Journal of Pharmacognosy and Phytotherapy Vol. 5(3), pp. 38-46, March 2013
Available online at http://www.academicjournals.org/jpp
DOI: 10.5897/JPP2013.0260
ISSN 2141-2502 ©2013 Academic Journals

Review

An overview on *Hypericum* species of Turkey

Esra Eroğlu Özkan* and Afife Mat

Department of Pharmacognosy, Faculty of Pharmacy, Istanbul University, 34116, Istanbul, Turkey.

Accepted 28 January, 2013

The genus *Hypericum* (Hypericaceae) is represented by nearly 100 taxa grouped under 19 sections in Turkey. Among them, 45 species are endemic. All members of the genus may be referred to as St. John's wort in the world. The genus is known as "sari kantaron, kantaron, binbirdelik otu, mayasil otu" and most of them, especially *H. perforatum*, have been used for the treatment of burns, wounds, haemorroids, diarrhorea and ulcers in Turkish traditional medicine. The pharmacological studies showed that this species has several activities: anti-depressant, anti-inflammatory, anti-microbial, anti-viral, anti-nociceptive and wound healing. The chemical composition of the *Hypericum* species is composed of naphthodianthrones (especially hypericin and pseudohypericin), acylphloroglucinol derivatives (especially hyperforin and adhyperforin), flavonoids (especially quercetin, quercitrin, hyperoside and biapigenin), tannins and volatile oils. Investigations on the chemical composition and biological activities, as well as hypericin content of Turkish *Hypericum* species, have been carried out for about 25 years. The aim of this study was to review and summarise important studies about Turkish *Hypericum* species. Endemic species are indicated with (e) in the text.

Key words: *Hypericum* species, Turkey, endemic, chemical composition, biological activity, agricultural study, traditional use.

INTRODUCTION

Traditional uses of *Hypericum* species in Turkey

Hypericum species have been used in traditional medicine in Anatolia for centuries. The existence of four species including; *H.crispum, H. perforatum, H. perfoliatum and H. coris* as medicinal plants was reported in Dioscorides' Materia Medica. Various traditional uses have been reported for *H. atomarium, H. aviculariifolium, H. cerastoides, H. calycinum, H. confertum* subsp. *confertum, H. confertum* var. s*tenobotrys, H. heterophyllum, H. hyssopifolium, H. hyssopifolium* subsp. *elongatum* var. *elongatum, H. lydium, H. montbretii, H. olympicum, H. orientale, H. scabrum, H. ternatum, H. thymifolium, H. triquetrifolium* and mainly *H. perforatum* (Yesilada et al., 1993; Yesilada et al., 1995; Honda et al., 1996; Tuzlaci and Tolon, 2000; Tuzlaci and Aymaz, 2001; Keskin and Alpinar, 2002; Ezer and Avci, 2004; Bulut, 2006; Buyukgebiz, 2006; Ecevit and Ozhatay, 2006; Ezer and Mumcu, 2006; Mart, 2006; Cimen, 2007; Akgul, 2008; Demirci, 2010; Aktan, 2011; Kizilarslan, *2008)* in the form of infusion, decoction, ointment and oleat (dried herbs with flowers are kept in olive oil for 1 month and filtered through muslin) in Turkey. Table 1 shows species having traditional uses.

AGRICULTURAL STUDIES

A study was undertaken to enhance the germination rate of *H. aviculariifolium* subsp. *depilatum* var. *depilatum* (e) seeds. Results revealed that the seeds have exogenous dormancy and light is required for germination (Cirak et al., 2007a). The ontogenetic and morphogenetic variation of hypericin, chlorogenic acid and flavonoids was determined in *H. origanifolium*. Hypericin, quercetin and quercitrin content in whole plant increased during the course of ontogenesis, and the highest level was reached in blooming stage whereas, hyperoside content of whole plant decreased linearly with advancing of development stages, and the highest level was observed at vegetative stage. Among different tissues, reproductive parts accumulated the highest level of hypericin, quercetin and

*Corresponding author. E-mail: esraeroglu@gmail.com

Table 1. The traditional uses of *Hypericum* species in Turkey.

