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Ethnopharmacological implications of *Argemone ochroleuca – A Critical Review*

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ABSTRACT

In the genus Argemone (Papaveraceae) there are approximately 30 species; most of them are perennial herbs with prickly stems, capsules, and leaves. This is a genus that is invasive around the world and has significant economic significance. An ethnopharmacological review of Argemone ochroleuca is presented in this article. Several ailments can be treated with this plant, such as eye infections, dermatological disorders, insomnia, warts, scabies, and spots. A large proportion of alkaloids are found in the Argemone genus including flavonoids, fatty acids, tannins, saponins, phenols, terpenoids, steroids, proteins, and carbohydrates.

Keywords: *A. ochroleuca*; Papaveraceae; ethnopharmacological significance

INTRODUCTION

Non-native plants (weeds) can disturb ecosystem operations such as nutrient cycling. Weeds promote a decline in ecosystem diversity and an overall decrease in native plant species abundance. *Argemone ochroleuca* is an invasive worldwide medicinal plant with economic importance. It occurs as a weed of pastures, arable land, and in waste places, roadsides and fence rows (Sanna AIM, 2012). *A. ochroleuca* is commonly known as Mexican prickly poppy and chicalote. *A. ochroleuca* is an annual or perennial herb having a short life. *A. ochroleuca* is native and noxious weed of various agricultural crops and pastures in semi-arid and arid regions of Africa, Asia and Australia includes crop fields in Eastern Ethiopia, widespread in Taif area, North America widely spread from Southern USA to Central Mexico (Sanna AIM *et al.,* 2012). It has the ability to invade disturbed areas and roadside verges, where it rapidly regenerates after rain and spreads from viable seed banks. *A. ochroleuca* was identified as a new species in India by (Reddy CS and Chiranjibi P, 2007) in Andhra Pradesh and in Gujarat by (Patel NK *et al.,* 2013). *A. ochroleuca* is an erect annual herb up to 50cm in height. Young stems are whitish purple in colour. Leaves are oblanceolate, semi amplexicaul, and sessile at base, sinuate to pinnatified, basal leaves deeply lobed, lobes oblong, glaucous. Flower buds are oblong. Flowers are whitish or pale lemon yellow in colour, sepals three, and petals six, obviate. Stamens are numerous, long filaments pale yellow, anthers oblong, recurved dark yellow. Stigmas five lobed, deeply dissected, dark red, capsules ovoid or lanceolate ovoid (Reddy CS and Chiranjibi P, 2007).

Figure 1: *Argemone ochroleuca*

Survival of *A. ochroleuca* in different ecological conditions

Two closely related species, *A. mexicana L*. And *A. ochroleuca Sweet,* are often found together, responding differently to nitrogen, phosphorus, and potassium. Their nutrient uptake, shoot-to-root ratios, and total yield are all different. The two species live in ecologically distinct habitats, but can also live in apparent co-existence (Ramakrishnan PS and Usha G, 1972). Plant density and their response to

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associated species of *A. mexicana L.* as well as *A. ochroleuca Sweet,* was examined. Both species displayed a high mortality rate and marked decline in vegetative and reproductive growth when their own density was increased, but *A. mexicana* showed greater susceptibility than *A. ochroleuca* (Ramakrishnan P. S. and Jeet N, 1972).

Taif native desert communities were investigated to determine the role played by *Argemone ochroleuca Sweet*, an exotic worldwide weed, in a variety of habitats (sand plains, dams, wadies). (Sanna AIM, 2012). Based on the physiological and morphological characteristics of *Argemone*, it was observed that this plant is able to survive in conditions where humidity is limited and water is deficient for prolonged periods (Carbajal, X *et al.,* 2022). The mixed mating systems and reproductive assurance mechanisms are important for the reproduction of *A. ochroleuca,* an invasive weed with a similar mating pattern (Rios-Carrasco S. And Vázquez-Santana S. 2022).

Study on seed dormancy

A series of experiments was conducted on the dormancy of seeds of *Argemone ochroleuca Sweet* and *Argemone mexicana* L. Various durations of light and darkness, five temperature regimes and their different combinations were examined.The impact of *A. ochroleuca's* severe dormancy was shown in the field when only 8% of seeds sown generated seedlings in the first season after shedding. It was noticed that the greater number of seeds do not germinate during their first season after shedding but instead enter the seed bank and produce seedlings for several years, even in a well-maintained field (Laila MK *et al.,* 2003).

