Review Article

PHARMACOLOGICAL PROPERTIES OF *VERBASCUM THAPSUS* - A REVIEW

Mayank A. Panchal[1*], Krishna Murti[1], Vijay Lambole[1]
[1]Department of Pharmacology, Vidyabharti Trust College of Pharmacy, Umrakh, Gujarat, India.
*Corresponding author's E-mail: mynk_1511@ymail.com

Received on: 29-09-2010; **Finalized on:** 30-11-2010.

ABSTRACT

The present review describes the morphological, phytochemical and pharmacology aspects of *Verbascum thapsus* (Scrophulariaceae). The herb *Verbascum thapsus 1s* widely distributed in Himalaya (altitude 500&12000 ft). It has been employed for the treatment of asthma and other pulmonary complaints. It is widely used for herbal remedies with emollient and astringent properties. Great Mullein has been used since ancient times as a remedy for skin, throat and breathing ailments. It has long had a medicinal reputation, especially as an astringent and emollient. So, the present paper ennumerates an overview of phytochemical and pharmacological properties, which may help the researchers to set their minds for approaching the efficacy and potency of herb.

Keywords: *Verbascum thapsus*; Scrophulariaceae; Phytochemistry; Pharmacological profile.

INTRODUCTION

Verbascum thapsus (Great or Common Mullein) (figure 1) is a species of mullein, native to Europe, northern Africa and Asia, and introduced in the Americas and Australia. It is a hairy biennial plant that can grow to 2 m or more tall. Its small yellow flowers are densely grouped on a tall stem, which bolts from a largerosette of leaves. It grows in a wide variety of habitats, but prefers well-lit disturbed soils, where it can appear soon after the ground receives light, from long-lived seeds that persist in the soil seed bank. It is a common weedy plant that spreads by prolifically producing seeds, but rarely becomes aggressively invasive, since its seed require open ground to germinate. It is a very minor problem for most agricultural crops, since it is not a very competitive species, being intolerant of shade from other plants and unable to survive tilling. It also hosts many insects, some of which can be harmful to other plants. Although individuals are easy to remove by hand, populations are difficult to eliminate permanently[1].

Figure 1: *Verbascum thapsus*

Botanical name: *Verbascum thapsus*

Family: Scrophulariaceae

Common name: Great or Common Mullein, Velvet Dock, Velvet Plant, Woolly Mullin

Part used: Leaves, stems, roots and flowers.

Habitant: The plant grows all over Europe and in temperate Asia as far as the Himalayas, and in North America.

V. thapsus is unmistakable in the field. The fuzzy leaves and long flowering spikes can't be missed. The plant is common throughout Missouri. Traditionally *V. Thapsus* has been used to cure headaches, fevers, cramps, burns, and a host of other ailments (including cold feet). The plant does contain coumarins and other toxins so it should be used wisely[2].

Great Mullein has been used as an alternative medicine for centuries and in many countries throughout the world. It has been employed for the treatment of asthma and other pulmonary complaints. The seeds are reported to be aphrodiasic and narcotic in nature[3]. The value of Great Mullein as a proven medicinal herb is now backed by scientific evidence. Some valuable constituents contained in Mullein are coumarin and hesperidin. They exhibit many healing abilities. Research indicates some of the uses as analgesic, antihistaminic, anti-inflammatory, anticancer, antioxidant, antiviral, antibacterial, cardio-depressant, estrogenic, fungicide, hypnotic, sedative and pesticide are valid. Leaves, roots, and the flowers are anodyne, anti-inflammatory, antiseptic, antispasmodic, astringent, demulcent, diuretic, emollient, expectorant, nervine, and vulnerary[4].

Mullein oil is a very medicinal and valuable destroyer of disease germs. An infusion of the flowers in olive oil is used as earache drops, or as a local application in the

treatment of piles and other mucous membrane inflammations. This infusion is a strong antibacterial. The oil being used to treat gum and mouth ulcers is very effective. A decoction of the roots is used to alleviate toothache and also relieve cramps and convulsions. It is also used in alternative medicine for the treatment of migraine headaches accompanied with oppression of the ear. The whole plant possesses slightly sedative and narcotic properties. The seeds are considered toxic. They have been historically used as a narcotic and also contain saponins[5].

