Available online at www.derpharmachemica.com

ISSN 0975-413X
CODEN (USA): PCHHAX

Der Pharma Chemica, 2017, 9(23): 89-96
(http://www.derpharmachemica.com/archive.html)

Review on Phytochemical and Pharmacological Activity of Yarrow (*Achilla millefolium* Linn)

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ABSTRACT

Achillea millefolium L. commonly known as Yarrow is a perennial herb native to North America, Northern Asia, and Southern Europe. Plant belongs to family Asteraceae, which possess various medicinal healing properties for human life. Traditionally, its various parts like flowers, leaves and stems are being used as anti-inflammatory, antidysenteric, antiallergic, platelet aggregation, antipyretic, anti-bacterial, antispasmaodic, diuretic, urinary antiseptic, antimutagenic and in the treatment of hyperpigmentation of skin. A. millefolium contains active constituents like are luteolin, quercetin, apigenin, artemetin, betonicine, stachydrine, trigonelline, palmitic acid linoleic acid, aspartic acid, glutamic acid, camphor, linalool, azulene, chamazulene, sabinene, achillin, 1,8-cineole and many others. The present work highlighted the overall therapeutic potential of the yarrow (A. millefolium) and its preclinical reported activities in different disease.

Keywords: *Achillea millefolium*, Asteraceae/Compositae, Uses, Essential oils

INTRODUCTION

Plants are one of the rich sources of medicine and number of active constituents is derived and synthesizes to treat various disorders [1]. The therapeutic uses of these plants are effective, safe and economical to their bioavailability [1,2]. According to the report of World Health Organization (WHO), the 80% of the world population uses the different constituents of the plant extract, traditionally in folk medicine [2]. Over 50% of all modern clinical drugs are obtained from natural origin [3-6]. *Achillea millefolium* L. (Yarrow) is a flowering plant belonging to the family Asteraceae/Compositae. The name of *A. millefolium* is derived from Achilles, who carried it with his army to heal the wounds of his fellow soldiers during Trojan War, its specific name a thousand leaves and refers to shape like feather of bird. In veterinary medicine the aerial parts of yarrow have a long history of traditional herb medicine [4,5]. *Achillea* genus consists of 140 perennial herbs native to the northern hemispheres [6-9]. Aerial parts of yarrow has the great range of herbs applications in the world, it contains alkaloids and volatile oil rich in sesquiterpenes lactones [10]. *Achillea* species are used in folk medicine as diuretic, against diarrhoea, for abdominal pain, emmenagogue, flatulence and also for wound healing purposes. *A. millefolium* essential oil consists of a numerous monoterpenes such as 1,8-cineole, α-pinene, β-pinene, borneol and camphor in addition to sesquiterpenes lactones of germacrene derivatives [11]. The plant has been reported for activities like antiulcer [12], antinociceptive [13], antianxiety [14], antimutagenic [15], antifibrinogenic [16], antioxidant and antimicrobial activity [17], muscle relaxant [18], hepatoprotective and antispasmodic [19], reproductive activity [20], vasoprotective activity [21], hypotensive activity [22], antispermatogenic activity [23], diuretic activity [24] and hypoglycaemic, hypolipidemic activity [25] and antidiarrheal activity [26].

Plant habitat

Yarrow is a common herb found in urban waste places throughout the temperate and boreal zones of the northern hemisphere and to a small extent of southern hemisphere [23,24]. *A. millefolium* is most widely spread in southern Europe, abundantly throughout central and northern Europe, and has been widely distributed in North America [25]. In India it grows at an altitude of 1.050-3.600 m especially in the temperate Himalaya [26]. Found in the western Himalayas from Kashmir to Kumaon [27].

General description

The herb grows at a height up to 30-60 cm and large number of small hairs covering it, the plant seems to be grey-green. Stem is angular with lanceolate, leaves are dissected ranging from 1-6 cm in width and 3-20 cm in length. Microscopic examination of leaves showed feathery appearance. The flowers of the plant are arranged in terminal, flattened, loose heads or cymes and are mostly white, magenta, although pink and also red in color. The plant is cultivated and collected in month of May to October. Odour of the plant is highly aromatic (Table 1 and Figure 1) [28].

Scientific classification

Table 1: Taxonomical classification of *Achillea millefolium*

Species	*Achillea millefolium* L.
Synonyms	Milfoil, Achillea lanulosa Nutt.
Family	Asteraceae, Compositae
English	Yarrow, Milfoil, Thousand Leaf
Unani	Biranjaasif
Folk	Gandanna, Rojmari
Kingdom	Plantae
Order	Asterales
Subfamily	Asteroideae
Tribe	Anthemideae
Genus	Achillea

Traditional uses

A. millefolium aggregate are used in traditional European medicine as infusions and tinctures against gastrointestinal and hepatobiliary disorders due to their antiphlogistic, spasmolytic and antimicrobial properties and externally in case of skin inflammations and for wound healing [29,30]. It is also used in folk medicine as an anti-inflammatory and an astringent, as well as in the treatment of fever, diarrhoea, hemorrhoids, cancer, bacterial infections, hypertension and as diuretic [31]. Also used as an emmenagogue and to reduce menstrual pain [32].