Taxonomic relationship

A discussion has been held regarding the combination of morphological and molecular data (chloroplast barcode) to understand the taxonomic relationship between *A. ochroleuca subsp ochroleuca and A. ochroleuca subsp stenopetla*. Flower diameter, petal shape, and stigmatic lobe structure differ between the two species. The stigmatic lobes of *ochroleuca ssp ochroleuca* are divergent or crossed in form. The lobes are not pushed on the style. The non-receptive patches are readily apparent and pinkish-blue in color. The stigmatic lobes of *A. ochroleuca ssp stenopetla* are divergent, with non-receptive portions evident. *Sub sp ochroleuca* capsules are lanceolate or oblong-elliptic, with robust, even-sized spines. Spines in *sub sp stenopetla* were enormous but mixed with little spines and prickles. Fruit features are frequently adaptable, and so mislead when resemblance is tried to indicate close kinship. Furthermore, prickle density and form are highly variable characteristics that cannot be used to classify species (Monika K and Malik CP, 2011).

Ethanopharmacological Importance of *A. ochroleuca*

a) Phytochemical analysis

Screening of phytochemical tests by using solvents viz. Petroleum ether, methanol and chloroform of seed extract indicated the presence of carbohydrates, tannins, flavonoids, alkaloid and phenols in methanol and chloroform extract. The presence of tannins, alkaloids and phenols were found in the petroleum ether, chloroform and methanol extract of leaf of *A. ochroleuca* (Mahmoud FMM *et al.,* 2013). Extraction into acidified methanol and HPLC showed dihydro sanguinarine and dihydro chelerythrine as major alkaloid components and minor amounts of sanguinarine ,chelerythrine , protopine and berberine (Fletcher MT *et al.*, 1993). In *A. ochroleuca*, a component of crystalline solid from seed oil is 11- oxo-octadecanoic acid and 11-oxo-triacontanoic acid, which are also the major components of *A. mexicana* (Alamri SA and Mahmoud FM, 2010**)**. Characterization of essential oil from the invasive plant *A. ochroleuca* has revealed approximately seventy four components via GC-MS analysis. The oxygenated components found as the key components, including mono, sesqui, and di-terpenes, as well as carotenoids and hydrocarbons. In addition, the overall mass was characterised as non-oxygenated constituents with mono, sesqui terpenes, and hydrocarbons as minors. From all identified components, γ-cadinene, trans-chrysanthenyl acetate, methyl ester, oleic acid, dihydromyrcenol, terpinen-4-ol, γ-himachalene and α-muurolene were found in plenty (Abd-ElGawad *et al.,* 2020). *Argemone ochroleuca* is known for its dihydro-keleritrin and dihydro-sanguinarine, two of the 45 alkaloids

found in the species. Diahydro-keleritrin is the most abundant alkaloid in the seeds and vegetative tissue of *A. ochroleuca* (Hernández-Ruiz J.*et al.,* 2020).

b) Allelopathic effects:

It was found that aqueous extracts from rangeland habitat exhibited high allelopathic potential, inhibiting seed germination at 100% concentration (Basharat A.D. *et al.,* 2017). *A. ochroleuca* extract had concentration-dependent inhibitory effects on germination and growth variables with shoot extracts exhibiting greater anti allelopathic activity than root extracts (Mlombo N. *et al.,* 2021).

Table 1: Biological activity of *Argemone ochroleuca*

Used plant tissue /product	Antimicrobial activity	Technique used	Microorganisms tested	References
Crude latex	Antibacterial activity	Agar well diffusion method	*Bacillus subtilis, Enterobacter aerogenes, Micrococcus luteus, Escherichia coli, and Staphylococcus aureus*	(Alamri S.A. and Mahmoud F.M. 2010)
Crude latex	Antifungal activity	Agar well diffusion method	*Candida albicans, Candida glabrata, Candida krusei* and *Candida tropicalis, Alternaria alternate, Drechslera halodes, Fusarium oxysporum, Macrophomina phaseolina, Pythium ultimum* and *Rhizoctonia solani*	(Mahmoud F.M.M. *et al.,* 2013)
Aerial parts(methanol extract)	Antimicrobial activity, antifungal activity, antibacterial activity	Minimal Inhibitory Concentration (MIC)	*C. neoformans, S. aureus, S. epidermidis, B. subtilis, Vibrio cholerae CDC V12, Cryptococcus neoformans,* and *Candida albicans,*	(Reyes F.D. *et al.,*2011)
Aerial parts (methanolic extract)	Antimicrobial activity	Agar well diffusion method	*Escherichia coli, Proteus vulgaris, Pseudomonas aeruginosa, Staphylococcus aureus, Sarcinalutea, Bacillus subtilis, Mycobacterium phlei* and *Candida albicans*	(Abdel-Sattar E *et al.,* 2008
Aerial parts (methanol, hexane and ethyl acetate extracts)	Antimicrobial activity	MIC	*S.aureus* and *C. neoformans*	(Fletcher M.T. *et al.,* 1993)
Seed and leaf oil	Antifungal activity	Disc diffusion method	*A.niger* and *F. oxysporum*	(Alamri S.A. and Mahmoud F.M., 2010)
Aerial parts (petroleum ether, ethyl acetate and chloroform extracts)	Antiprotozoal activity	Agar well diffusion method	*P. falciparum GHA, T. cruzi*	(Abdel-Sattar, E. *et al.*, 2010)
Mixture of tertiary and quaternary alkaloids	Antifungal (inhibition of spore germination)	Agar well diffusion method	*Alternaria alternata*, *Alternaria brassicae*, *Alternariacajani*, *Bipolaris* sp., *Curvularia lunata*, *Curvularia* sp., *Colletotrichum musae*, *Fusariumudum*, *Helminthosporium* sp., *Helminthosporiumpennisetti* and *Helminthosporium speciferum*. Spore germination of *Fusarium udum* and *Helminthosporium* sp.	(Singh S. *et al.,* 2010)
Aerial parts (ethanol crude extract)	Antimicrobial activity	Disk diffusion method	*Staphylococcus aureus, Bacillus subtilis, Streptococcus faecalis, Escherichia coli and Candida albicans*	(EncarnacionDimayuga R. *et al.,* 1998)