***Hypericum* species**	**Traditional uses**	**Administration**	**References**
H. atomarium	Stomach diseases, enteritis, sedative	Inf. (int)	Vural (2008)
H. avicullariifolium	Urethra diseases	Inf. (int)	Keskin and Alpınar (2002)
H. cerastoides	To against diarrhea	Inf. (int)	Kızılarslan (2008)
H. calycinum	To abolish spasm, anti-asthmatic	Dec. (int)	Aktan (2011)
H. confertum subsp *confertum*	Anti-asthmatic, wound healing	Inf. (int), Oleat (ext)	Buyukgebiz (2006)
H. confertum var. *stenobotrys*	To abolish spasm, stomach diseases	Inf. (int)	Buyukgebiz (2006), Bulut (2006) and Mart (2006)
H. heterophyllum	Anti-inflammatory	Oleat (ext)	Unal et al. (2008)
H. hyssopifolium and *H. hyssopifolium* subsp. *elongatum* var. *elongatum*	To abolish spasm, against diarrhea, hemorrhoid, and as a sedative, anti-helmintic, antiseptic against eczema and as an anti-fungal for various fungal disorders, psoriasis	Inf. (int), Oleat (ext)	Unal et al. (2008)
H. lydium	To treat indigestions and stomach diseases, hemorrhoid	Inf. (int)	Yesilada et al. (1995), Sezik et al. (2001) and Yesil (2007)
H. montbretii	Eczema	Dec. (int)	Keskin and Alpınar (2002)
H. olympicum	For stomach ache, inflamed wounds, cuts.	Dec., int. Dec., ext.	Tuzlacı et al. (2001)
H. orientale	Stomach diseases, sedative	Inf. (int)	Ezer (2006) and Tatlı et al. (2009)
H. perforatum	Kidney stones, urinary diseases, diabetes, antihypertensive, cold, stomachache, enteritis, eczema, antifungal, cardiac diseases, arteriosclerosis, antihemorrhagic	Dec. (int)	Yesilada et al. (1993), Yesilada et al. (1995), Tuzlacı et al. (2000), Sezik et al. (2001), Tuzlacı et al. (2001), Ezer (2004), Ecevit and Ozhatay (2006), Kultur (2007), Cimen Oral (2007) and Demirci (2010)
	Asthma, insomnia, uroclepsia(forbabies), gall bladder ailments, facial paralysis, gastritis, chestdiseases, internal hemorrhage, bronchitis, anti-inflammatory, tuberculosis, pharyngitis	Inf. (int)	
	Wounds	Ointment (ext)	
	Wounds, burns, cuts, herpes labialis, lip chap	Ointment (ext)	
	Stomach diseases, diabetes, enteritis, ulcers	Ointment (ext)	
	Stomach disease	Dec. (int)	
H. scabrum	Hemmorroid, constipation, peptic ulcer	Inf. (int), Oleat (int)	Yesilada et al. (1996), Ezer and Mumcu-Arısan (2006) and Unal et al. (2008)
H. ternatum	Antiasthmatic, wound healing	Inf. (int), Oleat (ext)	Bulut (2006) and Mart (2006)
H. thymifolium	Stomach diseases	Inf. (int)	Mart (2006)
H. triquetrifolium	Cardiac diseases, diabetes	Inf. (int)	Akgul (2008)

Dec. = decoction, Inf. = infusion, int. = internal, ext. = external.

quercitrin, however, leaves produced substantially higher amount of chlorogenic acid and hyperoside. Rutin and apigenin-7-O-glucoside were detectable in all tissues only during fruit maturation (Cirak, 2007b).

Chemical and morphological variability was studied in *H. perforatum* samples collected from different locations of Northern Turkey. Hypericin content was found to be correlated positively with leaf dark gland density, however, negatively with leaf area and no correlation was detected between the other morphological traits and bioactive substances examined (Cirak et al., 2007c).

Ontogenetic, morphogenetic and diurnal variation of the total hypericins content was determined in *H. aviculariifolium* subsp. *depilatum* var. *depilatum* (e), *H. perforatum* and *H. pruinatum*. The hypericin content of leaves and whole plant was higher in *H. aviculariifolium* subsp. *depilatum* var. *depilatum* (e) whose leaves had more numerous dark glands than those of the two other species (Cirak et al., 2006a). Ontogenetic, morphogenetic and diurnal variations in total phenolic contents was investigated in *H. aviculariifolium* subsp. *depilatum* var. *depilatum* (e), *H. perforatum* and *H. pruinatum*. Phenolic contents of *H. perforatum* and *H. pruinatum* were the highest during flowering stage, although no diurnal fluctuations were observed in those species (Ayan et al., 2006).

The ability to predict the number of days for seeds of four *Hypericum* species (*H. perforatum*, *H. bupleuroides*, *H. nummularioides* and *H. pruinatum*) to germinate was investigated by using mathematical models based on temperature. Optimum seed germination temperature in the tested species was determined and germination time was calculated using coefficients obtained from regression models (Cirak et al., 2006b). The possibilities of domesticating *H. crenulatum* (e) collected from the Nigde-Demirkazik (Camardi) mountains were investigated. It was observed that the *H. crenulatum* (e) seeds did not germinate, thus did not adapt to the region (Inan and Kirici, 2003).

CHEMİCAL COMPOSİTİON

The chemical composition of the *Hypericum* species is composed of naphthodianthrones (especially hypericin and pseudohypericin), acylphloroglucinol derivatives (especially hyperforin and adhyperforin), flavonoids (especially quercetin, quercitrin, hyperoside and biapigenin), tannins, n-alkanes, xanthones and essential oils (Bombardelli and Morazzoni, 1995; Bruneton, 1995).

Naphthodianthrones and acylphloroglucinol derivatives

Table 2 shows quantitative determination of hypericin, pseudohypericin and hyperforin in Turkish *Hypericum* species.

Volatile compounds

The volatile compounds of ten taxa have been investigated by using Gas chromatography (GC) and Gas chromatography/Mass spectrometry (GC/MS). Caryophyllene oxide was found as a major component in *H. hyssopifolium* var. *microcalycinum* and *H. lysimachioides* var. *lysimachioides* (Toker et al., 2006). Thirty components representing 92% of the total volatiles were characterized in *H. Bupleuroides*, and sesquiterpenes such as β-sesquiphellandrene (33.2%) and β-caryophyllene (20.2%) were assigned as major compounds (Demirci and Baser, 2006).