The dried leaves are sometimes smoked to relieve the irritation of the respiratory mucus membranes, and the hacking cough of consumption. They can be employed with equal benefit when made into cigarettes, for asthma and spasmodic coughs in general. Externally, a medicinal poultice of the leaves is applied to sunburn, ulcers, tumors and piles[6].

MORPHOLOGY

Stems - To +2m tall at anthesis, from stout taproot, herbaceous, densely stellate pubescent, winged by decurrent leaf tissue, erect, sometimes branching at inflorescence.

Leaves - First years leaves in a basal rosette to 1m in diameter but typically less. Blades entire to crenate to crenate-dentate, to 75cm long, 15cm broad, oblong to narrowly obovate, tapering at base, rounded or subacute at apex, dense stellate pubescent (soft to the touch), with prominent veins below. Margins often undulate. Cauline leaves becoming oblanceolate, sessile, reduced upwards, with tissue decurrent and undulate.

Inflorescence - Indeterminate dense terminal spike to 1m tall (long). Foliaceous to scalelike bracts subtending flowers. Bracts equaling or longer than calyx, dense stellate pubescent.

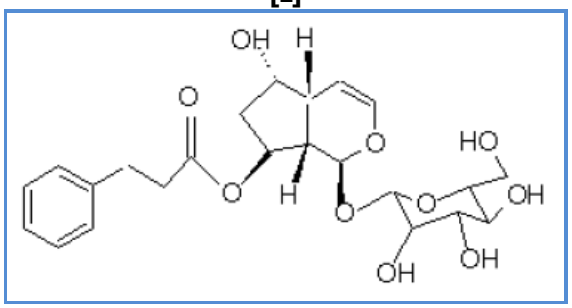
Flowers - Corolla yellow, zygomorphic, five lobed, 2.5cm broad. Corolla tube to 8mm long. Lobes rounded, stellate pubescent externally, glabrous internally. Stamens 5(3+2), alternating with corolla lobes, adnate on basal half of corolla tube, the upper 3 shorter than the lower 2. Filaments yellow, to 1.1cm long, villous mostly in upper half (hairs fewer and secund on lower two stamens). Anthers orange, 2mm long. Style green, mostly glabrous but with some hairs at base, 1cm long. Stigma capitate. Ovary superior, stellate pubescent to tomentose, 2-locular. Placentation axile. Calyx accrescent, five lobed, dense stellate pubescent. Tube to2mm long. Lobes 5-6mm long, 2-3mm broad at base, lance-acuminate. Capsule to 1cm long, broadly ovoid, stellate pubescent, many-seeded, with persistent style[7].

PHYTOCHEMISTRY

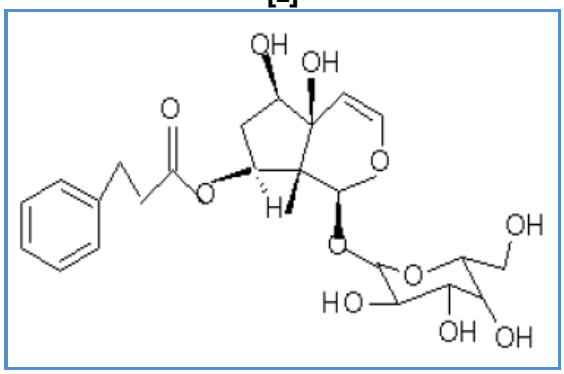
The present study reported the isolation of iridoid glycosides (1-4), three iridoid (6, 7 and 8), one phenylethyl glycoside (5), two sesquiterpenes (9, 10), one diterpene (11), and one biflavonoid (12) from the whole plant of *V. thapsus*. The iridoid glycosides, laterioside (1) and harpagoside (2) have been isolated previously from *V. thapsus*[8]. The occurrence of iridoid glycosides (3, 4) and verbacoside (5) in *V. thapsus* is in agreement with compounds previously reported from other Verbascum species i.e from *V. pterocalycinum* var. mutense[9]. Thus, the isolation of compounds 3-5 from Verbascum species indicates that these compounds could be chemotaxonomic markers for the Verbascum genus.

