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RESEARCH ARTICLE

UTILITY OF MAKO (*SOLANUM NIGRUM*) IN UNANI SYSTEM OF MEDICINE

***Fouzia Bashir**

Research Associate, Central Council for Research in Unani Medicine, 61-65 Institutional Area, Opposite D-Block, Janakpuri, New Delhi. India

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ABSTRACT

The various traditional systems such as Unani, Ayurveda and Siddha use several plant species to treat different ailments. The Unani (Greco-Arab) system of medicine has been practiced since ancient times for the treatment of range of diseases. Mako (*Solanum nigrum*) is an important plant in traditional medicines belonging to the Solanaceae family. The plant is cultivated throughout the country in dry parts, quite common in cultivated lands, road sides and gardens. The Unani physicians have prescribed Mako in various ailments like Ascites, Piles, Chronic cirrhosis of the liver, Gonorrhoea, rheumatic and gouty joints and various skin disorders. Through this paper, an effort has been made to collect information on medicinal properties of Mako mentioned in Unani classical literature as well as those which have been validated in the light of recent scientific studies.

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INTRODUCTION

Medicinal plants have been used by humans for centuries in folklore medicine (Ghani, 2011). *Solanum nigrum* commonly known as Mako or black nightshade usually grows as a weed in moist habitats in different kinds of soils. Its two varieties are found, one is bearing black color fruit, and other one has reddish brown color fruit. In both varieties, black color fruits are toxic. The leaves, whole plant and roots are used for health point of view. It has been extensively used traditionally to treat various ailments such as hepatitis, pain, inflammation and fever (Anonymous, 2005 and Kirtikar and Basu, 2005). The plant is also used in the Oriental systems of medicine for various purposes – as an anti-tumorigenic, antioxidant (Nadkarni, 2005), anti-inflammatory (Jain, 2010), hepato protective (Nadkarni, 2007), diuretic (Jain, 2010), and antipyretic agent (Anonymous, 2005). Various compounds have been identified which are responsible for diverse activities. Mako is widely used in many traditional systems of medicine worldwide for disparate ailments but has not garnered attention for modern therapeutic use.

Scientific Classification

Kingdom: Plantae
Subkingdom: Tracheobionta
Superdivision: Spermatophyta
Division: Magnoliophyta
Class: Magnoliopsida
Subclass: Asteridae
Order : Solanales
Genus: Solanum
Species: *Solanum nigrum* L.
Authority: Linn (Potawale, 2008)

VERNACULAR NAMES

Sanskrit : Dhvansamaci
Bengali: Gudakamai
English: Garden night shade
Hindi: Makoya, Kakamachi, Kali makoy
Kannada: Ganikesopu
Malayalam : Manatakkali
Marathi : Kamoni
Punjabi: Mako, Peelak, Mamoli
Urdu: Mako
Arabic: Inab us Salab (JaniDilip, 2012)

Description

According to Unani Literature, Mako is of different types like *jangli, bustani* and *pahadi*. The branches of *bustani* variety are about one and a half meter, and its leaves are broad and blackish in color. Its flowers are small and white in color. Its fruits are round like that of small pea, and seeds are of small in size. Fresh fruits are of green color whereas dried fruits are of red color. Dried fruits contain small seeds like seeds of *Khashkhas* (Hakim, 2011 and Jurjani, 1878).

There are two types of Mako described by Ibn Baitar in *Al-Jami al-Mufradat wa al-Adwiya wa al-Aghzia* (1999) and successive writers followed the classification, such as Najmul Ghani, Hakim Momin, Ibn Hubal Baghdadi and others .Their description is as follows (Ghani, 2011 and Ibn Baitar, 1999).

Mako-e-Barri / Jangli: This variety has male and female. The male plant is known as *Inab-us-salab munawwim*, and female plant is known as *Inab-us-salab mujannan*.

Mako-e-Bustani: This variety has male and female variety too. The male plant is known as *Kaknaj*. The female plant is mainly used for medicinal purpose.

Mako-e-Hajari / Pahari: This variety of plant is known as *Kaknaj ghalia* and mainly cultivated in houses and it is smaller than *Kaknaj*.

Fig. 1. Leaves and Fruits of Mako

Macroscopic: The bark is thin and easily peeled off exposing pale yellow wood. The flowers have five petals and are generally regular in shape. They may be round and flat or star-shape, but are often bell shaped or tubular. Members of this family are often climbers or at least scrambling plants, often with hairy stem and leaves. The leaves are variable, and may be entire or dissected, without stipules, and are usually alternate. The morphological study shows the root with few branches and numerous small lateral roots, externally it is smooth pale brown. The fruit shows thin, papery epicarp, pulpy mesocarp and axle placentation, seeds lie free in pulp of fruit. The fruits are berry; 6mm diameter, obtuse, usually (Jain, 2010).