The essential oil of *H. linarioides* was found to contain 74 compounds, mainly δ-cadinene (6.9%), (Z)-β-farnesene (5.2%), γ-muurolene (5.5%), spathulenol (4.8%), hexahydrofarnesyl acetone (4.5%) and selinene (4.0%). The oil was also characterized by high content of sesquiterpenes (64.2% of total oil) (Cakir et al., 2005). *H. adenotrichum* (e), *H. calycinum*, *H. cerastoides*, *H. montbretii*, and *H. perforatum* have been investigated and their major volatile compounds were determined as follows:

Germacrene D (38%) in *H. adenotrichum*; α-pinene (24%) and β-pinene (14%) in *H. calycinum*; α-pinene (58%), undecane (5%) and β-pinene (3%) in *H. cerastoides*; α-pinene (26%), β-pinene (19%) and undecane (5%) in *H. montbretii*; α-pinene (50%) and carvacrol (22%) in *H. perforatum* (Erken et al., 2001). The volatile oil of *H. hircinum* was obtained with an efficiency of 0.73%. The main components of the oil were determined as follows, α-pinene (88.3%), mircene (3%), β-pinene (2.8%), β-caryophyllene (1.5%) and (E)-β-ocimene (1.4%) (Demirci et al., 2008).

Phenolic compounds

H. hyssopifolium, H. pamphylicum (e), *H. calycinum* and *H. perforatum* have been investigated for their phenolic compounds. Five flavonoids (I3, II8-biapigenin, quercetin, quercetin-3-O-α-arabinofuranoside, quercetin-3-O-β-D-galactopyranoside, quercetin-3-O-β-D-galactopyranoside-7-O-β-D-glucopyranoside) and a napthodianthrone (hypericin) were isolated, and their structures were determined by Ultar violet (UV), Infra red (IR), Nuclear magnetic resonance (NMR) and Mass spectrometry (MS) spectroscopic methods in *H. hyssopifolium* (Cakir et al., 2003).

Quercetin, quercetin 3-glucoside, and quercetin 3-galactoside were isolated from *H. pamphylicum* (e) (Eroglu, 2007). A capillary zone electrophoretic (CZE) method for the determination of rutin in an ethanolic extract of the aerial parts of *H. perforatum* is described and the amount of rutin in the total plant material was found to be 0.21% (Dogrukol-Ak et al., 2001).

Two caffeoylquinic acid derivatives (chlorogenic acid

Table 2. Quantitative determination of hypericin, pseudohypericin and hyperforin.

Species	Method	Hypericin (mg/g)	Pseudohypericin (mg/g)	Hyperforin (mg/g)	Reference
H. androsaemum	LC/MS	< 0.01	< 0.01	0.09	Smelcerovic et al. (2008)
H. aviculariifolium	LC/MS	0.66	0.58	0.02	
H. bithynicum	LC/MS	1.05	2.03	0.15	
H. heterophyllum	LC/MS	0.51	0.32	0.08	
H. hirsitum	LC/MS	0.54	0.38	0.20	
H. hyssopifolium	LC/MS	0.52	0.46	0.04	
	HPLC	0.03	0.051	-	Ayan et al. (2004)
H. linarioides	LC/MS	0.34	0.56	< 0.01	Smelcerovic et al. (2008)
H. lydium	UV	1.21	-	-	Cirak (2006)
H. montanum	LC/MS	1.13	1.56	< 0.01	Smelcerovic et al. (2008)
H. montbretii	LC/MS	0.74	2.10	3.45	
	HPLC	2.52	3.58	-	Ayan et al. (2008)
H. nummularioides	LC/MS	0.20	0.18	0.25	Smelcerovic et al. (2008)
H. orientale	LC/MS	0.02	0.04	0.03	
H. origanifolium	LC/MS	< 0.01	0.01	< 0.01	
	HPLC	-	0.93	1.63	Cirak et al. (2008)
H. pamphylicum (e)	HPLC	0.00016	-	trace	Eroglu (2007)
H. perfoliatum	LC/MS	0.29	0.23	0.14	Smelcerovic et al. (2008)
	HPLC	-	2.62	1.84	Ayan et al. (2008)
H. perforatum	LC/MS	3.47	3.54	5.46	Smelcerovic et al. (2008)
	HPLC	2.9	-	-	Oktayoglu (2003)
	HPTLC	2.7	-	-	Kırmızıbekmez et al. (2008)
H. pruinatum	LC/MS	0.36	1.18	0.05	Smelcerovic et al. (2008)
H. scabrum	LC/MS	0.04	0.07	0.02	
	HPLC	0.0046	0.0035	-	Yesilada et al. (1995)
H. triquetrifolium	LC/MS	4.56	3.49	0.05	Smelcerovic et al. (2008)
H. venustum	HPLC	0.03	-	-	Ayan et al. (2004)

and butyl chlorogenate), seven flavonoids (quercetin, quercitrin, hyperoside, isoquercitrin, miquelianin, rutin and I3, II8-biapigenin) and two flavanols [(+)-catechin and (-)-epicatechin] were isolated from *H. calycinum* (Kirmizibekmez et al., 2008a). Four major quercetin glycosides (rutin, miquelianin, hyperoside and quercitrin) were separated and quantitatively determined in methanolic extracts of *H. perforatum* by employing High performance thin layer chromatography (HPTLC)-densitometry (Kirmizibekmez et al., 2008b).

