medicine (Feuereisen et al., 2017; Rebolledo et al., 2021). Its antifungal and antitumoral properties have been also reported (Souza et al., 2012; Gois et al., 2016). *Schinus terebinthifolia* leaf extract includes lectin, hydrolysable tannins, and flavonoids (Camaroti et al., 2018). Brazilian peppertree essential oils have been suggested as an efficacious formulation of natural herbicides to suppress germination and initial development of lovegrass (*Eragrostis plana*) (Maldaner et al., 2020). Its essential oil has been considered as a peppery flavor, and is applied in beverages, syrups, and vinegar in Peru as well as Chilean wines (Patocka, Almeida, 2017). It has been used to treat respiratory problems, wounds, ulcers, diarrhea, rheumatism, arthritis, gout, and skin disease in Brazilian folk medicine (Lima et al., 2009; Patocka, Almeida, 2017). Its methanolic extract had both the highest antioxidant activity and polyphenol content (Rebolledo et al., 2021), and antibacterial activity of bioflavonoids from Brazilian peppertree was found (Linden et al., 2020). Extracts from *S. terebinthifolia* successfully controlled Zika virus entry in trophoblast cells, and showed a potential early antiviral impact (Oliveira et al., 2020a). The potential antimicrobial and antioxidant activity of Brazilian peppertree extracts is reflected in popular application for urinary tract infection (Uliana et al., 2016; Dannenberg et al., 2019). Its fruits contain different phenolic components such as gallotannins, anthocyanins, and bioflavonoids, and its flavonoids act as a growth regulator, and a constitutive defense against abiotic stresses, and both reddish fruits and leaves are rich in essential oil (Richter et al., 2010). Feuereisen et al. (2017) reported that it contains gallotannins, bioflavonoids, and anthocyanins which have been identified in the exocarp of plants. Reis et al. (2023) reported that its essential oil may show significant and important source of active natural components in traditional Brazilian medicinal science as the main essential oil of ripe pink pepper fruits were α -pinene, sylvestrene, and *l*-phellandrene*.

The identified compounds in leaves and fruits of *Schinus terebinthifolia* volatile oil extracted by hydrodistillation (HD) and by supercritical CO₂ at 90 bar 40 °C (SFE) were α -thujene, sabinene, α -pinene, (*E*)-caryophyllene, γ -terpinene, myrcene, β -pinene, β -elemene, α -phellandrene, α -terpinene, *o*-cymene, β -phellandrene, terpinolene, δ -selinene, α -copaene, δ -elemene, β -copaene, *trans*- β -guaiene, α -cadinol, α -himachalene, germa-

* *l*-phellandrene = α -phellandrene

Table 1. Examples of benefits of Brazilian peppertree fruit.

Benefits	Keypoint	Reference
Antimycobacterial activity	Its flavonoids are responsible for antimycobacterial activity.	Bernardes et al., 2014
Antibacterial activity	– Its tetrahydroamentoflavone revealed the highest antibacterial activity.	Linden et al., 2020
	– Its bioflavonoids showed inhibition biofilm formation, and activity against planktonic cells.	
	– Linkage of flavonoids and degree of saturation of the C-ring identified due to its antibacterial activity.	
	α -phellandrene and α -pinene showed promising antibacterial activity.	Salem et al., 2018
	Its essential oil promoted cell damage in all tested bacteria, and promoted the leakage of macromolecules and small ions from bacterial cells.	Dannenberg et al., 2019
Antimicrobial activity	Its bioflavonoids have significant role in the response to microbial infections.	Linden et al., 2020
Antifungal activity	It showed antifungal activity against <i>Candida albicans</i> .	Alves et al., 2013
Antiallergic activity	Its ethyl acetate fraction showed antiallergic activity.	Cavalher-Machado et al., 2008
Anticancer activity	It has shown anticancer activity and it was found effective in reducing the number of lung tumor nodules.	Matsuo et al., 2011 Silva et al., 2019
Antitumor activity	Its extracts showed potential activity against tumor cell lines such as glioma and kidney.	Silva et al., 2017
Antidiabetic activity	Its extract showed antidiabetic activities because of glycosylated flavonols, gallotannins, and gallic acid.	Rocha et al., 2019
Antiinflammatory activity	Its extracts inhibited cytokine, leukocyte migration and chemokine production which makes it suitable for the treatment of inflammatory diseases.	Fedel-Miyasato et al., 2014 Rosas et al., 2015 Feriani et al., 2021
Antihypertensive activity	It has shown antihypertensive activity due to its phenolic components.	Gloria et al., 2017
Antioxidant activity	It has shown high antioxidant potential due to its high tannins, anthocyanins, flavonoids, and phenolic acids.	Sassi et al., 2020 Barreira et al., 2023
	Its fruit can be considered as a natural food additive due to its high antioxidant activity.	Tlili et al., 2018 De Oliveira et al., 2020a,b Oliveira et al., 2020b
	It is recommended as an alternative to replace synthetic antioxidants in processed food.	Vieira et al., 2023
	Its essential oil reduced contents of primary and secondary ingredients of lipoxidation, and the essential oil of ripe fruits showed antioxidant activity in cheese.	Dannenberg et al., 2016
Insecticidal activity	Its seed flour is toxic to the cowpea weevil (<i>Callosobruchus maculatus</i> (F.), larval development, as the seeds are rich in proteins such as chitinases, lipoxxygenase, glycinin, 7S globulins, and others.	Oliveira et al., 2022
	Its essential oil shows high insecticidal activity against <i>Phthorimaea operculella</i> and <i>Spodoptera littoralis</i> .	Ennigrou et al., 2017
	Its fruit essential oil can be used for control of castor bean whitefly (<i>Trialeurodes ricini</i> Misra), and sweet potato whitefly (<i>Bemisia tabaci</i> Gennadius).	Hussein et al., 2017
	The essential oil of its fruits showed insecticidal activity against <i>Trialeurodes ricini</i> , <i>Bemisia tabaci</i> , <i>Culex pipiens</i> , and <i>Rhyzopertha dominica</i> .	Manrique et al., 2008 Camaroti et al., 2018 Bernardi et al., 2024
	Its essential oil can be used against cowpea weevil (<i>Callosobruchus maculatus</i> Fabricius).	Torre et al., 2024

crene D, γ -muurolene, β -selinene, bicyclogermacrene, α -muurolene, *trans*-isolongifolanone, γ -cadinene, germacrene A, δ -cadinene, germacrene B, viridiflorol, spathulenol, α -muurolol, *cis*-isolongifolanone, *epi*- α -muurolol, β -eudesmol, and eudesma-4(15),7-dien-1- β -ol (Piras et al., 2017). α -pinene, β -caryophyllene, and germacrene D represents *S. terebinthifolia* dried leaves essential oil principle components, as well as, germacrene D, α -pinene, and β -pinene in the fruit (Cavalcanti et al., 2015; Fagundes et al., 2020). Chemical composition of the essential oil of its fruits are tricyclene, 4-aliloxy-2-methyl-2-pentanol, α -tujene, α -pinene, β -pinene, canfene, δ -3-carene, mircene, β -phellandrene, α -terpineol, bornilene, bornil acetate, germacrene D, and citronellil acetate (Salem et al., 2018; Acacio et al., 2023). On the basis of principal component analysis (PCA), the main compounds, namely limonene, phellandrene, and carene obtained from samples of several geographical locations in Brazil (Ennigrou et al., 2017; Carneiro et al., 2017). More specifically, phenolic compounds like bioflavonoids, gallotannins, and anthocyanins have been discovered in the exocarp of *S. terebinthifolia* fruits (Fedel-Miyasato et al., 2014).

Brazilian peppertree fruit presented better results than synthetic additives against cholesterol thermo-oxidation and the protective impacts of it is connected with the presence of bioactive compounds (De Oliveira et al., 2020a). *Schinus terebinthifolia* Raddi fruit is considered as a natural food additive due to its nutritional values and high antioxidant (De Oliveira et al., 2020b). *Schinus terebinthifolia* significantly mediated through its antioxidant activity, showing a potential therapeutic advantage of this species in the treatment of Parkinson's disease (Sereniki et al., 2016). Antiadherent activity of *S. terebinthifolia* on *in vitro* biofilms shaped by and *Streptococcus mutans* and *Candida albicans* were proved, suggesting the importance of trials about these extracts for therapeutic prevention of oral diseases related to oral biofilms (Barbieri et al., 2014). Antimicrobial activity of Brazilian peppertree was associated with phenolic compounds enriched extract; gallotannins, gallic acids, flavonoids and their derivatives were the major constituents in the extracts (Gomes et al., 2020). Antiallergic characteristics of the acetate fraction of *S. terebinthifolia* leaves was identified, which contained the inhibition of edema formation and histamine release due to mast cell degranulation and eosinophil influx into the pleural cavity possibly reflected by the decreased levels of chemokines in recovered pleural lavage fluid (Cavalher-Machado et al., 2008). Its extract also indicated potent activity against tumor cell lines, especially glioma and kidney (Silva et al., 2017). Rosas et al. (2015) suggested a putative application of *S. terebinthifolia* for the development of phytochemicals to treat inflammatory diseases, such as joint inflammation. *Schinus terebinthifolia* extracts suppressed the activity of the enzyme α -glucosidase and revealed antiglycation activity (Rocha et al., 2019). The monoterpenes β -pinene and α -pinene could be accountable for cytotoxic activity de-

tected in the crude oil from leaves (Santana et al., 2012). Oliveira et al. (2024) reported that the essential oil from the leaves showed higher antibacterial potential against *Staphylococcus aureus* and *Escherichia coli*, and on the basis of the activities of its essential oil, it is recommended to be used as a biopreservative in foods. StELL, which is a lectin isolated from the leaves has anxiolytic, analgesic, and antitumor activities, which is characterized as an *N*-acetylglucosamine binding protein a molecular weight of 12.4 kDa (Nunes et al., 2022). Pharmacological benefits of Brazilian peppertree fruit are shown in Table 1.