Interestingly, compounds (6-11) were characterized for the first time from the genus Verbascum and have been isolated from genus Buddleja of same family[10, 11, 12]. Therefore compounds 6-11 might be useful taxonomic markers for the genus, and thus a contribution to chemotaxonomic studies of the Scrophulariaceae family. This finding confirms that the genera Verbascum and Buddleja are closely related taxonomically. On the other hand, amentoflavone[12] has been reported from genus Drypetes of Euphorbiaceae family[13, 14] and this is reported first time from Scrophulariaceae family.

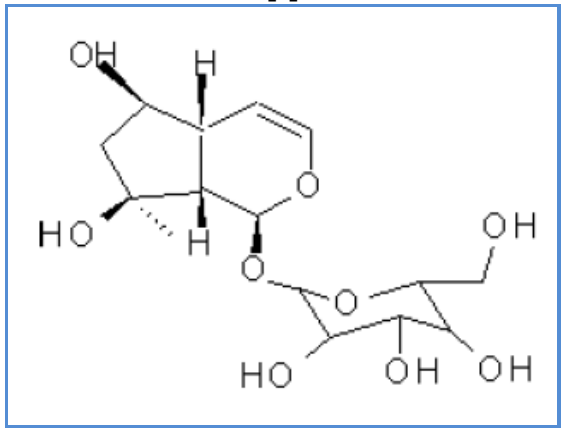
[1]



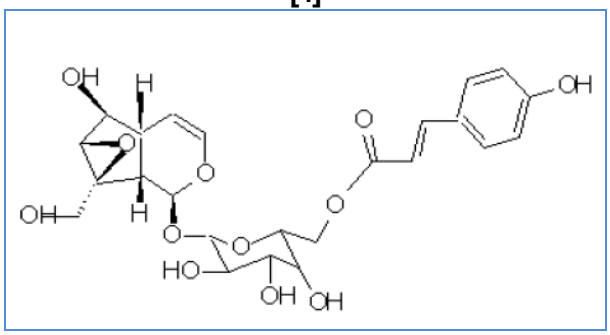
[2]



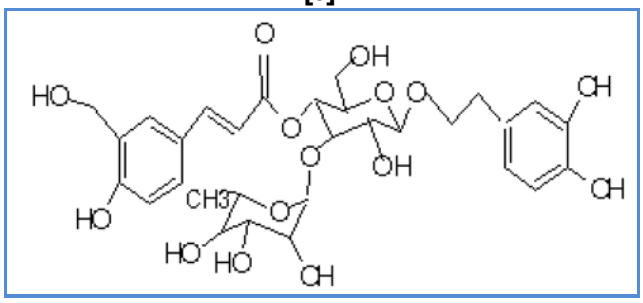
[3]



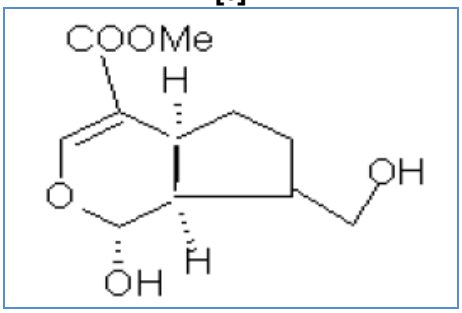
[4]