BIOLOGICAL ACTIVITIES

Antioxidant activity

Antioxidant activity of ethanol and water extracts of the flowers of *H. venustum* was investigated. They were found to possess strong reducing power, free radicals and hydrogen peroxide scavenging activity, as well as metal chelating ability (Spiteller et al., 2008). *H. lysimachioides* var. *lysimachioides* was investigated for *in vitro* antioxidant activity. It was observed that antioxidative activities of ethanol extracts of *H. lysimachioides* are comparable with vitamin E, and it was concluded that the use of this extract could be useful in the management of cardiovascular disease in which atherosclerosis is important (Hakimoglu et al., 2007). 2,2-Diphenyl-1-picrylhydrazyl (DPPH) radical-scavenging activities of fruiting and flowering samples of *H. pamphylicum* (e) have been investigated. Both plant samples were active in DPPH radical-scavenging activities assay which was carried out in comparison with ascorbic acid (Eroglu, 2007). Fruiting and flowering samples of *H. montbretii* and *H. perforatum* have been investigated for DPPH radical-scavenging activities and all plant samples were active, compared with ascorbic acid and α-tocopherol (Oktayoglu, 2003). Antioxidant activity of phenolic compounds isolated from *H. hyssopifolium* subsp. *elongatum* var. *elongatum* was

determined, and all the compounds were found to be active (Cakir et al., 2003). The free radical scavenging activities of the compounds isolated from *H. calycinum* were determined. Compounds showed strong DPPH and nitric oxide (NO) scavenging activities in a concentration dependent manner. (+)-Catechin and (-)-epicatechin were found to be the most active compounds (Kirmizibekmez et al., 2008a).

Analgesic activity

The mechanism of the analgesic activity caused by *H. perforatum* was investigated. The authors reported that endogenous opioid mechanisms related to OP1-receptors play an important role in *H. perforatum* induced analgesia (Ozturk, 2001).

Wound-healing activity

Wound-healing effect of St. John's wort extract was investigated on cultured chicken embryonic fibroblasts. It was reported that *H. perforatum* extract exhibits a wound-healing activity whose mechanism of action is similar to that of titrate extract of *Centella asiatica* (Ozturk et al., 2007).

Hepatoprotective activity

The hepatoprotective activity of *H. perforatum* was investigated *in vivo*. The authors suggested that *H. perforatum* has a protective effect on the liver (Ozturk et al., 1992).

Anti-inflammatory activity

The probable anti-inflammatory effect of *H. triquetrifolium* was explored in a rat model of carrageenan induced inflammation. It was concluded that *H. triquetrifolium* extract may exert an antiinflammatory effect in rats (Ozturk et al., 2002).

Anti-nociceptive activity

Total extract of *H. triquetrifolium* exibited anti-nociceptive activity in the mouse (Apaydin et al., 1999).

Anti-Helicobacter pylori activity

The anti-*Helicobacter pylori* effect of the extracts and fractions obtained from *H. perforatum* was studied by using agar dilution method. *H. perforatum* extract showed inhibitory activity against the microorganism (Yesilada et al., 1999).

Human leukocyte myeloperoxidase activity

In vitro effects of *H. perforatum*, *H. empetrifolium* and *H. triquetrifolium* were investigated on human polymorphonuclear leukocyte myleloperoxidase (MPO) activity.

Each extract of *Hypericum* species reduced the peroxidative and chlorinating activity of human leukocyte MPO in concentration-dependent manner. The anti-inflammatory activity of these species may be related with inhibition of MPO activity (Pabuccupglu et al., 2003).

Antidepressant activity

Anti-depressant effect of certain *Hypericum* species on animal models was summarized. It was observed that anti-depressant activity with the alcoholic extract of *H. Calycinum*, whose effects on the central nervous system of mice are almost equal to the extract prepared from *H. perforatum*. *H. hyssopifolium* ssp. *elongatum* var. *elongatum*, seems to have no anti-depressant activity (Ozturk, 1997). The effects of *H. perforatum* and *H. calycinum* on the central nervous system were investigated using various behavioural models, including swimming time, locomotor activity, tail-flick and hole-board experiments.

According to the results, it was found that the extracts prepared from *H. perforatum* and *H. calycinum* were as effective as anti-depressant drugs, desipramine and trimipramine used as reference. This conclusion suggested that the anti-depressant effect of *H. calycinum* may be as potent as that of *H. perforatum* and may be used for therapeutic purposes in depression (Ozturk et al., 1996).

Substance dependence

In a review study on *H. perforatum* and substance dependence, Uzbay (2008) discussed the effects of *H. perforatum* on substance dependence and its possible benefit. The results suggest that an extract of *H. perforatum* (HPE) has some beneficial effects on ethanol withdrawal syndrome and that HPE blocks caffeine-induced locomotor hyperactivity in mice. Furthermore, it was reported that HPE may be useful for the treatment of alcoholism in clinical trials (Uzbay et al., 2007; Coskun et al., 2006; Uzbay, 2008).