CAT'S CLAW (*UNCARIA TOMENTOSA* DC.)

Uncaria tomentosa DC. (Rubiaceae) is a medicinal plant which grows wild in the upper Amazon region of Brazil, Peru. It is commonly known as "Una de Gato", "Cat's Claw", and "Vilcacora" (Alvarenga-Venutolo et al., 2018) and it has been widely applied in folk medicine to treat various health conditions especially cancer (Pilarski et al., 2010; Ciani et al., 2018; Kaiser et al., 2020), and commonly used to treat disorders such as arthritis, gastritis, and osteoarthritis (Calvo et al., 2017), inflammatory processes and tumor (Prado et al., 2007; Goncalves et al., 2005). It has high immunostimulant, antioxidant, antiviral, antioxidant, and antiapoptotic characteristics (Lemaire et al., 1999; Pilarski et al., 2006; Allen-Hall et al., 2007; Reis et al., 2008). It is used in blood purification, its anticoagulant properties are usage in haemorrhage therapy (Kolodziejczyk-Czepas et al., 2021). Secondary metabolites, namely quinovic acid glycosides and alkaloids have noticeable importance in biological activities of *U. tomentosa* (Pavei et al., 2012). Sheng et al. (2005) reported that the efficacy of *U. tomentosa* was connected to oxindole alkaloids and quinic acid esters. Moreover, the antitumor activity of it has been basically related to pentacyclic oxindole alkaloids from stem bark and leaves (Kaiser et al., 2016). Cat's claw bark water-insoluble fractions were active against resistant non-*albicans* *Candida* isolates, and its high molecular mass polyphenols indicated the maximum antifungal activity (Moraes et al., 2015). Antimutagenic and mutagenic activities of extracts and chromatographic fractions of *Uncaria tomentosa* bark have been discovered (Rizzi et al., 1993). Its root and bark have been traditionally used as a therapy in tropical South America for different conditions, like cancer, inflammations, infections, arthritis, and gastric ulcers as well as unique potential for skin health, asthma, blood purification, fevers, hemorrhages, menstrual irregularity, and possess a normalization activity on body systems (Dreifuss et al., 2013). Many active components have been identified from it, including antioxidants such as flavonoids, procyanidins, carboxyl alkyl esters, triterpenes, tannin, sterols, catechins, and indole and oxindole alkaloids (Aquino et al., 1997; Maria et al., 1997; Kuras et al., 2009). Bioactive components of *U. tomentosa* extracts include oxindole alkaloids, indole alkaloidal glu-

cosides (Montoro et al., 2004), proanthocyanidins (Navarro et al., 2017), quinovic acid glycosides, catechins, polyphenols, proteins, tannins, and beta-sitosterol (Cerri et al., 1988; Aquino et al., 1997). Oxindole alkaloids, separated from its bark are accountable for the biological activity of this herb (Paradowska et al., 2008; Pilarski et al., 2013). The leaves' polyphenolic-enriched compounds and extracts identification, showed that they contain flavan-3-ols, alkaloids, flavalignans, propylargenonins, and procyanidins (Falkiewicz, Lukasiak, 2001; Navarro et al., 2017; Navarro-Hoyos et al., 2017; Navarro-Hoyos et al., 2018). Its anti-inflammatory activity was significantly higher using the hydroalcoholic compared with the aqueous extract (Aguilar et al., 2002; Martino et al., 2006; Allen-Hall et al., 2010; Gurrola-Diaz et al., 2011). The primary mechanism for its anti-inflammatory actions appears to be immunomodulation via suppression of TNF α synthesis (Sandoval et al., 2000; Rojas-Duran et al., 2012). Cat's claw ethyl acetate extracts' induction of apoptosis in HL-60 cells may make it very important in the development of medicine that can trigger chemopreventive activities (Sandoval et al., 2002; Cheng et al., 2007; Santos et al., 2016; Lima et al., 2020). A standardized aqueous extract of *Uncaria tomentosa* can be considered as important therapeutic intervention against Parkinson's disease, as it can scavenge different types of free radicals, particularly hydroxyl radical and may al-

leviate the aggregation of α -synuclein (Shi et al., 2013). Hydroethanolic extracts from *U. tomentosa* may be considered promising for the suppression of viral attachment to cell was the significant mechanism of antiherpetic action (Caon et al., 2014). Both antitumoral and antioxidant effects of *Uncaria tomentosa* hydroalcoholic extract was reported (Dreifuss et al., 2010; Neto et al., 2011). *In vivo* assays showed that aqueous bark extract was more appropriate in treating asthmatic inflammation while aqueous leaf extract was more important in controlling respiratory mechanics, and both extracts may have promising alternatives in the phytotherapy of allergic asthma (Junior, Dantas, 2016; Azevedo et al., 2018). The potential effectiveness of *U. tomentosa* as complementary and/or alternative medicine for COVID-19 treatment is proposed (Yepes-Perez et al., 2020). Mitraphylline is the main abundant pentacyclic oxindolic alkaloid from *U. tomentosa* may be the main modulator for promoting the plasticity of monocytes/macrophages and the attenuation of the inflammatory response (Akeson et al., 2003a,b; Jurgensen et al., 2005; Paz et al., 2015). Among its bioactive alkaloids, uncarine F has anticancer activity (Akeson et al., 2005), mitraphylline has anti-inflammatory and antioxidant activities (Rojas-Duran et al., 2012; Azevedo et al., 2019), isomitraphylline has antioxidant activity (Azevedo et al., 2019), speciophylline has antineoplastic activity (Dreifuss et al.,

Table 2. Some of the most important health benefits of *Uncaria tomentosa*.

Pharmacological benefits	Keypoint	Reference
Anticancer activity	It contains different types of pentacyclic oxindole alkaloids which have shown anticancer activities against breast cancer, cervical, thyroid, and bladder cells.	Riva et al., 2001 Rinner et al., 2009 Pilarski et al., 2010
	Its extracts decrease the infiltration of T cells into the tumours, and reduced angiogenic markers in cancer cells.	Zari et al., 2021
	It has shown antiproliferative effect against different cell lines, such as neuroblastoma, leukaemia, acute lymphoblastic, breast cancer, promyelocytic leukaemia, and glioma.	Akeson et al., 2003a,b Cheng et al., 2007
Antineoplastic activity	It has immunostimulatory and antitumor activity due to its oxindole alkaloids content.	Piscoya et al., 2001
Antioxidant activity	It has antioxidant activity, and it can be used for treatment of chronic inflammatory diseases.	Sandoval et al., 2000 Piscoya et al., 2001 Araya-Sibaja et al., 2022
	It was discovered to protect against oxidative stress in human erythrocytes.	Sandoval et al., 2002
	It has also the significant cytoprotective effect due to its ability to interact with the injurious oxidant.	Sandoval et al., 2000
Antiinflammatory activity	It has antiinflammatory activity due to its NF- κ B inhibition.	Allen-Hall et al., 2010
Antimicrobial activity	It shows antimicrobial activity against <i>Staphylococcus aureus</i> , <i>Pseudomonas aeruginosa</i> , and <i>Enterococcus faecalis</i> .	Ccahuana-Vasquez et al., 2007
Antiviral activity	It has been examined as a binding factor for the ACE2 receptor at the site where Covid-19 spike protein binds.	Yepes-Perez et al., 2020
	Its extracted alkaloid is useful against dengue virus-2 (DENV) <i>in vitro</i> .	Reis et al., 2008 Lima-Junior et al., 2013
Skin health and wound dressing material	Alginate films with its extract could be applied as wound dressings materials.	Elgegren et al., 2021

2013), isopteropodine has antimicrobial activity (Bacher et al, 2006), pteropodine has immunomodulating properties (Kosmider et al., 2017), corynoxine inhibits aortic vascular smooth muscle cell proliferation (Kim et al., 2008) and rhynchophylline can inhibit the platelet aggregation and thrombosis (Chen et al., 1999). Sowjanya and Rao (2023) also found that the fast dissolving oral films of *Uncaria tomentosa* extract is attractive, novel, and the proposed alternative to the available marketed products which can be used in treatment of osteoarthritis. *Uncaria tomentosa* prevented piroxicam- and ethanol-induced ulceration which can minimize ulcer recurrence and improve gastric healing in rodents (Simomura et al., 2024). It is a source of alkaloids with neuroprotective impacts which can improve memory in the Morris water maze test, and protects against DNA damage (Castilhos et al., 2020). Its extract also could improve hypertension induced by angiotensin II infusion in mice, downregulated antiangiogenic factors in human placenta and human umbilical vein endothelial cells (HUVECs) (Oogaki et al., 2021). Blanck et al. (2022) also concluded that its components have antibacterial potential. Lima et al. (2024) also reported that the extract of *Uncaria tomentosa* has antiviral activity against the chikungunya virus. Sanchez-Hernandez et al. (2022) reported that the aqueous extract of its bark can be used to control crown and fruit rot, gray mold, and verticillium wilt of strawberry. Azevedo et al. (2019) showed that the aqueous leaf extract has antioxidant activity in *Caenorhabditis elegans* as a model organism. Pharmacological benefits of *U. tomentosa* are presented in Table 2.