c) Medicinal Importance:

There is a clinical condition known as Epidemic Dropsy that is associated with consumption of oil extracted from *Argemone* seeds that have been accidentally or deliberately contaminated with mustard seeds (Mukul D. and Subhash K.K., 1997). A survey of paediatric patients with asthma, bronchitis, cough, and other respiratory issues was conducted using the aerial parts of *A. ochroleuca*. Dichloromethane extract of leaves and flowers have been reported for a relaxant action mechanism in guinea pig tracheal smooth muscle (Sánchez-Mendoza M E *et al.,* 2008). It is used as traditional medicine by the dwellers of Tepotzotlan, State of Mexico. Based on information obtained from curers in the region it is known that mixtures of the aerial part are used to relieve eye infections, warts and spots, cough, dermatological disorders and combat insomnia (Carbajal X O *et al.,* 2022).

d) Antimicrobial Activity of *A. ochroleuca*:

Study showed *Mycobacterium phlei* was effectively inhibited by *A. ochroleuca* (Abdel-

Sattar E. *et al.,* 2008).Some plant pathogenic fungi were tested against spore germination by the mixture of tertiary and quaternary alkaloids isolated from *Argemone ochroleuca* (Singh S *et al.,* 2010). Antiprotozoal activity of *A. ochroleuca* was tested against *Plasmodium falciparum, Trypanosoma bruceibrucei, T. cruzi* and *Leishmania infantum* (Abdel-Sattar, E *et al.,* 2010). A total of thirteen bacteria and nine fungi were tested for antimicrobial activity in which the most sensitive strains were *Staphylococcus aureus* and *C. neoformans*. Antimicrobial activity was found in the methanol extract only (Francisco DR *et al.,* 2011). Crude latex of *Argemone ochroleuca* showed an effective zone of inhibition using well diffusion method for its antifungal properties against four clinical *Candida species (Candida albicans, Candida glabrata, Candida krusei,* and *Candida tropicalis)* and six plant pathogen species (*Alternaria alternate, Drechslera halodes, Fusarium oxysporum, Macrophomina phaseolina, Pythium ultimum)* (Mahmoud FMM *et al.,* 2013; Alamri SA and Mahmoud FM, 2010**)**. *Staphylococcus aureus, Bacillus subtilis,* were tested for antimicrobial activity using ethanol extracts from *A. ochroleuca* and was used in traditional medicine in Baja California Sur (Mexico) (Encarnacion Dimayuga R *et al.,* 1998).

A review of antibacterial, antifungal, antiprotozoal activities studied till date is briefly summarised in Table 1.

CONCLUSION

A. ochroleuca is a medicinal plant invasive worldwide with economically important spp. It is widely distributed in Taif Governorate KSA. The reason behind this review was that *Argemone* communities occupy virtually every habitat where extreme conditions keep out other forms of life. This article sums up all the studies conducted so far on the plant *A. ochroleuca* reports suggest that this plant rich in alkaloids namely (dihydrosanguinarine, dihydrochelerythrine, sanguinarine, chelerythrine, protopine and berberine), flavonoids, tannins and phenols. Various extracts of *A. ochroleuca* such as petroleum ether, methanol, hexane, ethanol, ethyl acetate and chloroform report its antimicrobial, antibacterial and antifungal properties against different pathogens. It was found to be most effective against *Candida albicans, Candida glabrata, Candida krusei, and Candida tropicalis, Alternaria alternate, Drechslera halodes, Fusarium oxysporum, Macrophomina phaseolina, Pythium ultimum, Staphylococcus aureus, Bacillus subtilis, Streptococcus faecalis, Escherichia coli and Candida albicans.* Out of all the extract used methanolic extract of *A. ochroleuca*is most effective against *S.aureus and C. neoforman.* There are several reports on its survival in different ecological conditions and limited reports on medicinal importance and its allelopathic effect have been reported. A summary of all the available literature is provided here so that readers can gain a better understanding of what *Argemone ochroleuca* is, what its potential is, and how it might be used. *Argemone ochroleuca's* potential for future application and research will be invigorated by this review.

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