DISCUSSION

Among 100 *Hypericum* taxa growing widely in Turkey, some of them were investigated and many articles were published. Table 3 shows published articles about Turkish

Table 3. Investigation on the *Hypericum* spp. of Turkey.

Species	Investigation														References
	Traditional Uses	Agricultural	Quantitative Determination	Chemical Compositions	Antioxidant Activity	Antimicrobial Activities	Antinociceptive Activity	Wound-Healing Activity	Hepatoprotective Activity	Antiinflammatory Activity	Substance Dependence	Anti-H.pylori Activity	MPO Activity	Antidepressant Activity	
H. adenotrichum (e)				+											Erken et al. (2001)
H. androsaemum	+		+												Kultur (2007) and Smelcerovic et al. (2008)
H. atomarium	+														Kultur (2007)
H. aviculariifolium	+		+												Smelcerovic et al. (2008)
H. aviculariifolium subsp. depilatum var. depilatum (e)		+	+												Cirak et al. (2006a), Cirak et al. (2007c) and Ayan et al. (2004)
H. bithynicum			+												Smelcerovic et al. (2008)
H. bupleuroides		+		+											Cirak et al. (2006b) and Demirci et al. (2006)
H. calycinum	+		+	+	+								+	+	Erken et al. (2001), Kırmızıbekmez et al. (2008), Ozturk et al. (1996) and Ozturk (1997)
H. capitatum						+									Sokmen et al. (1999)
H. cerastoides	+			+											Erken et al. (2001)
H. crenulatum (e)		+													Inan et al. (2003)
H. empetrifolium	+												+		Pabuccuoğlu et al. (2003) and Kultur (2007)
H. heterophyllum	+		+												Cirak et al. (2008)
H. hircinum				+											Demirci et al. (2008)
H. hirsitum			+												Smelcerovic et al. (2008)
H. hyssopifolium	+		+	+											Cakir et al. (2003) and Cakir et al. (2005)
H. hyssopifolium subsp. elongatum var. elongatum	+				+								+		Ozturk (1997) and Cakir et al. (2003)
H. hyssopifolium var. microcalycinum				+		+									Toker et al. (2006)
H. imbricatum						+									Dulger (2005a)
H. kazdaghensis (e)						+									Dulger and Gonuz (2005b)
H. kotschyanun (e)			+	+	+	+									Unsal et al. (2008, 2009)
H. linarioides			+	+		+									Cakir et al. (2005), Smelcerovic et al. (2008) and Ayan et al. (2008)
H. lydium			+												Cirak (2006c)
H. lysimachioides var. lysimachioides				+	+	+									Toker et al. (2006) and Hakimoglu et al. (2007)
H. montanum			+												Smelcerovic et al. (2008)

Table 3. Contd.

H. montbretii			+	+	+	+									Erken et al. (2001) and Oktayoglu (2003)
H. nummularioides		+	+												Cirak et al. (2006b) and Smelcerovic et al. (2008)
H. olympicum	+														Kultur (2007)
H. orientale	+		+												Ayan et al. (2008)
H. origanifolium		+	+												Cirak et al. (2007c), Smelcerovic et al. (2008) and Ayan et al. (2008)
H. pamphylicum (e)			+		+	+									Eroglu (2007)
H. perfoliatum			+	+											Smelcerovic et al. (2008**)** and Cirak et al. (2008)
H. perforatum	+	+	+	+	+	+	+	+	+		+	+	+	+	Cirak et al. (2006a, b, 2007c), Ayan et al. (2006), Ozturk et al. (2007), Kırmızıbekmez et al. (2008) and Uzbay (2008)
H. pruinatum		+	+												Cirak et al. (2006a) and Ayan et al. (2004)
H. rupestre						+									Dulger (2005a)
H. salsugineum (e)			+	+	+	+									Unsal et al. (2008, 2009)
H. scabroides (e)			+	+	+	+									
H. scabrum	+		+												Smelcerovic et al. (2008), Kultur (2007) and Ayan et al. (2008)
H. thymopsis (e)			+	+	+	+									Unsal et al. (2008, 2009)
H. triquetrifolium	+		+				+			+			+		Ozturk et al. (2002), Apaydın (1999), Pabuccuoglu et al. (2003) and Kultur (2007)
H. uniglandulosum (e)			+	+	+	+									Unsal et al. (2008, 2009)
H. vaccinifolium						+									Dulger (2005a)
H. venustum			+		+										Spiteller et al. (2008) and Ayan et al. (2004)
H. xylostrifolium	+														Kultur (2007)

Turkish *Hypericum* species. Sixteen *Hypericum* have traditional uses. Hypericin, pseudohypericin and hyperforin percentages were determined in 20 species. The highest content of hypericin was found in *H. triquetrifolium* (4.56 mg/g) and *H. perforatum* (3.47 mg/g). Hyperforin was the highest in *H. perforatum* (5.46 mg/g) (Smelcerovic, et al., 2008). Volatile compounds were isolated and identified in 10 species, and phenolic compounds in only 4 species. Twenty-one species were investigated for their activities in wound healing, hepatoprotective, anti-inflammatory, anti-ulcerogenic, analgesic, anti-oxidant, anti-nociceptive, anti-depressant, anti-microbial activities.