CONCLUSION

Schinus terebinthifolia Raddi belongs to the Anacardiaceae family, which is commonly known as aroeirinha, aroeira-vermelha, or the Brazilian peppertree. Chemical compounds identified in *Schinus terebinthifolia* are consist of β -pinene, α -pinene, limonene, δ -3-carene, β -phellandrene, α -phellandrene, *p*-cymene, and mono-alcohols, triterpene alcohols, terpinolene, ketones, and sesquiterpene hydrocarbons. The main chemical components in the essential oils extracted from its fruits are α -funebrene, α -pinene, sabinene, β -pinene, Z-salvene, and limonene. *Schinus terebinthifolia* has been used as antipyretic, analgesic, and depurative as well as antimicrobial, antiinflammatory, and antiulcerogenic activity. *Uncaria tomentosa* (Cat's claw) is a plant from South and Central America, which has become relatively prominent in different countries, because of its proven antiinflammatory and immunostimulatory activities as well as its antioxidant and anticancer properties. The most important pharmacological activities of *Uncaria tomentosa* are antiprotozoal activity, antiinflammatory activity, antioxidant activity, antimicrobial activity, antineoplastic activity, and cardiovascular activity. Some of the most notable bioactive alkaloids isolated from *Uncaria*

tomentosa are speciophylline, uncarine F, isomitraphylline, mitraphylline, isopteropodine, petropodine, rhynchophylline, and corynoxine.

Since their widespread popular use as medicinal plants, Brazilian peppertree, and Cat's claw have shown high potential for the development of new herbal products in an organic life style.

REFERENCES

- Acacio R.D.S., Pamphile-Adrian A.J., Florez-Rodriguez P.P., Freitas J.D.D., Goulart H.F. et al., 2023. Dataset of *Schinus terebinthifolius* essential oil microencapsulated by spray-drying. Data in Brief, 47: 08927, <https://doi.org/10.1016/j.dib.2023.108927>.
- Aguilar J.L., Rojas P., Marcelo A., Plaza A., Bauer R., et al., 2002. Anti-inflammatory activity of two different extracts of *Uncaria tomentosa* (Rubiaceae). Journal of Ethnopharmacology, 81(2): 271-276, [https://doi.org/10.1016/s0378-8741\(02\)00093-4](https://doi.org/10.1016/s0378-8741(02)00093-4).
- Akesson C.H., Pero R.W., Ivars F., 2003. C-Med 100®, a hot water extract of *Uncaria tomentosa*, prolongs lymphocyte survival *in vivo*. Phytomedicine, 10(1): 23-33, <https://doi.org/10.1078/094471103321648629>.
- Akesson C., Lindgren H., Pero R.W., Leanderson T., Ivars F., 2003. An extract of *Uncaria tomentosa* inhibiting cell division and NF-kappa B activity without inducing cell death. International Immunopharmacology, 3: 1889-1900, <https://doi.org/10.1016/j.intimp.2003.07.001>.
- Akesson C., Lindgren H., Pero R.W., Leanderson T., Ivars F., 2005. Quinic acid is a biologically active component of the *Uncaria tomentosa* extract C-Med 100®. International Immunopharmacology, 5(1): 219-229, <https://doi.org/10.1016/j.intimp.2004.09.028>.
- Aldayel T.S., Abdel-Rahman H.G., El-Hak H.N.G., Abdelrazek H.M.A., Mohamed R.M., et al., 2021. Assessment of modulatory activity of *Uncaria tomentosa* extract against fipronil immunotoxicity in male rats. Ecotoxicology and Environmental Safety, 224: 112674, <https://doi.org/10.1016/j.ecoenv.2021.112674>.
- Allen-Hall L., Cano P., Arnason J.T., Rojas R., Lock O., et al., 2007. Treatment of THP-1 cells with *Uncaria tomentosa* extracts differentially regulates the expression of IL-1 β and TNF- α . Journal of Ethnopharmacology, 109(2): 312-317, <https://doi.org/10.1016/j.jep.2006.07.039>.
- Allen-Hall L., Arnason J.T., Cano P., Lafrenie R.M., 2010. *Uncaria tomentosa* acts as a potent TNF- α inhibitor through NF- κ B. Journal of Ethnopharmacology, 127(3): 685-693, <https://doi.org/10.1016/j.jep.2008.12.004>.
- Alvarenga-Venutolo S., Rosales-Lopez C., Sanchez-Chinchilla L., Munoz-Arrieta R., Aguilar-Cascante F., 2018. Seasonality effect on the composition of oxindole alkaloids from distinct organs of *Uncaria tomentosa* from the Caribbean region of Costa Rica. Phytochemistry, 151: 26-31, <https://doi.org/10.1016/j.phytochem.2018.03.008>.
- Alvares-Carvalho S., Duarte J.F., Carvalho D., Pereira G.S., Silva-Mann R., et al., 2015. *Schinus terebinthifolius*: Population structure and implications for its conservation. Biochemical Systematics and Ecology, 58: 120-125, <https://doi.org/10.1016/j.bse.2014.10.002>.