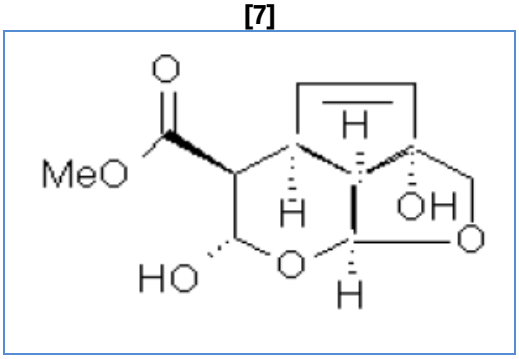
[5]



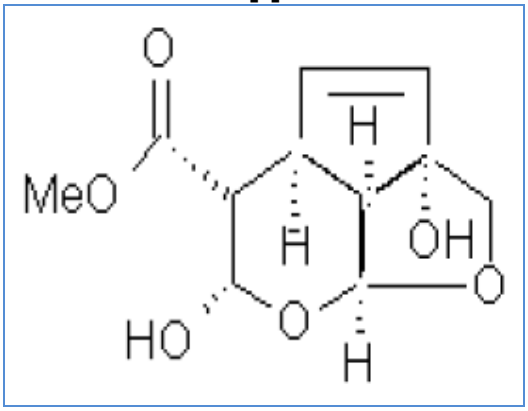
[6]



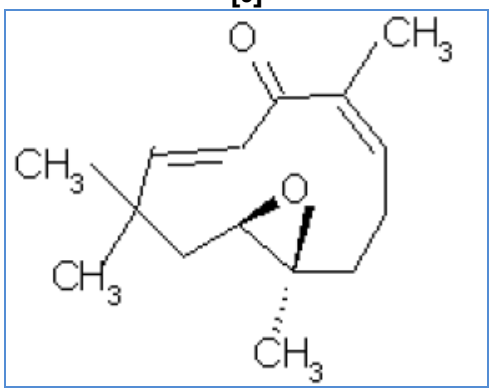
[7]



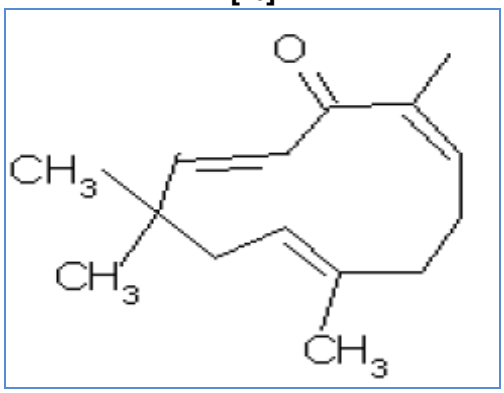
[8]



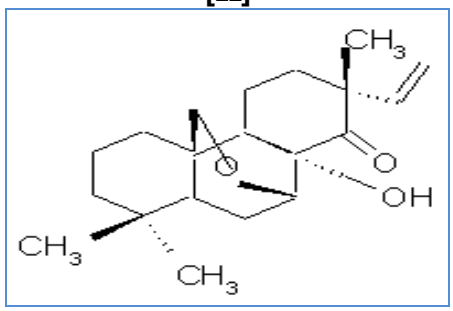
[9]



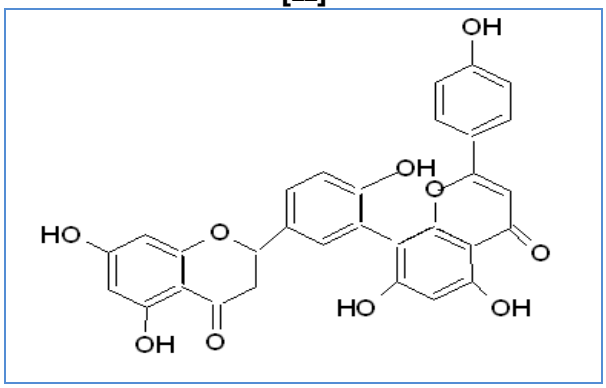
[10]



[11]



[12]



Iridoid glycosides: 0.56% in *V. phlomoides*, 0.13% in *V. densiflorum*, including aucubin, catalpol, 6-xylosylaucubin and 6-xylosylcatalpol. *V. densiflorum* flower contains ten fold less aucubin but two fold more catalpol than *V. phlomoides* flower. Also, 6-(4”-p-coumaroyl)-xylosylaucubin (named phlomoide) and another

iridoidester glycoside, specioside, occur in *V. phlomoides* flower[15].