H. triquetrifolium showed anti-inflammatory and anti-nociceptive activities (Ozturk et al., 2002; Apaydin et al., 1999). The anti-depressant effect of *H. calycinum* was as potent as that of *H. Perforatum*, therefore it may be used for therapeutic purposes in depression (Smelcerovic et al., 2008). *H. hyssopifolium* subsp. *elongatum* var. *elongatum*, *H. lysimachioides* var. *lysimachioides*, *H. montbretii*, *H. pamphylicum*, *H. venustum* and *H. perforatum* were all found to have antioxidant properties (Cakir et al., 2003; Eroglu, 2007). All *Hypericum* extracts investigated were found to have anti-bacterial activity against *Staphylococcus aureus*. The essential oils of *H. linarioides* and *H. capitatum* showed anti-fungal and slight anti-retroviral activity against human immunodeficiency virus I (HIV-I), respectively (Cakir et al., 2005; Sokmen et al., 1999).

Although several *Hypericum* species have been used in folk medicine, only *H. perforatum* exists as its pharmaceuticals in the market. Studies on Turkish *Hypericum* species continued with an increasing trend and we hope that these species will become valuable in the future.

REFERENCES

Akgul A (2008). Ethnobotany at Midyat (Mardin). Master Thesis, Ege University, Institute of Science. Izmir.

Aktan T (2011). Ethnobotanical Studies of Yenisehir (Bursa) Villages. Master Thesis, Celal Bayar University, Institute of