Microscopic: Its fruit is differentiated into an outer single layered epidermis and an inner fleshy mass of tissue in which the seeds are embedded. The epidermis is cutinised. The cells of the epidermis are rectangular to polygonal in shape. Below this, there is sub-epidermal collenchymatous layer. The ground tissue of the mesocarp is parenchymatous and filled with starch grains. Starch grains are simple or compound. The compound grains consist of 2-4 simple grains. The testa of the seed is nearly light brown to yellowish and smooth, the thickness being 15-20 microns. The testa consists of a single layer of stone cells. The hilum is present in the acute edge near the narrower end of the seed. The interior portion is filled with oily endosperm, embedded within which a cylindrical embryo 0.25-0.5 mm. in thickness having a hypocotyls and a radical, the radical in turn is directed towards the hilum and coiled parallel to the flat surfaces so as to bring the tips of the cotyledons adjacent to the radicle. Aleurone grains are observed in endosperm cells as main food reserve (Anonymous, 1987a).

Habitat and Distribution

These species are only semi-cultivated in a few countries in Africa and Indonesia, and are largely utilized as a vegetable and fruit source through harvesting from plants growing spontaneously as weeds in cultivated fields, or in weedy plant communities, under trees, along fences and roads, in shaded areas, near buildings and on waste land. They therefore constitute a volunteer crop. Some communities' semi cultivates the vegetable in home gardens or on fertile land portions near homesteads. There are a few reports of the cultivation of the garden huckleberry for its fruits in North America (Anonymous, 2005).

Part Used: Leaves, stems, flowers, seeds, root and fruits (Ghani, 2011; Nadkarni, 2005; Dymock, 2005; Anonymous, 2005; Al Biruni, 1973; Anonymous, 1987a; Kabiruddin, 2007 and Chatterjee, 1992).

MIZAJ (Temperament): Cold 2^{o}Dry 2^{o} (Ghani, 2011; Anonymous, 1987a and Kabiruddin, 2007).

AFAAL (Actions)

- *Muhallil-e-Auram* (Anti-inflammatory)
- *Dafa-e-Qai* (Antiemetic) (Anonymous, 2005 and Krishan, YNM)
- *Dafa-e-Is'hal* (Antidiarrheal) (Pullaiah, 2006 and Chatterjee, 1992).
- *Dafa-e-Zaheer* (Antidysentric) (Ghani 2011; Kirtikar & Basu, 2005 and Pullaiah, 2006)
- *Dafa-e-Humma* (Antipyretic /Febrifuge)
- *Dafa-e-Ratubat-e-Rahim* (Expellant of Uterine fluids) (Ghani, 2011 and Hakim, 2011).
- *Dafa-e-Suda* (Pain killer for headache) (Ghani, 2011; Kirtikar & Basu, 2005; Ibn Baitar, 1999 and Ibn Sina, 2007).
- *Mana-e-Hamal* (Abortifacient) (Ghani, 2011 and Ibn Sina, 2007).
- *Mubarrid* (Refrigerant) (Dymock, 2005; Kirtikar & Basu, 2005 and Ibn Baitar, 1999).

- *Mudir-e-Bawl* (Diuretic) (Ghani, 2011; Nadkarni. 2007; Dymock, 2005; Kirtikar & Basu, 2005; Pullaiah, 2006; Baghdadi, 2005; Anonymous, 1978a; Ibn Baitar, 1999; Ghulam, 2007; IbnSina, 2007; Anonymous, 2006).
- *Kasir-e-Riyah* (Carminative) (Ghani, 2011)
- *Mujaffif* (Desiccant) (Ghulam, 2007; Ibn Sina, 2007)
- *Mulattif* (Demulcent) (Ghani, 2011; Ghulam, 2007)
- *Mulayyin* (Laxative) (Ghani, 2011; Anonymous, 2005; Kirtikar & Basu, 2005; Ibn Baitar, 1999; Ghulam, 2007).
- *Munaffis* (Expectorant) (Nadkarni, 2007; Anonymous, 2005 and Kirtikar & Basu, 2005).
- *Munawwim* (Hypnotic) (Ghani, 2011; Nadkarni, 2007; Anonymous, 2005; Baghdadi, 2005; Ibn Baitar, 1999 Ibn Sina, 2007).
- *Musaffi-e-dam* (Blood purifier) (Ghani, 2011)
- *Mushil* (Purgative)
- *Musakkin-e-Alam* (Analgesic/Anodyne)
- *Musakkin-e-Atas* (Thirst quencher)
- *Mana-e-Sailan-e-Haiz* (Anti emmenagogue)
- *Qabiz* (Astringent)