- Alves L.A., Freires I.D.A., Pereira T.M., Souza A.D., Lima E.D.O., et al., 2013. Effect of *Schinus terebinthifolius* on *Candida albicans* growth kinetics, cell wall formation and micromorphology. *Acta Odontologica Scandinavica*, 71: 3-4, <https://doi.org/10.3109/00016357.2012.741694>.
- Aquino R., De Tommasi N., De Simone F., Pizza C., 1997. Triterpenes and quinovic acid glycosides from *Uncaria tomentosa*. *Phytochemistry*, 45(5): 1035-1040, [https://doi.org/10.1016/s0031-9422\(96\)00716-9](https://doi.org/10.1016/s0031-9422(96)00716-9).
- Araya-Sibaja A.M., Wilhelm-Romero K., Vargas-Huertas F., Quiros-Fallas M.I., Alvarado-Corella D., et al., 2022. Hybrid nanoparticles of proanthocyanidins from *Uncaria tomentosa* leaves: QTOF-ESI MS characterization, antioxidant activity and immune cellular response. *Plants*, 11: 1737, <https://doi.org/10.3390/plants11131737>.
- Azevedo B.C., Morel L.J.F., Carmona F., Cunha T.M., Contini S.H.T., et al., 2018. Aqueous extracts from *Uncaria tomentosa* (Willd. Ex Schult.) DC. Reduce bronchial hyper-responsiveness and inflammation in a murine model of asthma. *Journal of Ethnopharmacology*, 218: 76-89, <https://doi.org/10.1016/j.jep.2018.02.013>.
- Azevedo B.C., Roxo M., Borges M.C., Peixoto H., Crevelin E.J., et al., 2019. Antioxidant activity of an aqueous leaf extract from *Uncaria tomentosa* and its major alkaloids mitraphylline and isomitraphylline in *Caenorhabditis elegans*. *Molecules*, 24: 3299, <https://doi.org/10.3390/molecules24183299>.
- Bacher N., Tiefenthaler M., Sturm S., Stuppner H., Ausserlechner M.J., et al., 2006. Oxindole alkaloids from *Uncaria tomentosa* induce apoptosis, G0/G1-arrested and bcl-2-expressing acute lymphoblastic leukemia cells. *Brazilian Journal of Haematology*, 132: 615-622, <https://doi.org/10.1111/j.1365-2141.2005.05907.x>.
- Barbieri D.S.V., Tonial F., Lopez P.V.A., Sales Maia B.H.L.N., Santos G.D., et al., 2014. Antiadherent activity of *Schinus terebinthifolius* and *Croton urucurana* extracts on in vitro biofilm formation of *Candida albicans* and *Streptococcus mutans*. *Archives of Oral Biology*, 59(9): 887-896, <https://doi.org/10.1016/j.archoralbio.2014.05.006>.
- Barreira C.F.T., Oliveira V.S.D., Chavez D.W.H., Gamallo O.D., Castro R.N., et al., 2023. The impacts of pink pepper (*Schinus terebinthifolius* Raddi) on fatty acids and cholesterol oxides formation in canned sardines during thermal processing. *Food Chemistry*, 403: 134347, <https://doi.org/10.1016/j.foodchem.2022.134347>.
- Bernardes N.R., Heggdorne-Araujo M., Borges I.F.J.C., Almeida F.M., Amaral E.P., et al., 2014. Nitric oxide production, inhibitory, antioxidant and antimycobacterial activities of the fruits extract and flavonoid content of *Schinus terebinthifolius*. *Revista Brasileira de Farmacognosia*, 24(6): 644-650, <https://doi.org/10.1016/j.bjp.2014.10.012>.
- Bernardi J.L., Ferreira J.A., Puton B.M.S., Camargo S.D., Magro J.D., et al., 2024. Potential agrochemical applications of *Schinus terebinthifolius* essential oil. *Journal of Stored Products Research*, 105: 102260, <https://doi.org/10.1016/j.jspr.2024.102260>.
- Bigliani M.C., Rosso M.C., Zunino P.M., Baiardi G., Ponce A.A., 2013. Anxiogenic-like effects of *Uncaria tomentosa* (Willd.) DC. aqueous extract in an elevated plus maze test in mice: a preliminary study. *Natural Product Research*, 27(18): 1682-1685, <https://doi.org/10.1080/14786419.2012.761617>.
- Blanck J.J., Huebner T.M., Rolls A.M., Cornell J.S., Hwang C.S., 2022. Comprehensive review of the components in Cat's claw (*Uncaria tomentosa*) and their antibacterial activity. *Applied Chemistry*, 2(1): 1-29, <https://doi.org/10.3390/appliedchem2010001>.
- Calvo A., Devenyi D., Koszo B., Sanz S., Oelbermann A.L., et al., 2017. Controlling concentration of bioactive components in cat's claw based products with a hybrid separation process. *The Journal of Supercritical Fluids* 125:50-55, <https://doi.org/10.1016/j.supflu.2017.01.018>.
- Camaroti J.R.S.L., Almeida W.A.D., Belmonte B.D.R., Oliveira A.P.S.D., Lima T.D.A., et al., 2018. *Sitophilus zeamais* adults have survival and nutrition affected by *Schinus terebinthifolius* leaf extract and its lectin (SteLL). *Industrial Crops and Products*, 116: 81-89, <https://doi.org/10.1016/j.indcrop.2018.02.065>.
- Caon T., Kaiser S., Feltrin C., Carvalho A.D., Sincero T.C.M., et al., 2014. Antimutagenic and antiherpetic activities of different preparations from *Uncaria tomentosa* (cat's claw). *Food and Chemical Toxicology*, 66: 30-35, <https://doi.org/10.1016/j.fct.2014.01.013>.
- Carneiro F.B., Lopes P.Q., Ramalho R.C., Scotti M.T., Santos S.G., et al., 2017. Characterization of leaf extracts of *Schinus terebinthifolius* Raddi by GC-MS and chemometric analysis. *Pharmacognosy Magazines*, 13: S672-S675, https://doi.org/10.4103/pm.pm_555_16.
- Castilhos L.G., Oliveira J.S., Adefegha S.A., Manzoni A.G., Passos D.F., et al., 2020. *Uncaria tomentosa* improves cognition, memory and learning in middle-aged rats. *Experimental Gerontology*, 138: 111016, <https://doi.org/10.1016/j.exger.2020.111016>.
- Cavalcanti A.D.S., Alves M.D.S., Silva L.C.P.D., Patrocinio D.D.S., Sanches M.N., et al., 2015. Volatiles composition and extraction kinetics from *Schinus terebinthifolius* and *Schinus molle* leaves and fruit. *Revista Brasileira de Farmacognosia*, 25: 356-362, <https://doi.org/10.1016/j.bjp.2015.07.003>.
- Cavalher-Machado S.C., Rosas E.C., Brito F.D.A., Heringe A.P., Oliveira R.R.D., et al., 2008. The anti-allergic activity of the acetate fraction of *Schinus terebinthifolius* leaves in IgE induced mice paw edema and pleurisy. *International Immunopharmacology*, 8(11): 1552-1560, <https://doi.org/10.1016/j.intimp.2008.06.012>.
- Ccahuana-Vasquez R.A., Santos S.S., Koga-Ito C.Y., Jorge A.O., (2007). Antimicrobial activity of *Uncaria tomentosa* against oral human pathogens. *Brazilian Oral Research*, 21: 46-50, <https://doi.org/10.1590/s1806-83242007000100008>.
- Cerri R., Aquino R., De Simone F., Pizza C., 1988. New quinovic acid glycosides from *Uncaria tomentosa*. *Journal of Natural Products*, 51(2): 257-261, <https://doi.org/10.1021/np50056a010>.
- Chen C.X., Jin R.M., Li Y.K., Zhong J., Yue L., et al., 1999. Inhibitory effect of rhynchophylline on platelet aggregation and thrombosis. *Zhongguo Yao Li Xue Bao*, 13: 126-130, [https://doi.org/10.1016/0049-3848\(80\)90289-3](https://doi.org/10.1016/0049-3848(80)90289-3).
- Cheng A.-C., Jian C.-B., Huang Y.-T., Lai C.-S., Hsu P.-C., et al., 2007. Induction of apoptosis by *Uncaria tomentosa* through reactive oxygen species production, cytochrome c release, and caspases activation in human leukemia cells. *Food and Chemical Toxicology*, 45(11): 2206-2218, <https://doi.org/10.1016/j.fct.2007.05.016>.