Science, Department of Botany, Manisa.
Apaydin S, Zeybek U, Ince I, Elgin G, Karamenderes C, Ozturk B, Tuglular I (1999). *H. triquetrifolium* Turra. extract exhibits antinociceptive activity in the mouse. J. Ethnopharmacol. 67:307-312.
Ayan AK, Cirak C (2008). Hypericin and Pseudohypericin Contents in Some *Hypericum* Species Growing in Turkey. Pharm Biol. 46(4):288-291.
Ayan AK, Cirak C, Kevseroglu K, Zen T (2004). Hypericin in some *Hypericum* species from Turkey. Asian J. Plant Sci. 3(2):202-204.
Ayan AK, Yanar O, Cirak C, Bilgener M (2006). Variations in total phenolic during ontogenetic, morphogenetic and diurnal cycles in *Hypericum* species from Turkey. J. Plant Biol. 49(6):432-439.
Bombardelli E, Morazzoni P (1995). *Hypericum* perforatum. Fitoterapia 66:43-68.
Bruneton J (1995). Pharmacognosy, Phytochemistry, Medicinal Plants. Lavoisier Publishing, Paris 367-370.
Bulut Y (2006). Useful Plants of Manavgat District (Antalya). Master Thesis, Suleyman Demirel University, Institute of Science, Department of Biology. Isparta.
Buyukgebiz T (2006). Non-Wood Forest Products Of Sutculer District (Isparta). Master Thesis, Suleyman Demirel University, Department of Forest Engineering, Isparta.
Cakir A, Kordali S, Kilic H, Kilic H, Kaya E (2005). Antifungal properties of essential oil and crude extracts of *H. linarioides* Bosse. Biochem. Syst. Ecol. 33(3):245-256.
Cakir A, Mavi A, Yildirim A, Duru ME, Harmandar M, Kazaz C (2003). Isolation and characterization of antioxidant phenolic compounds from the aerial parts of *H. hyssopifolium* L. by activity-guided fractionation. J. Ethnopharmacol. 87:73-83.
Cimen OD (2007). Ethnobotanical Studies About Traditional Medicines in Konya. Master Thesis, Gazi University, Institute of Health Science, Program of Phytotheraphy. Ankara Cirak C (2006c). Hypericin in *H. lydium* growing in Turkey. Biochem. Syst. Ecol. 34:897-899.
Cirak C, Kevseroglu K, Ayan AK (2007a). Breaking of seed dormancy in a Turkish endemic *Hypericum* species: *H. aviculariifolium* subsp. *depilatum* var. *depilatum* by light and some pre-soaking treatments. J. Arid Environ. 68(1):159-164.
Cirak C, Odabas MS, Ayan AK, Kevseroglu K (2006b). Modeling the temperature effect on days to germinate some *Hypericum* species from Turkey. Seed Technol. 28(1):58-63.
Cirak C, Radusiene J, Camas N (2008). Pseudohypericin and Hyperforin in two Turkish *Hypericum* Species: Variations Among Plant Parts and Phenological Stages. Biochem. Syst. Ecol. 36:377-382.
Cirak C, Radusiene J, Ivanauskas L, Janulis V (2007b). Variation of bioactive secondary metabolites in *H. origanifolium* during its phenological cycle. Acta Physiol. Plant 29(3):197-203.
Cirak C, Radusiene J, Karabuk B, Janulis V (2007c). Variation of bioactive substances and morphological traits in *H. perforatum* populations from Northern Turkey. Biochem. Syst. Ecol. 35(7):403-409.
Cirak C, Saglam B, Ayan AK, Kevseroglu K (2006a). Morphogenetic and diurnal variation of hypericin in some *Hypericum* species from Turkey during the course of ontogenesis. Biochem. Syst. Ecol. 34(1):1-13.
Coskun I, Uzbay TI, Ozturk N, Ozturk Y (2006). Attenuation of ethanol withdrawal syndrome by extract of *Hypericum perforatum* in Wistar rats. Fundam. Clin. Pharmacol. 20:481-488.
Demirci B, Kıyan T, Başer KHC (2008). Chemical composition of volatile oil of *Hypericum hircinum* L. J. Scient. Phytother, Fitomed Turkey 2(6):52.
Demirci F, Baser KHC (2006). Volatiles of *H. bupleuroides* Griseb. J. Essential Oil Res. 18(6):650-651.
Demirci S (2010). Ethnobotanical Study In Andirin (Kahramanmaras) District. Master Thesis, Istanbul University, Institute of Health Science, Department of Pharmaceutical Botany. Istanbul.
Dogrukol-Ak D, Kirimer N, Tuncel M, Aboul-Enein HY (2001). Determination of Rutin in *H. perforatum* extract by Capillary Electrophoresis. Anal. Lett. 34(2):185-191.
Dulger B (2005a). Antimicrobial studies on three *Hypericum* species from Turkey. S. Afr. J. Bot. 71(1):100-103.
Dulger B, Gonuz A (2005b). Antibacterial activity of the endemic *H. kazdaghensis*. Fitoterapia 76(2):237-239.
Ecevit GG, Ozhatay N (2006). An Ethnobotanical Study in Catalca (European Part of Istanbul) II. Turk J. Pharm. Sci. 3(2):73-89.
Erken S, Malyer H, Demirci F, Demirci B, Baser KHC (2001). Chemical Investigations on some *Hypericum* Species Growing in Turkey-I. Chem. Nat. Compounds 37(5):434-438.
Eroglu E (2007). Investigaton of the *H. pamphylicum* in the Sense of Hypericin Content and Biological Activity. Master Thesis, Istanbul University, Department of Pharmacognosy.
Ezer N, Avcı K (2004). Traditional Medicines of Cerkes (Cankiri) Region. J. Hacettepe University, Faculty of Pharmacy 24(2):67-80.
Ezer N, Mumcu AO (2006). Folk Medicines in Merzifon (Amasya, Turkey). Turk. J. Bot. 30:223-230.
Hakimoglu F, Kizil G, Kanay Z, Kizil M, Isi H (2007). The effect of ethanol extracts of *H. lysimachioides* on lipid profile in hypercholesterolemic rabbits and its *in vitro* antioxidant activity. Atherosclerosis 192:113-122.
Honda G, Yesilada E, Tabata M, Sezik E, Fujita T, Takeda Y, Takaishi Y, Tanaka T (1996). Traditional medicine in Turkey VI. Folk medicine in West Anatolia: Afyon, Kütahya, Denizli, Muğla, Aydın provinces. J. Ethnopharmacol. 53:75-87.
Inan M, Kirici S (2003). The possibilities of domestication of some endemic *Achillea* and *Hypericum* species. Agric. Mediterr. 133(2):124-129.
Keskin M, Alpınar K (2002). Ethnobotanical Studies About Kışlak (Yayladağı-Hatay). J. OT Syst. Bot. 9(2):91-100.
Kırmızıbekmez H, Celep E, Bardakcı H, Yeşilada E (2008). Quantitative determination of hypericin on *Hypericum perforatum* by using HPTLC. J. Sci. Phytother. Fitomed Turk. 2(6):43.
Kızılarslan C (2008). An Ethnobotanical Survey in The South Part of İzmit Gulf. Master Thesis, Istanbul University, Institute of Health Science, Department of Pharmaceutical Botany. Istanbul.
Kirmizibekmez H, Atay I, Yesilada E (2008b). Determination of Four Major Flavonoids in the Methanolic Extract of *Hypericum perforatum* by HPTLC-Densitometry. Planta Medica 74(9):1103.
Kirmizibekmez H, Bassarello C, Pizza C, Celep E, Atay I, Mercanoglu G, Yesilada E (2008a). Antioxidant Phenolics From *Hypericum calycinum*. Planta Medica 74(9):951.
Kultur S (2007). Medicinal plants used in Kırklareli Province (Turkey). J. Ethnopharmacol. 111:341-364.
Mart S (2006). An Ethnobotanical Investigation of The Natural Plants Using By Inhabitants in Bahce and Hasanbeyli Districts of Osmaniye Province. University of Cukurova, Institute of Natural and Applied Sciences, Department of Biology, Adana.
Oktayoglu E (2003). Investigaton of the *H. montbretii* in the Sense of Hypericin Content and Biological Activity. Master Thesis, Istanbul University, Department of Pharmacognosy, Istanbul.
Ozturk B, Apaydin S, Goldeli E, Ince I, Zeybek U (2002). *H. triquetrifolium* Turra. extracts exhibits antiinflammatory activity in the rat. J. Ethnopharmacol. 80:207-209.
Ozturk N, Korkmaz S, Ozturk Y (2007). Wound-healing activity of St. John's Wort (*H. perforatum* L.) on chicken embryonic fibroblasts. J. Ethnopharmacol. 111:33-39.
Ozturk Y (1997). Testing the Antidepressant Effects of *Hypericum* Species on Animal Models. Pharmacopsychiatry 30:125-128.
Ozturk Y (2001). Possible mechanism of the analgesic effect of St. John's Wort. Fundam. Clin. Pharmacol. 15(1):113-153.
Ozturk Y, Aydin S, Baser KHC, Kirimer N, Kurtar-Ozturk N (1992). Hepatoprotective Activity of *H. perforatum* L. Alcoholic Extract in Rodents. Phytother. Res. 6:44-46.
Ozturk Y, Aydin S, Beis B, Baser KHC, Berberoglu H (1996). Effects of *H. perforatum* and *H. calycinum* extracts on Central Nervous System in mice. Phytomedicine 3(2):139-146.
Pabuccuoglu A, Konyalıoglu S, Bas M, Elgin-Meral G (2003). The in vitro effects of *Hypericum* species on human leukocyte myeloperoxidase activity. J. Ethnopharmacol. 87:89-92.
Sezik E, Yesilada E, Honda G, Takaishi Y, Takeda Y, Tanaka T (2001). Traditional medicine in Turkey X. Folk medicine in Central Anatolia. J. Ethnopharmacol. 75:95-115.
Smelcerovic A, Zuehlke S, Spiteller M, Raabe N, Özen T (2008). Phenolic constituents of 17 *Hypericum* species from Turkey. Biochem. Syst. Ecol. 36(4):316-319.