Therapeutic Uses

- *Warm-e-Ahsha* (Inflammation of viscera)
- *Waram-e-Mida* (Gastritis)
- *Waram-e-Jigar* (Hepatitis)
- *Waram-e-Lisan* (Glossitis) (Ghani, 2011; Nadkarni, 2007; Dymock, 2005; Kirtikar & Basu, 2005; Hakim, 2011; Krishan, YNM; Anonymous, 1978a; Chatterjee, 1992; Ibn Baitar, 1999; Ibn Sina, 2007; Fazalullah, YNM and Anonymous, 2006)
- *Humma* (Fever) (Ghani, 2011; Nadkarni, 2007; Dymock, 2005; Kirtikar & Basu, 2005; Pullaiah, 2011; Anonymous, 1978a; 1978b and Chatterjee, 1992)
- *Suda* (Headache)
- *Waja-al-Mafasil* (Arthritis)
- *Waja-al-Chasm* (Ophthalgia)
- *Waja-al Gosh* (Otalgia),
- *Waja-al Dandan* (Toothache) (Ghani, 2011; Nadkarni, 2007; Dymock, 2005; Anonymous, 2005; Kirtikar & Basu, 2005; Hakim, 2011; Krishan, YNM ; Baghdadi, 2005; Anonymous, 1978a & 1978b; Ibn Baitar, 1999 and Chatterjee, 1992)
- *Zaheer* (Dysentry)
- *Is'hal* (Diarrhoea) (Ghani, 2011; Kirtikar & Basu, 2005; Hakim, 2011; Krishan, YNM; Kabiruddin, 2007; Ibn Baitar., 1999; Ghulam, 2007 and Ibn Sina, 2007)
- *Amraze Chasm-wa-Uzn-wa-Anf* (Eye, Ear, Nose diseases) (Ghani, 2011; Nadkarni, 2007; Kirtikar & Basu, 2005; Hakim, 2011; Ibn Baitar, 1999; Ibn Sina, 2007)
- *Amraz-e-Jild* (Skin diseases) (Nadkarni, 2007; Dymock, 2005; Anonymous, 2005; Kirtikar & Basu, 2005; Pullaiah, 2011; Hakim, 2011 and Ibn Baitar, 1999).

MIQDAR E KHOORAK (Dose): (Hakim, 2011 and Fazalullah, YNM)

7to 10 gms

MURAKKABAT (Compound formulations) (Hakim, 2011**)** *ArqMako*

Chemical Constituents

Green unripe fruits contain glycol alkaloids and their eating is a toxic to human being as well as livestock that include solamargine, solasonine, solanine, α and β-solamagrine, solasodinsolanidine (0.09-0.65%). The former two also found in leaves. Solanine is found in all parts of the plants, with the level increasing as the plant matures, though it is apparently modified by soil type and climate (Dymock, 2005).

PHYSICOCHEMICAL STUDIES (Anonymous, 1987a)

Total ash : Not more than 16 per cent
Acid insoluble : Not more than 7 per cent
Alcohol soluble extractive : Not less than 4 per cent
Water-soluble extractive : Not less than 15 per cent
Foreign matter : Not more than 2 per cent

Pharmacological Studies

Anti-diabetic activity: Akubugwo (2008) evaluated hypoglycaemic activity of the a*queous* and *hydro-alcoholic* extracts of different parts of Mako plant, viz., leaf, fruit and stem in Sprague Dawley rats. The results of the study indicated that aqueous extracts of leaf and fruit possessed significant hypoglycaemic effect in dose dependent manner, followed by hydroalcoholic extracts. It was observed that the stem extract of Mako had no profound effects (Akubugwo, 2008). Ali *et al.*, (2010) studied effect of crude *ethanolic* extract of Mako on blood sugar of albino rat after daily oral administration of dose at the level of 250mg/kg b.wt. for five and seven days, respectively. It was observed that the chronic administration for longer duration lead to significant decrease in blood sugar as compared to control. Hence, it could be concluded that Mako had the anti-diabetic property (Ali, 2010).