- Ciani F., Tafuri S., Troiano A., Cimmino A., Fioretto B.S., et al., 2018. Anti-proliferative and pro-apoptotic effects of *Uncaria tomentosa* aqueous extract in squamous carcinoma cells. *Journal of Ethnopharmacology*, 211: 285-294, <https://doi.org/10.1016/j.jep.2017.09.031>.
- Dannenberg G.D.S., Funck G.D., Mattei F.J., Silva W.P.D., Fiorentini A.M., 2016. Antimicrobial and antioxidant activity of essential oil from pink pepper tree (*Schinus terebinthifolius* Raddi) in vitro and in cheese experimentally contaminated with *Listeria monocytogenes*. *Innovative Food Science and Emerging Technologies*, 36: 120-127, <https://doi.org/10.1016/j.ifset.2016.06.009>.
- Dannenberg G.D.S., Funck G.D., Silva W.P.D., Fiorentini A.M., 2019. Essential oil from pink pepper (*Schinus terebinthifolius* Raddi): Chemical composition, antibacterial activity and mechanism of action. *Food Control*, 95: 115-120, <https://doi.org/10.1016/j.foodcont.2018.07.034>.
- Da Silva M.M., Iriguchi E.K.K., Kassuya C.A., Vieira M.D.C., Foglio M.A., et al., 2017. *Schinus terebinthifolius*: phenolic constituents and *in vitro* antioxidant, antiproliferative and *in vivo* anti-inflammatory activities. *Revista Brasileira de Farmacognosia*, 27(4): 445-452, <https://doi.org/10.1016/j.bjp.2016.12.007>.
- De Oliveira V.S., Chaves D.W.H., Gamallo O.D., Sawaya A.C.H.F., Sampaio G.R., et al., 2020a. Effect of aroeira (*Schinus terebinthifolius* Raddi) fruit against polyunsaturated fatty acids and cholesterol thermo-oxidation in model systems containing sardine oil (*Sardinella brasiliensis*). *Food Research International*, 132: 109091, <https://doi.org/10.1016/j.foodres.2020.109091>.
- De Oliveira V.S., Augusta I.M., Da Conceicao Braz M.V., Riger C.J., Prudencio E.R., et al., 2020b. Aroeira fruit (*Schinus terebinthifolius* Raddi) as a natural antioxidant: Chemical constituents, bioactive compounds and *in vitro* and *in vivo* antioxidant capacity. *Food Chemistry*, 315: 126274, <https://doi.org/10.1016/j.foodchem.2020.126274>.
- Dlamini P., Zachariades C., Downs C.T., 2018. The effect of frugivorous birds on seed dispersal and germination of the invasive Brazilian pepper tree (*Schinus terebinthifolius*) and Indian laurel (*Listea glutinosa*). *South African Journal of Botany* 114: 61-68, <https://doi.org/10.1016/j.sajb.2017.10.009>.
- Donnelly M.J., Green D.M., Walters L.J., 2008. Allelopathic effects of fruits of the Brazilian pepper *Schinus terebinthifolius* on growth, leaf production and biomass of seedlings of the mangrove *Rhizophora mangle* and the black mangrove *Avicennia germinans*. *Journal of Experimental Marine Biology and Ecology*, 357(2): 149-156, <https://doi.org/10.1016/j.jembe.2008.01.009>.
- Dreifuss A.A., Bastos-Pereira A.L., Avila T.V., Soley B.D.S., Rivero A.J., et al., 2010. Antitumoral and antioxidant effects of a hydroalcoholic extract of cat's claw (*Uncaria tomentosa*) (Willd. Ex Roem. & Schult) in an *in vivo* carcinosarcoma model. *Journal of Ethnopharmacology*, 130(1): 127-133, <https://doi.org/10.1016/j.jep.2010.04.029>.
- Dreifuss A.A., Bastos-Pereira A.L., Fabossi I.A., Livero F.A., Stolf A.M., et al., 2013. *Uncaria tomentosa* exerts extensive anti-neoplastic effects against the Walker-256 tumor by modulating oxidative stress and not by alkaloid activity. *PLOS ONE*, 8: e54618, <https://doi.org/10.1371/journal.pone.0054618>.
- Ellegren M., Donayre A., Kim S., Galarreta B.C., Nakamatsu J., 2021. Tridimensional alginate films with Cat's claw (*Uncaria tomentosa*) extract or aloe vera (*Aloe barbadensis*) gel for potential use as wound dressings. *Proceedings*, 69: 24, <https://doi.org/10.3390/cgpm2020-07225>.
- Ennigrou A., Casabianca H., Laarif A., Hanchi B., Hosni K., 2017. Maturation-related changes in phytochemicals and biological activities of the Brazilian pepper tree (*Schinus terebinthifolius* Raddi) fruits. *South African Journal of Botany* 108:407-415, <https://doi.org/10.1016/j.sajb.2016.09.005>.
- Fagundes M.B., Ballus C.A., Soares V.P., Ferreira D.D.F., Leaes Y.S.V., et al., 2020. Characterization of olive oil flavored with Brazilian pink pepper (*Schinus terebinthifolius* Raddi) in different maceration processes. *Food Research International*, 137: 109593, <https://doi.org/10.1016/j.foodres.2020.109593>.
- Falkiewicz B., Lukasiak J., 2001. Vilcacora (*Uncaria tomentosa* (Willd.) DC. and *Uncaria guianensis* (Aublet) Gmel.) - A review of published scientific literature. *American Journal of Case Reports*, 2: 305-316, <https://doi.org/10.1007/978-94-024-1552-0-41>.
- Fedel-Miyasato L.E.S., Kassuya C.A.L., Auharek S.A., Formaggio A.S.N., Cardoso C.A.L., et al., 2014. Evaluation of anti-inflammatory, immunomodulatory, chemopreventive and wound healing potentials from *Schinus terebinthifolius* methanolic extract. *Revista Brasileira de Farmacognosia*, 24: 565-575, <https://doi.org/10.22276/ethnoscience.v4i1.236>.
- Feriani A., Tir M., Hamed M., Sila A., Nahdi S., et al., 2020. Multidirectional insights on polysaccharides from *Schinus terebinthifolius* and *Schinus molle* fruits: Physicochemical and functional profiles, *in vitro* antioxidant, anti-genotoxicity, antidiabetic, and antihemolytic capacities, and *in vivo* anti-inflammatory and anti-nociceptive properties. *International Journal of Biological Macromolecules*, 165(Part B): 2576-2587, <https://doi.org/10.3390/pr12081681>.
- Feriani A., Tir M., Arafah M., Gomez-Caravaca A.M., Contreras M.D.M., et al., 2021. *Schinus terebinthifolius* fruits intake ameliorates metabolic disorders, inflammation, oxidative stress, and related vascular dysfunction, in atherogenic diet-induced obese rats. Insight of their chemical characterization using HPLC-ESI-QTOF-MS/MS. *Journal of Ethnopharmacology*, 269: 113701, <https://doi.org/10.23880/izab-16000125>.
- Feuereisen M.M., Barraza M.G., Zimmermann B.F., Schieber A., Schulze-Kaysers N., 2017. Pressurized liquid extraction of anthocyanins and bioflavonoids from *Schinus terebinthifolius* Raddi: A multivariate optimization. *Food Chemistry*, 214: 564-571, <https://doi.org/10.1080/00986445.2014.901220>.
- Gloria L.D.L., Arantes M.B.D.S., Pereira S.M.D.F., Vieira G.D.S., Martins C.X., et al., 2017. Phenolic compounds present *Schinus terebinthifolius* Raddi influence the lowering of blood pressure in rats. *Molecules*, 22(10): 1792, <https://doi.org/10.1021/scimeetings.0c02999>.
- Gois F.D., Cairo P.L.G., Cantarelli V.D.S., Costa L.C.D.B., Fontana R., et al., 2016. Effect of Brazilian red pepper (*Schinus terebinthifolius* Raddi) essential oil on performance, diarrhea and gut health of weanling pigs. *Livestock Science*, 183: 24-27, <https://doi.org/10.1021/scimeetings.0c02971>.
- Gomes R.B.D.A., De Souza E.S., Barraqui N.S.G., Tosta C.L., Nunes A.P.F., et al., 2020. Residues from the Brazilian pepper tree (*Schinus terebinthifolia* Raddi) processing industry: Chemical profile and antimicrobial activity of extracts against hospital bacteria. *Industrial Crops and Products*, 143: 111430, <https://doi.org/10.5867/medwave.2023.s1.uta107>

- Goncalves C., Dinis T., Batista M.T., 2005. Antioxidant properties of proanthocyanidins of *Uncaria tomentosa* bark decoction: a mechanism for anti-inflammatory activity. *Phytochemistry*, 66(1): 89-98, <https://doi.org/10.1002/9780470330319.ch55>
- Gurrola-Diaz C.M., Garcia-Lopez P.M., Gulewicz K., Pilar-ski R., Dihlmann S., 2011. Inhibitory mechanisms of two *Uncaria tomentosa* extracts affecting the Wnt-signaling pathway. *Phytomedicine*, 18(8-9): 683-690, <https://doi.org/10.1016/j.phymed.2010.11.002>.
- Hussein H.S., Salem M.Z.M., Soliman A.M., 2017. Repellent, attractive, and insecticidal effects of essential oils from *Schinus terebinthifolius* fruits and *Corymbia citriodora* leaves on two whitefly species, *Bemisia tabaci*, and *Trialeurodes ricini*. *Scientia Horticulturae*, 216: 111-119, <https://doi.org/10.1016/j.scienta.2017.01.004>.
- Junior J.B.P., Dantas K.G.F., 2016. Evaluation of inorganic elements in cat's claw teas using ICP OES and GF AAS. *Food Chemistry*, 196: 331-337, <https://doi.org/10.1016/j.foodchem.2015.09.057>.
- Jurgensen S., DalBo S., Angers P., Santos A.R.S., Ribeiro-do-Valle R.M., 2005. Involvement of 5-HT₂ receptors in the antinociceptive effect of *Uncaria tomentosa*. *Pharmacology Biochemistry and Behavior*, 81(3): 466-477, [https://doi.org/10.1016/0006-8993\(91\)90046-x](https://doi.org/10.1016/0006-8993(91)90046-x).
- Kaiser S., Carvalho A.R., Pittol V., Dietrich F., Manica F., et al., 2016. Genotoxicity and cytotoxicity of oxindole alkaloids from *Uncaria tomentosa* (cat's claw): Chemotype relevance. *Journal of Ethnopharmacology*, 189: 90-98, <https://doi.org/10.1016/j.jep.2016.05.026>.
- Kaiser S., Carvalho A.R., Pittol V., Penalzoa E.M., Resende P.E.D., et al., 2020. Chemical differentiation between *Uncaria tomentosa* and *Uncaria guianensis* by LC-PDA, FT-IR and UV methods coupled to multivariate analysis: A reliable tool for adulteration recognition. *Microchemical Journal*, 152: 104346, <https://doi.org/10.1016/j.microc.2019.104346>.
- Kim T.-J., Lee J.-H., Lee J.-J., Yu J.-Y., Hwang B.-Y., Ye S.-K., Shujuan L., Gao L., Pyo M.-Y., Yun Y.-P., 2008. Corynox-eine Isolated from the Hook of *Uncaria rhynchophylla* Inhibits Rat Aortic Vascular Smooth Muscle Cell Proliferation through the Blocking of Extracellular Signal Regulated Kinase 1/2 Phosphorylation. *Biological & Pharmaceutical Bulletin*, 31(11): 2073-2078.
- Kolodziejczyk-Czepas J., Ponczek M., Sady-Janczak M., Pilarski R., Bukowska B., 2021. Extracts from *Uncaria tomentosa* as antiplatelet agents and thrombin inhibitors-The *in vitro* and *in silico* study. *Journal of Ethnopharmacology*, 267: 113494, <https://doi.org/10.14808/sci.plena.2025.021101>.
- Kosmider A., Czepielewska E., Kuras M., Gulewicz K., Pietrzak W., et al., 2017. *Uncaria tomentosa* leaves decoction modulates differently ROS production in cancer and normal cells, and effects cisplatin cytotoxicity. *Molecules*, 22: 620, <https://doi.org/10.1055/s-2006-961582>.
- Kuras M., Pilarski R., Nowakowska J., Zobel A., Brzost K., et al., 2009. Effect of alkaloid-free and alkaloid-rich preparations from *Uncaria tomentosa* bark on mitotic activity and chromosome morphology evaluated by Allium Test. *Journal of Ethnopharmacology*, 121(1): 140-147, <https://doi.org/10.1016/j.jep.2008.10.023>.
- Lamboro T., Mengistu M., Hordofa T.G., 2020. Phytochemical screening, characterization of essential oil and antimicrobial activity of *Schinus molle* (Anacardiaceae) collected from Eastern Hararghe, Ethiopia. *Brazilian Journal of Natural Sciences*, 3: 305, <https://doi.org/10.31415.bjns.v3i2.93>.
- Lemaire I., Assinewe V., Cano P., Awang D.V.C., Arnason J.T., 1999. Stimulation of interleukin-1 and -6 production in alveolar macrophages by the neotropical liana, *Uncaria tomentosa* (Una de Gato). *Journal of Ethnopharmacology*, 64(2): 109-115, [https://doi.org/10.1016/s0378-8741\(98\)00113-5](https://doi.org/10.1016/s0378-8741(98)00113-5).
- Lima L.B., Vasconcelos C.F.B., Maranhao H.M.L., Leite V.R., Ferreira P.A., et al., 2009. Acute and subacute toxicity of *Schinus terebinthifolius* bark extract. *Journal of Ethnopharmacology*, 126(3): 468-473, <https://doi.org/10.1016/j.jep.2009.09.013>.
- Lima V., Melo I.M., Taira T.M., Buitrago L.Y.W., Fonteles C.S.R., et al., 2020. *Uncaria tomentosa* reduces osteoclastic bone loss *in vivo*. *Phytomedicine*, 79: 153327, <https://doi.org/10.1016/j.phymed.2020.153327>.
- Lima B.R.F.D., Patriota L.L.D.S., Marinho A.D.O., Costa J.A.D., Napoleao T.H., et al., 2022. The anxiolytic activity of *Schinus terebinthifolia* leaf lectin (SteLL) is dependent on monoaminergic signaling although independent of the carbohydrate-binding domain of the lectin. *Pharmaceuticals*, 15(11): 1364, <https://doi.org/10.3390/ph15111364>.
- Lima R.C.D., Valente L.M.M., Macedo D.F., de-Oliveira-Pinto L.M., Santos F.B.D., et al., 2024. Antiviral and virucidal activities of *Uncaria tomentosa* (Cat's Claw) against the Chikungunya virus. *Viruses*, 16(3): 369, <https://doi.org/10.3390/v16030369>.
- Lima-Junior R.S., Da Silva Mello C., Kubelka C.F., Siani A.C., Valente L.M.M., 2013. *Uncaria tomentosa* alkaloidal fraction reduces aracellular permeability, il-8 and ns1 production on human microvascular endothelial cells infected with dengue virus. *Natural Product Communications*, 8(11): 1547-1550, <https://doi.org/10.1177/1934578x1300801112>.
- Linden M., Brinckmann C., Feuereisen M.M., Schieber A., 2020. Effects of structural differences on the antibacterial activity of biflavonoids from fruits of the Brazilian peppertree (*Schinus terebinthifolius* Raddi). *Food Research International* 133: 109134, <https://doi.org/10.1016/j.foodres.2020.109134>.
- Maldaner J., Steffen G.P.K., Missio E.L., Saldanha C.W., De Moraes R.M., Steffen R.B., 2020. Rue and Brazilian peppertree essential oils inhibit the germination and initial development of the invasive plant lovegrass. *International Journal of Environmental Studies*, 77(2): 255-263, <https://doi.org/10.1080/00207233.2020.1723963>.
- Manrique V., Cuda J.P., Overholt W.A., Williams D.A., Wheeler G.S., 2008. Effect of host-plant genotypes on the performance of three candidate biological control agents of *Schinus terebinthifolius* in Florida. *Biological Control*, 47(2): 167-171, <https://doi.org/10.1016/j.foodres.2020.109561>.
- Manrique V., Cuda J.P., Overholt W.A., 2009. Effect of herbivory on growth and biomass allocation of Brazilian peppertree (Sapindales: Anacardiaceae) seedlings in the laboratory. *Biocontrol Science and Technology*, 19(6): 657-667, <https://doi.org/10.1080/21688370.2024.2424628>.
- Maria A.S., Lopez A., Siaz M.M., Alban J., Mera A.G.D., et al., 1997. Evaluation of the toxicity of *Uncaria tomentosa* by bioassays *in vitro*. *Journal of Ethnopharmacology*, 57(3): 183-187, <https://doi.org/10.1101/2020.02.11.944116>.
- Martino L.D., Martinot J.L.S., Franceschelli S., Leone A., Piza C., et al., 2006. Proapoptotic effect of *Uncaria tomentosa* extracts. *Journal of Ethnopharmacology*, 107(1): 91-94, <https://doi.org/10.1016/j.jep.2020.112952>.