Flavonoids: 0.57% in *V. phlomoides*, 0.22% in *V. densiflorum*, although up to 4% of flavonoids has been claimed. In the flower of *V. Thapsus*, 6-hydroxyluteolin 7-glucoside, 3'-methylquercetin and 7, 4'-dihydroxyflavone 4'-rhamnoside. In *V. densiflorum* flower, apigenin and luteolin and their 7-glucosides, quercetin 7-glucoside, 3, 7-diglucoside, tamarixetin 7-rutinoside and diosmin (diosmetin 7-rutinoside), the glycosides of luteolin and quercetin being predominant. In *V. phlomoides* flower, tamarixetin 7-rutinoside (predominant), tamarixetin 7-glucoside, apigenin and luteolin and their 7-glucosides, diosmin, chrysoeriol, eriodictyol, kaempferol, quercetin and rutin. The reported presence of hesperidin was not confirmed in a later investigation[16].

Phenylethanoid glycosides: 0.6% Verbascoside (acteoside) in *V. densiflorum* flower, but only traces in *V.phlomoides* flower, traces of forsythoside B (verbascoside 6'-apioside) in both species[17].

Triterpene saponins: Verbascosaponin, a monodesmosidic oleanane saponin with ether bridge between C-13 and C-28 and a group of four neutral sugar residues at the 3-position, was first isolated in 1980 from *V. phlomoides* flower; the structure was revised in 1992. The closely-related verbascosaponin A, verbascosaponin B and desrhamnosyl verbascosaponin have also been isolated from *V. phlomoides*. In *V. thapsus* flower, four saponins of fairly similar structure have been isolated and named thapsuins A, B and hydroxythapsuins A and B[18].

Polysaccharides: 2-3% water-soluble acidic polysaccharides, principally a highly-branched arabinogalactan with a β-1, 6-linked galactan backbone (MW 70,000), and neutral polysaccharides (an arabinogalactan and a xyloglucan) have been isolated from commercial mullein flower (*V. phlomoides* and/or *V. densiflorum*). The European Pharmacopoeia 6.0 includes a test for swelling index with minimum 9[19].

Phenolic acids: Vanillic, *p*-hydroxybenzoic, p-coumaric, ferulic, protocatechuic and p- hydroxycinnamic acids have been identified in the flowers of *V. densiflorum* and *V. phlomoides*. Also *p*-coumaric acid glucoside has been found in *V. phlomoides* flowers[20].

Other constituents: Phytosterols (β-sitosterol and ergosterol peroxide) and oleanolic acid in *V. thapsus* flower; phytosterol glycosides and digiprolactone (a biclyclic monoterpene) in *V. phlomoides* flower, fixed oil in flowers of *V. phlomoides* (2.4%) and *V. densiflorum* (1.6%), in which the main fatty acids are palmitic and linolenic acids; amino acids and free sugars in *V. densiflorum* flower; carotenoids and xanthophylls[21].

PHARMACOLOGICAL ACTIVITIES

Antibacterial activity:

A study shows that a commercial product FO-Com (Flowers extracted of *V. thapsus* in pure olive oil), had antibacterial activity against *Klebsiella pneumoniae, Escherichia coli, Pseudomonas aeruginosa* and *Staphylococcus aureus*. This activity was attributed to the saponins[22].

Antitumor activity:

The commercial product FO-Com (flowers extracted of *V. thapsus* in pure olive oil) showed antitumor activity. In screening for substances with antitumour activity, aqueous extracts from *V. densiflorum* flower had a strong inhibitory effect on the elongation step of protein biosynthesis in isolated rat liver microsomes. The saponin fraction was shown to be mainly responsible[23].