Sokmen A, Jones BM, Erturk M (1999). Antimicrobial Activity of Extracts from the Cell Cultures of some Turkish Medicinal Plants. Phytother. Res.13:355-357.

Spiteller M, Ozen T, Smelcerovic A, Zuehlke S, Mimica-Dukic N (2008). Phenolic constituents and the *in vitro* antioxidant activity of the flowers of *H. venustum*. Fitoterapia 79(3):191-193.

Tatlı I, Sahpaz S, Kupeli AE, Martin-Nizard F, Gressier B, Ezer N, Bailleul F (2009). Antioxidant, anti-inflammatory and antinociceptive activities of Turkish medicinal plants. Pharm Biol. 47(9):916-921.

Toker Z, Kizil G, Ozen HC, Kizil M, Ertekin S (2006). Compositions and antimicrobial activities of the essential oils of two *Hypericum* species from Turkey. Fitoterapia 77(1):57-60.

Tuzlaci E, Aymaz PE (2001). Turkish folk medicinal plants, Part IV: Gönen (Balıkesir). Fitoterapia 72:323-343.

Tuzlaci E, Tolon E (2000). Turkish folk medicinal plants, Part III: Şile (Istanbul). Fitoterapia 71:673-685.

Unal E, Mavi A, Kara A, Cakir A, Sengul M, Yildirim A (2008). Antimicrobial and Antioxidant Activities of Some Plants Used as Remedies in Turkish Traditional Medicine. Pharm Biol. 46(3):207-224.

Unsal C, Kultur S, Eroglu E (2009). Investigation On Some Endemic *Hypericum* Species in Turkey. University of Istanbul, Project No: 442/27122005, Istanbul.

Unsal C, Ozbek B, Eroglu E, Kultur S (2008). Antimicrobial activity of some *Hypericum* species from Turkey. J. Sci. Phytother. Fitomed Turkey 2(6):74.

Uzbay TI (2008). *Hypericum perforatum* and Substance Dependence: A Review. Phytother. Res. 22:578-582.

Uzbay TI, Coskun I, Kayır H, Ozturk N (2007). Extract of *Hypericum perforatum* blocks Caffeine-induced Locomotor Activity in Mice: A Possible Role of Nitric Oxide. Phytother. Res. 21:415-419.

Vural G (2008). Ethnobotanical Features Some Of The Willd Plants On The Honaz Mountain And Its Environment Ethnobotanic. Master Thesis, Afyon Kocatepe University, Graduate School of Natural and Applied,Sciences, Afyon.

Yesil Y (2007). An Ethnobotanical Study in Kürecik District (Malatya/Akçadag). Master Thesis, Istanbul University, Institute of Health Science, Department of Pharmaceutical Botany, Istanbul.

Yesilada E, Gurbuz I, Shibata H (1999). Screening of Turkish anti-ulcerogenic folk remedies for anti-*Helicobacter pylori* activity. J. Ethnopharmacol. 66:289-293.

Yesilada E, Honda G, Sezik E, Tabata M, Fujita T, Tanaka T, Takeda Y, Takaishi Y (1995). Traditional medicine in Turkey V. Folk medicine in the inner Taurus Mountains. J. Ethnopharmacol. 46:133-152.

Yesilada E, Honda G, Sezik E, Tabata M, Goto K, Ikeshiro Y (1993). Traditional medicine in Turkey IV. Folk medicine in the Mediterranean subdivision. J. Ethnopharmacol. 39:31-38.