Immuno-stimulant activity: Hanifa (2011) studied that immune stimulant potential of Mako was an alternative for preventing fish diseases. On the basis of results of the study, the *ethanol* and *methanol extract* treated group showed less mortality rate when compared to chloroform toluene and water extract treated group. It was concluded that plant extracts had great potential as immune stimulant against micro-organisms and that they could be used in the treatment of infectious diseases caused by microorganisms (Hanifa, 2011).

Antimicrobial study: Kavishankar *et al.*, has investigated on the anti-bacterial activity of *methanol* and water extracts of Mako leaves. The study evaluated anti-bacterial activity and phytochemical screening was carried out to know the compounds responsible for these activities. On the basis of the results obtained, it could be concluded that methanol could be used for extracting antimicrobial compounds from leaves (Kavishankar, 2011).

Antibacterial study: Kavishankar *et al.*, (2011) studied on the antibacterial activity of methanol and water extracts of SO leaves by the phytochemical screening. The methanol and water extracts of the drug were tested against *Escherichia coli, Staphylococcus aureus, Entero bacteraerogenes* and *Pseudomonas aeruginosa.* On the basis of the results obtained,

it was concluded that methanol could be used for extracting antimicrobial compounds from leaves (Kavishankar, 2011).

Anti-HCV study: Javed *et al.*, (2011) studied on methanol and chloroform extracts of SO (SN) seeds and exhibited 37% and more than 50%inhibition of HCV, respectively at non -toxic concentration. The results of the study demonstrated that chloroform extract of *Solanum* extracts decreased the expression or function of HCV NS3protease in a dose dependent manner and GAPDH remained constant. These results suggested that extract of the SO contain potential antiviral agents against HCV and combination of SN extract with interferon would be better option to treat chronic HCV (Javed, 2011).

Anticonvulsant study: Son and Yen (2014) investigated the preliminary phytochemical properties, acute oral toxicity and anticonvulsant activity of the berries of SO in mice. In the result of the study, Phytochemical screening of berries of SO showed that they contain carbohydrates, flavonoids, saponins, tannins, alkaloids, phenols and steroids. The study suggested that the ethanol berry extract of SO was safe and possessed anticonvulsant activity in PTZ-induced seizure in mice (Son, 2014).

Antifungal study: Prakash and Jain (2011) conducted a study to evaluate the possibility for the presence of novel bio-active compounds against fungal pathogens. The preliminary phytochemical screening of the leaves revealed the presence of Alkaloids, Flavonols, Flavones, Flavanols, Saponins and Steroids. The results of the study showed presence of these bio-active compounds of SO against fungal pathogens (Prakash, 2011).

Antiulcer study: Jainu and Devi (2006) studied on the antiulcerogenic activity of the *methanolic* extract of SO berries on aspirin induced ulceration in rats with respect to antioxidant status in the gastric mucosa. The results of the study indicated that berries of the SO might exert its gastro-protective effect by a free radical scavenging action (Jainu, 2006).

Hepatoprotective study: Kuppuswamy *et al.*, (2003) carried out a study on *aqueous* and *methanolic* extracts of SO for hepato-protective activity in rats injected with 0.2 ml/kg carbon tetrachloride (CCl4) for 10 consecutive days. The results of the study showed remarkable hepato-protective activity of the *methanolic* extracts of SO (Kuppuswamy, 2003).

Antioxidant study: Jainu & Devi (2004) studied on the antioxidant activity of *methanolic* extract of berries of the plant SO by tissue biochemical antioxidant profile. The results of the study showed that the extract of berries exhibited significant ($p<0.001$) antioxidant activity as evident from the cardiac tissue biochemical antioxidant profile. It was showed that the *methanolic* extract of berries of the plant SO possessed antioxidant activity (Jainu, 2004).

Cardio protective study: Bhatia *et al.*, (2011) evaluated the cardio protective activity against global *in vitro* ischemia reperfusion injury of methanolic extract of berries of the plant SO by using doses of 2.5 and 5.0 mg/kg for 6 days per week for 30 days. The results of the study showed that the extract exhibited significant ($p<0.001$) cardio protective activity against global *in vitro* ischemia reperfusion injury. The results of the study showed cardio-protective activity of the *methanolic* extract of berries of the plant SO (Bhatia, 2011).

Analgesic study: Kaushik *et al.*, (2009) evaluated the analgesic activity of ethanolic extracts of SO by using Eddy's hot plate and acetic acid induced writhing, respectively. The study was carried out using doses of100, 250 & 500 mg/kg orally. The results of the study showed significant analgesic activity of the extracts of SO at the dose of 500mg/kg ($P<0.01$) as compared to standard drug Diclofenac sodium (50mg/kg) (Kaushik, 2009).