- Matsuo A.L., Figueiredo C.R., Arruda D.C., Pereira F.V., Scutti J.A.B., et al., 2011. A-Pinene isolated from *Schinus terebinthifolius* Raddi (Anacardiaceae) induces apoptosis and confers antimetastatic protection in a melanoma model. *Biochemical and Biophysical Research Communications* 411(2):449-454, <https://doi.org/10.21203/rs.3.rs-3055879/v1>
- Montoro P., Carbone V., de Dizio Zuniga Quiroz J., De Simone F., Pizza C., 2004. Identification and quantification of components in extracts of *Uncaria tomentosa* by HPLC-ES/MS. *Phytochemical Analysis*, 15(1): 55-64, <https://doi.org/10.23880/izab-16000125>.
- Moraes R.C., Lana A.J.D., Kaiser S., Carvalho A.R., Oliveira L.F.S.D., et al., 2015. Antifungal activity of *Uncaria tomentosa* (Willd.) D.C. against resistant non-*albicans* *Candida* isolates. *Industrial Crops and Products*, 69: 7-14, <https://doi.org/10.1002/chin.200517191>.
- Navarro M., Zamora W., Quesada S., Azofeifa G., Alvarado D., et al., 2017. Fractioning of proanthocyanidins of *Uncaria tomentosa*. Composition and structure-bioactivity relationship. *Antioxidants*, 6: 60, <https://doi.org/10.21275/mr231205040746>.
- Navarro-Hoyos M., Lebron-Aguilar R., Quintanilla-Lopez J., Cueva C., Hevia D., et al., 2017. Proanthocyanidin characterization and bioactivity of extracts from different parts of *Uncaria tomentosa* L. (Cat's Claw). *Antioxidants*, 6: 12, <https://doi.org/10.1016/j.jep.2006.03.018>.
- Navarro-Hoyos M., Alvarado-Corella D., Moreira-Gonzalez I., Arnaez-Serrano E., Monagas-Juan M., 2018. Polyphenolic composition and antioxidant activity of aqueous and ethanolic extracts from *Uncaria tomentosa* bark and leaves. *Antioxidants*, 7: 65, <https://doi.org/10.1016/j.aquaculture.2018.06.061>.
- Neto J.N., Coelho T.M., Aguiar G.C., Carvalho L.R., Araujo A.G.P.D., et al., 2011. Experimental endometriosis reduction in rats treated with *Uncaria tomentosa* (cat's claw) extract. *European Journal of Obstetrics and Gynecology and Reproductive Biology*, 154(2): 205-208, <https://doi.org/10.1093/molehr.5.2.96>.
- Nunes M.A.S., Silva L.D.S., Santos D.M., Cutrim B.D.S., Vieira S.L., et al., 2022. *Schinus terebinthifolius* leaf lectin (SteLL) reduces the bacterial and inflammatory burden of wounds infected by *Staphylococcus aureus* promoting skin repair. *Pharmaceutical*, 15(11): 1441, <https://doi.org/10.23880/jenr-16000384>.
- Oliveira M.B.S., Valentim I.B., Rocha T.S., Santos J.C., Pires K.S.N., et al., 2020a. *Schinus terebinthifolius* Raddi extracts: From sunscreen activity toward protection of the placenta to Zika virus infection, new uses for a well-known medicinal plant. *Industrial Crops and Products*, 152: 112503, <https://doi.org/10.1021/acsfoodscitech.3c00263.s001>.
- Oliveira R.F., Henry F.D.C., Valle F.D., Oliveira D.B.D., Santos Junior A.C.D., et al., 2020b. Effect of the fruit aqueous extract of Brazilian pepper tree (*Schinus terebinthifolius*, Raddi) on selected quality parameters of frozen fresh prok sausage. *Journal of Agriculture and Food Research*, 2: 100055, <https://doi.org/10.23880/izab-16000125>.
- Oliveira O.A., Ferreira S.R., Ferreira A.T.S., Perales J., Fernandes K.V.S., Oliveira A.E.A., 2022. Deleterious effects of *Schinus terebinthifolius* Raddi seed flour on cowpea weevil, *Callosobruchus maculatus* (F.), larval development. *Pesticide Biochemistry and Physiology*, 183, 105082, <https://doi.org/10.1016/j.pestbp.2022.105082>.
- Oliveira K.C., Franciscato L.M.S.S., Mendes S.S., Barizon F.M.A., Goncalves D.D., et al., 2024. Essential oil from the leaves, fruits and twigs of *Schinus terebinthifolius*: chemical composition, antioxidant, and antibacterial potential. *Molecules*, 29(2): 469, <https://doi.org/10.3390/molecules29020469>.
- Oogaki Y., Ozawa R., Seshima K., Shinoda, R., Torii, Y., et al., 2021. *Uncaria tomentosa* extract (AC-11) improves pregnancy hypertension together with suppression of sFlt-1 and sEng. *Pregnancy Hypertension*, 26: 127-132, <https://doi.org/10.1016/j.preghy.2021.10.013>.
- Paradowska K., Wolniak M., Pisklak M., Glinski J.A., Davey M.H., et al., 2008. ¹³C, ¹⁵N CPMAS NMR and GIAO DFT calculations of stereoisomeric oxindole alkaloids from Cat's Claw (*Uncaria tomentosa*). *Solid State Nuclear Magnetic Resonance*, 34(4): 202-209, <https://doi.org/10.1016/j.ssnmr.2008.10.002>.
- Patocka J., Almeida J.D.D., 2017. Brazilian pepper tree: review on pharmacology. *Military Medical Science Letters*, 86(1): 32-41, <https://doi.org/10.31482/mmsl.2017.005>.
- Pavei C., Kaiser S., Verza S.G., Borre G.L., Ortega G.G., 2012. HPLC-PDA method for quinovic acid glycosides assay in Cat's claw (*Uncaria tomentosa*) associated with UPLC/Q-TOF-MS analysis. *Journal of Pharmaceutical and Biomedical Analysis*, 62: 250-257, <https://doi.org/10.1016/j.jpba.2011.12.031>.
- Paz S.M.-D.I., Puerta R.D.I., Fernandez-Arche A., Quilez A.M., Muriana F.J.G., et al., 2015. Pharmacological effects of mitraphylline from *Uncaria tomentosa* in primary human monocytes: Skew toward M2 macrophages. *Journal of Ethnopharmacology*, 170: 128-135, <https://doi.org/10.1016/j.jep.2015.05.002>.
- Pilarski R., Zielinski H., Ciesiolka D., Gulewicz K., 2006. Antioxidant activity of ethanolic aqueous extracts of *Uncaria tomentosa* (Willd.) DC. *Journal of Ethnopharmacology*, 104(1-2): 18-23, <https://doi.org/10.1016/j.phymed.2006.12.023>.
- Pilarski R., Filip B., Wietrzyk J., Kuras M., Gulewicz K., 2010. Anticancer activity of the *Uncaria tomentosa* (Willd.) DC. Preparations with different oxindole alkaloid composition. *Phytomedicine*, 17(14): 1133-1139, <https://doi.org/10.1021/np50056a010>.
- Pilarski R., Gurrola-Diaz C.M., Garcia-Lopez P.M., Soldevila G., Olejnik A., et al., 2013. Enhanced proapoptotic response of the promyelocytic leukemia HL-60 cells treated with an *Uncaria tomentosa* alkaloid preparation. *Journal of Herbal Medicine*, 3(4): 149-156, <https://doi.org/10.1079/fc.49031.20210113984>.
- Piras A., Marzouki H., Falconieri D., Porcedda S., Goncalves M.J., et al., 2017. Chemical composition and biological activity of volatile extracts from leaves and fruits of *Schinus terebinthifolius* Raddi from Tunisia. *Records of Natural Products*, 11(1): 9-16, [https://doi.org/10.1016/0021-9673\(94\)80511-3](https://doi.org/10.1016/0021-9673(94)80511-3).
- Piscocya J., Rodriguez Z., Bustamante S.A., Okuhama N.N., Miller M.J., et al., 2001. Efficacy and safety of freeze-dried cat's claw in osteoarthritis of the knee: Mechanisms of action of the species *Uncaria guianensis*. *Inflammation Research*, 50: 442-448, [https://doi.org/10.1016/s0031-9422\(01\)00043-7](https://doi.org/10.1016/s0031-9422(01)00043-7).
- Prado E.G., Garcia Gimenez M.D., Vazquez R.D.I.P., Sanchez J.L.E., Rodriguez M.T.S., 2007. Antiproliferative effects of mitraphylline, a pentacyclic oxindole alkaloid of *Uncaria tomentosa* on human glioma and neuroblastoma cell lines. *Phytomedicine*, 14(4): 280-284, <https://doi.org/10.1016/j.phymed.2006.12.023>.