Cardiovascular activity:

In isolated, perfused rat hearts (Langendorff model) verbacoside (1 mM) increased heart rate by 37%, the force of contraction by 9% and coronary perfusion rate by 68%. Verbascoside significantly increased chronotropism ($p = 0.010$), inotropism ($p = 0.016$) and CPR ($p = 0.016$) when tested against the competitive a-adrenergic blocker phentolamine (1 μM) [24].

Anti-inflammatory activity:

Verbascoside was found to have nitric oxide radical scavenging activity, which possibly contributes to its anti-inflammatory effect. Seven phenylethanoids, including acteoside (verbascoside) at the concentration of 100-200 mM reduced (6.3-62.3%) nitrite accumulation in lipopolysaccharide (0.1 μg/ml) stimulated J774.1 cells. At 200 mM, they inhibited by 32.2–72.4% nitrite accumulation induced by lipopolysaccharide (0.1 μg/ml)/ interferon-γ (100 U/ml) in mouse peritoneal exudate macrophages. Furthermore, verbascoside inhibited formation of the 5-lipoxygenase product 5-HETE and leucotriene B in human polymorphonuclear leukocytes. Verbascoside (acteoside) had strong radical scavenging actions [25].

Hepatoprotective activity:

Aucubin administered intravenously at 100 mg/kg significantly protected beagle dogs from lethal poisoning caused by ingestion of *Amanita virosa* mushrooms. The activity of aucubin was partly due to a preventive effect on the depression of m-RNA biosynthesis in the liver caused by a-amanitin intoxication. It has also been reported that aucubin protected mice from hepatic damage induced by carbon tetrachloride intoxication[26].

Analgesic activity:

Verbascoside (acteoside) exhibited analgesia on acetic acid-induced writhing and on tail pressure pain in mice by the oral administration of 300 mg/kg and 100 mg/kg respectively. Verbascoside also caused weak sedation by prolongation of pentobarbital-induced anesthesia and on the depression of locomotion enhanced by metamphetamine[27].

CONCLUSION

The multiple benefits of *Verbascum thapsus* made it a true miracle of nature. Numerous studies have been conducted on different parts of *Verbascum thapsus*, but this plant has not yet developed as a drug by pharmaceutical industries. A detailed and systematic study is required for identification, cataloguing and documentation of plants, which may provide a meaningful way for the promotion of the traditional knowledge of the herbal medicinal plants. The present review reveals that the plant is used in treating various ailments. It elicits on all the aspects of the herb and throws the attention to set the mind of the researchers to carry out the work for developing its various formulations, which can ultimately be beneficial for the human beings as well as animals.