Anti -inflammatory study: Ravi *et al.*, (2009) carried out a study to evaluate the phytochemical and pharmacological activity of ethanolic extract of SO in experimental animal models. The results of the study showed that ethanolic extract of SO produced significant anti-inflammatory ($P <0.01$) and anticonvulsant ($P < 0.05$) effect in dose dependent manner. Thus, it was concluded that the flavonoids present in the berries might be responsible active constituent for anti-inflammatory activity (Ravi Kumar, 2009). Arunachalam *et.al* has investigated on the *methanolic* extract of whole plants of *Solanum nigrum* L. was investigated for anti-inflammatory activity on the experimental animal models. The methanolic extract decreased the edema induced in hind paw. The methanolic extract of *Solanum nigrum* (375 mg/kg b.w.) has showed significant anti-inflammatory activity. (Arunachalam, 2009).

Anti- Seizure study: Noel *et al.*, (2008) evaluated anti-seizure activity in chicks, mice and rats of aqueous extract of the leaves of *S. nigrum*. The results of the study suggested that aqueous leaf extract produced a significantly ($P<0.05$) dose dependent protection against electrically induced seizurein chicks and rats, pentylenetetrazole induced seizure in mice and ratsand picrotoxin induced seizure in mice and rats (Noel, 2008).

Nutritional study: Akubugwo *et al.*, (2007) studied the nutritional potential of the leaves and seeds of *Solanum nigrum* L. var*virginicum*. The results indicated protein content of the leaves and seed as 24.90% and 17.63%respectively. Levels of cyanide were found higher in the leaves as compared to the seeds. The results of the study suggested that despite the presence of some anti-nutritive components like oxalate, *Solanum nigrum* L. Var*virginicum* to be nutritive (Akubugwo, 2007).

Anthelmintic study: Elias *et al.*, (2013) conducted a study on leaves of SO for its pharmacognostical, phytochemical and anthelmintic activity. The results of the study showed that ethanol and water extracts exhibited significant anthelmintic activity as compared to the standard drug whereas petroleum ether and chloroform extracts of the SO showed less significant activity as compared with the standard drug (Elias, 2013).

Anti-cancerous study: Li *et al.*, (2008) carried out a study on the antitumor activity of aqueous extract of seeds of SO. The results of the study showed that SNL-AE could inhibit U14 cervical carcinoma growth. SNL-AE increased the number of CD4+ T lymphocyte subsets and the ratio of CD4+/CD8+ T lymphocyte and decreased the number of CD8+ T lymphocyte subsets of tumor bearing mice and PCNA positive cells. These results of the study indicated that the aqueous extract of seeds

of SO could suppress the cervical carcinoma via modulating immune response of the tumor bearing mice and causing tumor cell cycle arrest in G0/G1 phase (Li, 2008).

Anti-proliferative study: Gabrani *et al.*, (2012) evaluated anti-proliferative activity on leukemic cell lines for Jurkat and HL-60 (Human promyelocytic leukemia cells)of organic solvent and aqueous extracts obtained from berries of SO. The results of the study indicated increased cytotoxicity with increasing extract concentrations of berries of SO (Gabrani, 2012).

In vitro Antibacterial Activity: Sridhar *et al.*, (2011) studied on six solvent extracts from leaf, seed and roots of SO for *in vitro* antibacterial activity and phytochemical Analysis. The organic solvent extracts of seeds of SO had strong antibacterial activity as compared to leaf and root solvent extracts. Onthe basis of the study, strong activity of the ethyl acetate seed extracts of SO was found against *Pseudomonas, Proteous vulgaris, Klebsiella* (Sridhar, 2011).

Conclusion

The paper revealed therapeutic importance of *Mako* as evident by the recent research performed on it. Several Unani formulations containing *Mako* are indicated in liver, kidney, stomach and joint diseases etc. Recent researches also validated the indications of *Mako* (*Solanum nigrum*) in Unani Medicine such as in liver debility, arthritis, rheumatism, as an liver tonic, anti-inflammatory, analgesic etc. Beside traditional therapeutic utilization in Unani medicine its new indications such as Cardio protective, antioxidant, antimicrobial activity etc, make it more important easily available drug. In present time many phytochemical and pharmacological studies have been performed on this drug. Therefore, more researches can be done to exploit the unexplored potentials of *Mako* which have already been mentioned in Unani classical literature.

Conflict of interest: The author has declared that no conflict of interest exists.

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