- Rebolledo V., Otero M.C., Delgado J.M., Torres F., Herrera M., et al., 2021. Phytochemical profile and antioxidant activity of extracts of the Peruvian peppertree *Schinus areira* L. from Chile. *Saudi Journal of Biological Sciences*, 28(1): 1052-1062, <https://doi.org/10.1016/j.sjbs.2020.10.043>.
- Reis S.R.I.N., Valente L.M.M., Sampaio A.L., Siani A.C., Gandini M., et al., 2008. Immunomodulating and antiviral activities of *Uncaria tomentosa* on human monocytes infected with dengue Virus-2. *International Immunopharmacology*, 8(3): 468-476, <https://doi.org/10.1016/j.intimp.2007.11.010>.
- Reis M.Y.D.F.A., Xavier A.L.D.M., Souza R.R.M.D., Ramalho I.M.D.M., Nascimento Y.M.D., et al., 2023. Pink pepper (*Schinus terebinthifolius* Raddi) essential oil: phytochemical composition and cytotoxic activity. *Natural Product Research*, <https://doi.org/10.1016/j.foodcont.2018.07.034>.
- Richter R., von ReuB S.H., Konig W.A., 2010. Spirocyclopropane-type sesquiterpene hydrocarbons from *Schinus terebinthifolius* Raddi. *Phytochemistry*, 71(11-12): 1371-1374, <https://doi.org/10.1016/j.phytochem.2010.05.003>.
- Rinner B., Li Z.X., Haas H., Siegl V., Sturm S., et al., 2009. Antiproliferative and pro-apoptotic effects of *Uncaria tomentosa* in human medullary thyroid carcinoma cells. *Anticancer Research*, 29: 4519-4528, <https://doi.org/10.1016/j.jep.2017.09.031>.
- Riva L., Coradini D., Di Fronzo G., De Feo, V., De Tommasi, N., et al., 2001. The antiproliferative effects of *Uncaria tomentosa* extracts and fractions on the growth of breast cancer cell line. *Anticancer Research*, 21: 2457-2461, <https://doi.org/10.5530/pc.2018.1.3>.
- Rizzi R., Re F., Bianchi A., Feo V.D., Simone F.D., et al., 1993. Mutagenic and antimutagenic activities of *Uncaria tomentosa* and its extracts. *Journal of Ethnopharmacology*, 38(1): 63-77, [https://doi.org/10.1016/0378-8714\(93\)90080-o](https://doi.org/10.1016/0378-8714(93)90080-o).
- Rocha P.D.S.D., Boleti A.P.D.A., Vieira M.D.C., Carollo C.A., Silva D.B.D., et al., 2019. Microbiological quality, chemical profile as well as antioxidant and antidiabetic activities of *Schinus terebinthifolius* Raddi. *Comparative Biochemistry and Physiology Part C: Toxicology & Pharmacology*, 220: 36-46, <https://doi.org/10.1016/j.cbpc.2019.02.007>.
- Rocha P.D.S.D., Paula V.M.B., Olinto S.C.F., Santos E.L.D., Souza K.D.P., et al., 2020. Diversity, chemical constituents and biological activities of endophytic fungi isolated from *Schinus terebinthifolius* Raddi. *Microorganisms*, 8(6): 859, <https://doi.org/10.21577/1984-6835.20190113>.
- Rojas-Duran R., Gonzalez-Aspajo G., Ruiz-Martel C., Bourdy G., Doroteo-Ortega V.H., et al., 2012. Anti-inflammatory activity of Mitraphylline isolated from *Uncaria tomentosa* bark. *Journal of Ethnopharmacology*, 143(3): 801-804, <https://doi.org/10.1515/znc-1987-1-203>.
- Rosas E.C., Correa L.B., Padua T.D.A., Costa T.E.M.M., Mazzei J.L., et al., 2015. Anti-inflammatory effect of *Schinus terebinthifolius* Raddi hydroalcoholic extract on neutrophil migration in zymosan-induced arthritis. *Journal of Ethnopharmacology*, 175: 490-498, <https://doi.org/10.4103/0973-1296.160459>.
- Salem M.Z.M., El-Hefny M., Ali H.M., Elansary H.O., Nasser R.A., et al., 2018. Antibacterial activity of extracted bioactive molecules of *Schinus terebinthifolius* ripened fruits against some pathogenic bacteria. *Microbial Pathogenesis*, 120: 119-127, <https://doi.org/10.37473/fic/10.1007/s11033-022-07193-8>.
- Sanchez-Hernandez, E., Martin-Ramos, P., Martin-Gil, J., Santiago-Aliste, A., Hernandez-Navarro, S., et al., 2022. Bark extract of *Uncaria tomentosa* L. for the control of strawberry phytopathogens. *Horticulturae*, 8(8): 672, <https://doi.org/10.1080/0972060x.2009.10643686>.
- Sandoval M., Charbonnet R.M., Okuhama N.N., Roberts J., Krenova Z., et al., 2000. Cat's claw inhibits TNF α production and scavenges free radicals: role in cytoprotection. *Free Radical Biology and Medicine*, 29(1): 71-78, <https://doi.org/10.1163/22941932-90000114>.
- Sandoval M., Okuhama N.N., Zhang X.-J., Condezo L.A., Lao J., et al., 2002. Anti-inflammatory and antioxidant activities of cat's claw (*Uncaria tomentosa* and *Uncaria guianensis*) are independent of their alkaloid content. *Phytomedicine*, 9(4): 325-337, <https://doi.org/10.1078/0944-7113-00117>.
- Santana J.S., Sartorelli P., Guadagnin R.C., Matsuo A.L., Figueiredo C.R., et al., 2012. Essential oils from *Schinus terebinthifolius* leaves-chemical composition and *in vitro* cytotoxicity evaluation. *Pharmaceutical Biology*, 50(10): 1248-1253, <https://doi.org/10.3109/13880209.2012.666880>.
- Santos K.F., Gutierrez J.M., Pillat M.M., Rissi V.B., Araujo M.D.C.D.S., et al., 2016. *Uncaria tomentosa* extract alters the catabolism of adenine nucleotides and expression of ecto-5'-nucleotidase/CD73 and P2X7 and A1 receptors in the MDA-MB-231 cell lines. *Journal of Ethnopharmacology*, 194: 108-116, <https://doi.org/10.1016/j.jep.2016.08.051>.
- Sassi A.B., Elayeb A., Karaman I., Marzouk B., Mastouri M., 2020. Phytochemical profile and antiproliferative, anti-tyrosinase, antioxidant, and antibacterial potential of *Schinus terebinthifolius* growing in Tunisia. *Journal of Herbs, Spices, & Medicinal Plants*, 26(1): 61-76, <https://doi.org/10.1080/10496475.2019.1677277>.
- Sereniki A., Linard-Mediros C.F.B., Silva S.N., Silva J.B.R., Sobrinho T.J.S.P., et al., 2016. *Schinus terebinthifolius* administration prevented behavioral and biochemical alterations in a rotenone model of Parkinson's disease. *Revista Brasileira de Farmacognosia*, 26(2): 240-245, <https://doi.org/10.1016/j.bjp.2015.11.005>.
- Shahrajabian M.H., Sun W., 2024a. The significance and importance of dPCR, qPCR, and SYBR green PCR kit in the detection of numerous diseases. *Current Pharmaceutical Design*, 30(3): 1-11, <https://doi.org/10.2174/0113816128276560231218090436>.
- Shahrajabian M.H., Sun W., 2024b. Mechanism of action of collagen and epidermal growth factor: A review on theory and research methods. *Mini-Reviews in Medicinal Chemistry*, 24(4): 453-477, <https://doi.org/10.2174/1389557523666230816090054>.
- Shahrajabian M.H., Sun W., 2024c. Carob (*Ceratonia siliqua* L.), pharmacological and phytochemical activities of neglected legume of the Mediterranean basin, as functional food. *Reviews on Recent Clinical Trials*, 19(2): 1-15, <https://doi.org/10.2174/0115748871278128240109074506>.
- Shahrajabian M.H., Sun W., 2024d. Importance of thymoquinone, sulforaphane, phloretin, and epigallocatechin and their health benefits. *Letters in Drug Design and Discovery*, 21(2): 209-225, <https://doi.org/10.2174/1570180819666220902115521>.
- Shahrajabian M.H., Sun W., 2024e. Biochar amendment and its impacts on medicinal and aromatic plants in sustainable agriculture. *Current Green Chemistry*, 11(3): 296-311, <https://doi.org/10.37766/insplasy2022.7.0024>.