REFERENCES

1. Watts, Donald. Elsevier's Dictionary of Plant Names and their Origin. Amsterdam: Elsevier Science 2002. pp. 633–634.
2. Niering, William A. (1979). The Audubon Society field guide to North American wildflowers, eastern region. New York: Knopf. p. 798.
3. Khuroo MA, Qureshi MA, Razdan TK, Nichols P. Pharmacological activity of plant V. Thapsus. Phytochemistry 1988; 27: 3541.
4. Kivilaan, A.; Robert S. Bandurski H. "The One Hundred-Year Period for Dr. Beal's Seed Viability Experiment". American Journal of Botany 1981; 69 (9): 1290–1292
5. Westrich, Paul. "Habitat requirements of central European bees and the problems of partial habitats." The Conservation of Bees. Linnean Society Symposium Series, London: Academic Press.1996; 18: 1-16.
6. Hanrahan, Claire; Rebecca J. Frey. "Mullein". In Jacqueline L. Longe. The Gale encyclopedia of alternative medicine. 2006; 2(3): 11-30.
7. "Mullein flower". The Commission E Monographs. American Botanical Council. February 1, 1990.
8. Warashina T, Miyase T, Ueno A. Irridoid glycosides from Verbascum siniaticum. Chem. Pharm. Bull. 1991; 39: 3261.
9. Tatli II, Akdemir ZS, Bedir E, Khan IA. Phenyletanoid glycosides from Verbascum siniaticum. Turkish J. Chem.2004; 28: 111.
10. Ahmad I, Malik A, Fatima I, Nawaz SA, Tareen RB, Choudhary MI. Hidroxycinnamoyl ester glycosides and saponins from flowers of Verbascum phlomoides. J Nat Prod 2005; 60: 341.
11. Lu J, Tu G, Zhao Y, Lu Y, Liu LY, Wu Y. Verbacoside, a new luteolin glycosides from V. Thapsus. Magn. Reson. Chem. 2004; 42: 893.
12. Pardo F, Perich F, Torres R, Monache FD.A cinnamon derived compounds obtained from fifferent sources of species of Verbascum spp. Biochem. Syst. Ecol.2004; 32: 367.
13. Lin MT, Chen LC, Chen CK, Liu KC, Lee SS. Chemical constituents of Verbascum L.species. J. Nat. Prod. 2001; 64: 707.
14. Nganga MM, Chhabra S, Langat-Thoruwa C, Hussain H, Krohn K. Isolation of different flavanoid glycosides from species of Verbascum. Biochem. Syst. Ecol. 2008; 36: 320.
15. Skaltsounis AL, Tsitsa-Tzardis E, Demetzos C, Harvala C. Unduloside, a new iridoid glycoside from Verbascum undulatum. J Nat Prod. 1996; 59: 673-675.
16. Seifert KH, Jahne S, Hesse M. Verbascenine, ein macrocyclische spermin alkoloid aus Verbascum. Helv Chim Acta 1982; 65: 2540-2547.
17. Klimek B (1996): Hidroxycinnamoyl ester glycosides and phenylethanoid from flowers of Verbascum phlomoides. Phytochemistry 1996; 43: 1281-1284.
18. Hartleb I, Seifert K. Sangarosaponin-D a triterpenoid saponin from Verbacsum songaricum. Phytochemistry 1994; 35: 1009-1011.
19. Koblikova Z, Turecek F, Ninova P, Trojanek J, Blaha K. Verbaskine, a macrocyclic spermin alcholoide of a novel type and polysaccharides from Verbascum pseudonobile (Scrophulariaceae). Tet Lett 1983; 4381-4384.
20. Kalpoutzakis E, Aligiannis N, Mitakou S, Skaltsounis AL. Different types of phenolic acids from Verbascum spinosum. J Nat Prod. 1999; 62: 342-344.
21. Favel A, Steinmetz MD, Regli P, Olivier EV, Elias R, Balansard G. Phytosterols, amino acids and sugars from different species of Verbascum. Planta Med. 1994; 60: 50-53.
22. Meurer-Grimes B, Mcbeth DL, Hallihan B, Delph S. Antibacterial activity in medicinal plants of the Scrophulariaceae and Acanthaceae. Int J Pharmacog. 1996; 34: 243– 248.
23. Paszkiewicz G, Turker AU, Camper ND. Antitumor activity of common mullein, amedicinal plant. J Ethnopharmacol. 2002; 82: 117-125.
24. Pennacchio F, Mehrotra R, Ahmed B, Vishwakarma RA, Thakur R. Cardiovascular activity of Verbascum thapsus. J Nat Prod. 1989; 52: 640-643.
25. Kimura S, Favel A, Steinmetz MD, Regli P, Olivier EV, Elias R, Balansard G. In vitro antiinflammatory activity of triterpenoid saponins. Planta Med. 1987; 60: 50-53.
26. Chang J, Lu Y, Liu LY. Fungitoxic and phytotoxic properties of essential oil of Hyptis suaveolens. Pflanzenkrankheid Pflanzenschutz 1983; 89: 344-349.
27. Nakamura K, Vuotto M, Ferrara L. Antibacterial and allelopathic activity of extract from Castanea sativa leaves. Fitoterapia 1997; 71: S111-S116.

****