- Sheng Y., Akesson C., Holmgren K., Bryngelsson C., Giampapa V., et al., 2005. An active ingredient of Cat's Claw water extracts: Identification and efficacy of quinic acid. *Journal of Ethnopharmacology*, 96(3): 577-584, <https://doi.org/10.1055/s-2004-815536>.
- Shi Z., Lu Z., Zhao Y., Wang Y., Zhao-Wilson X., et al., 2013. Neuroprotective effects of aqueous extracts of *Uncaria tomentosa*: Insights from 6-OHDA induced cell damage and transgenic *Caenorhabditis elegans* model. *Neurochemistry International*, 62(7): 940-947, <https://doi.org/10.1079/cabi-compendium.55695>.
- Silva R.G.D., Fileti A.M.F., Foglio M.A., Ruiz A.L.T.G., Rosa P.D.T.V., 2017. Supercritical carbon dioxide extraction of compounds from *Schinus terebinthifolius* Raddi fruits: Effects of operating conditions on global yield, volatile compounds, and antiproliferative activity against human tumor cell lines. *The Journal of Supercritical Fluids*, 130: 10-16, <https://doi.org/10.32388/cpdohj>.
- Silva B.G.D., Foglio M.A., Rosa P.D.T.V., Taranto O.P., Fileti A.M.F., 2019. Optimization of hydrodistillation and *in vitro* anticancer activity of essential oil from *Schinus terebinthifolius* Raddi fruits. *Chemical Engineering Communications*, 206(5): 619-629, <https://doi.org/10.1080/00986445.2018.1515074>.
- Simomura V.L., Miorando D., Oliveira B.M.M.D., Manica A., Bohnen L.C., et al., 2024. Aqueous extract of the bark of *Uncaria tomentosa*, an Amazonian medicinal plant, promotes gastroprotection and accelerates gastric healing in rats. *Journal of Ethnopharmacology*, 321: 117542, <https://doi.org/10.1016/j.jep.2023.117542>.
- Souza A.R.M.D., Arthur V., Nogueira D.P., 2012. The effect of irradiation in the preservation of pink pepper (*Schinus terebinthifolius* Raddi). *Radiation Physics and Chemistry*, 81(8): 1082-1083, <https://doi.org/10.1016/j.radphyschem.2012.02.040>.
- Sowjanya J.N., Rao P.R., 2023. Development, optimization, and *in vitro* evaluation of novel fast dissolving oral films (FDOFs) of *Uncaria tomentosa* extract to treat osteoarthritis. *Heliyon*, 9(3): e14292, <https://doi.org/10.1016/j.heliyon.2023.e14292>.
- Sun W., Shahrajabian M.H., Soleymani A., 2024a. The roles of plant-growth-promoting rhizobacteria (PGPR)-based biostimulants for agricultural production systems. *Plants*, 13(613): 1-38, <https://doi.org/10.3390/plants13050613>.
- Sun W., Shahrajabian M.H., Kuang Y., Wang N., 2024b. Amino acids biostimulants and protein hydrolysates in agricultural sciences. *Plants*, 13(210): 1-22, <https://doi.org/10.3390/plants13020210>.
- Sun W., Shahrajabian M.H., Guan L., 2025a. The biocontrol and growth-promoting potential of *Penicillium* spp. and *Trichoderma* spp. in sustainable agriculture. *Plants*, 14(13): 2007, <https://doi.org/10.3390/plants14132007>.
- Sun W., Shahrajabian M.H., Ma K., Wang S., 2025b. Advances in molecular function and recombinant expression of human collagen. *Pharmaceuticals*, 18(3): 430, <https://doi.org/10.3390/ph18030430>.
- Sun W., Shahrajabian M.H., Wang N., 2025c. A study of the different strains of the genus *Azospirillum* spp. on increasing productivity and stress resilience in plants. *Plants*, 14(2): 267, <https://doi.org/10.3390/plants14020267>.
- Tlili N., Yahia Y., Feriani A., Labidi A., Ghazouani L., Nasri N., Saadaoui E., Khaldi A., 2018. *Schinus terebinthifolius* vs *Schinus molle*: A comparative study of the effect of species and location on the phytochemical content of fruits. *Industrial Crops and Products*, 122: 559-565, <https://doi.org/10.1016/j.indcrop.2018.05.080>.
- Torre R., Medeiros E.A.D.P.D., Pereira C.D.S.B., Menezes A.C.R., Fontes I.S., et al., 2024. Protection of cowpea seeds and toxicity against cowpea weevils by the essential oils from *Lippia alba* (Verbenaceae) and *Schinus terebinthifolius* (Anacardiaceae). *Crop Protection*, 180: 106670, <https://doi.org/10.1016/j.cropro.2024.106670>.
- Uliana M.P., Fronza M., Silva A.G.D., Vargas T.S., Andrade T.U.D., et al., 2016. Composition and biological activity of Brazilian rose pepper (*Schinus terebinthifolius* Raddi) leaves. *Industrial Crops and Products*, 83: 235-240, <https://doi.org/10.1016/j.indcrop.2015.11.077>.
- Vieira J.D.S., Oliveira V.S.D., Carneiro M.J., Silva T.L.D., Augusta I.M., et al., 2023. Phenolic composition and insights into the use of pink pepper (*Schinus terebinthifolius* Raddi) fruit against lipid oxidation in food systems. *Food Bioscience*, 53: 102556, <https://doi.org/10.1016/j.fbio.2023.102556>.
- Yepes-Perez A.F., Herrera-Calderon O., Quintero-Saumeth J., 2020. *Uncaria tomentosa* (cat's claw): a promising herbal medicine against SARS-CoV-2/ACE-2 junction and SARS-CoV-2 spike protein based on molecular modeling. *Journal of Biomolecular Structure and Dynamics*, pp. 1-17, <https://doi.org/10.1080/07391102.2020.1837676>.
- Zari A., Alfarteesh H., Buckner C., Lafenie R., 2021. Treatment with *Uncaria tomentosa* promotes apoptosis in B16-BL6 mouse melanoma cells and inhibits the growth of B16-BL6 tumours. *Molecules*, 26: 1066, <https://doi.org/10.3390/molecules26041066>.
- Zotti-Sperotto N.C., de Avila M.B.R., de Souza R.A., Melo E.D.C., Governici J.L., et al., 2021. Intermittent drying of *Lippia origanoides* H.B.K. leaves and *Schinus terebinthifolius* Raddi fruits. *Industrial Crops and Products*, 161: 113152, <https://doi.org/10.1016/j.indcrop.2020.113152>.

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