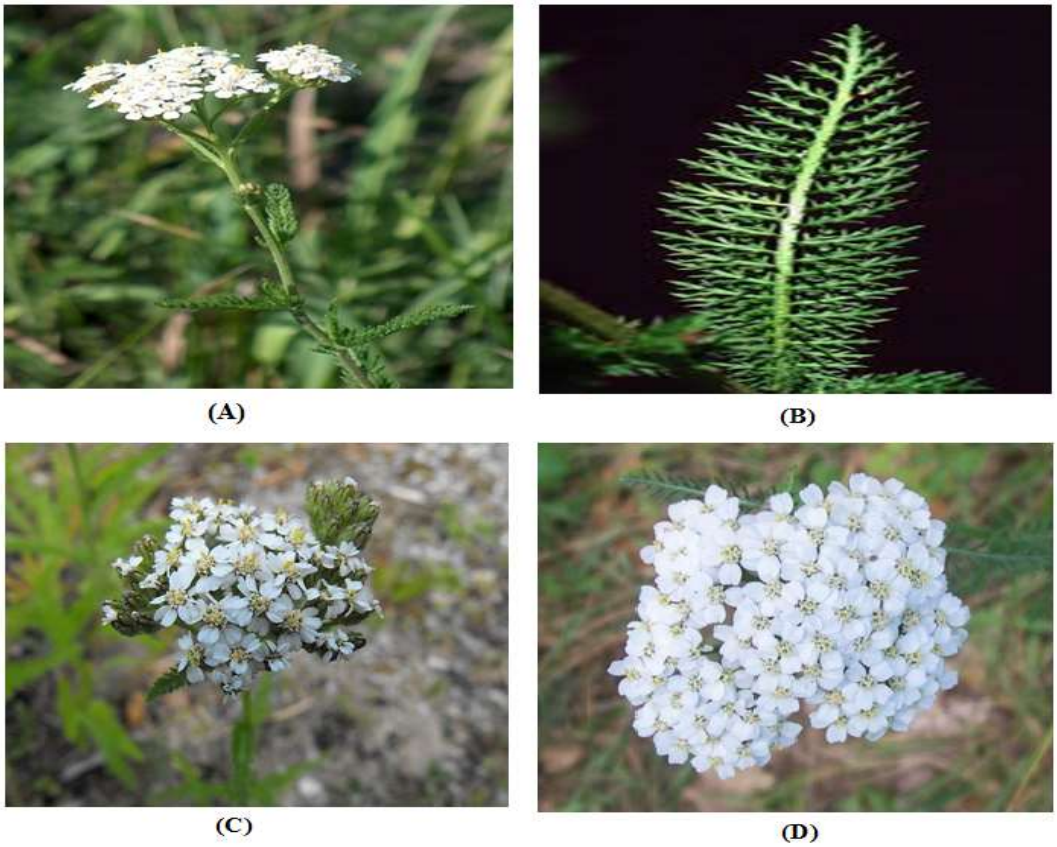
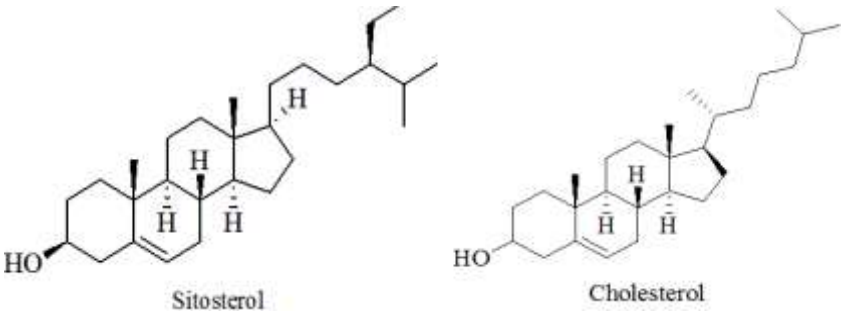


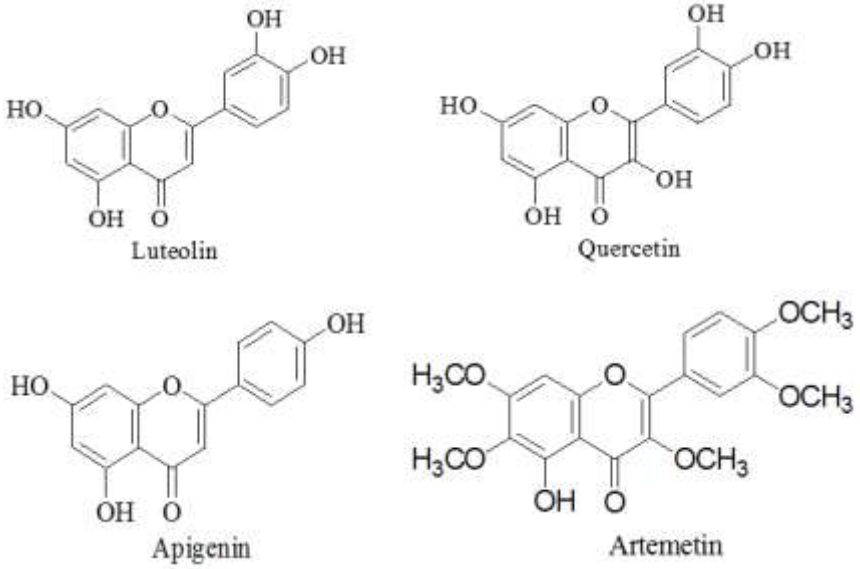
Figure 1: (A) *Achillea millefolium* L. Plant [42], (B) Yarrow leaves [42], (C) Yarrow budding [42], (D) Yarrow flowers [42]

Chemical constituents (Tables 2 and 3)

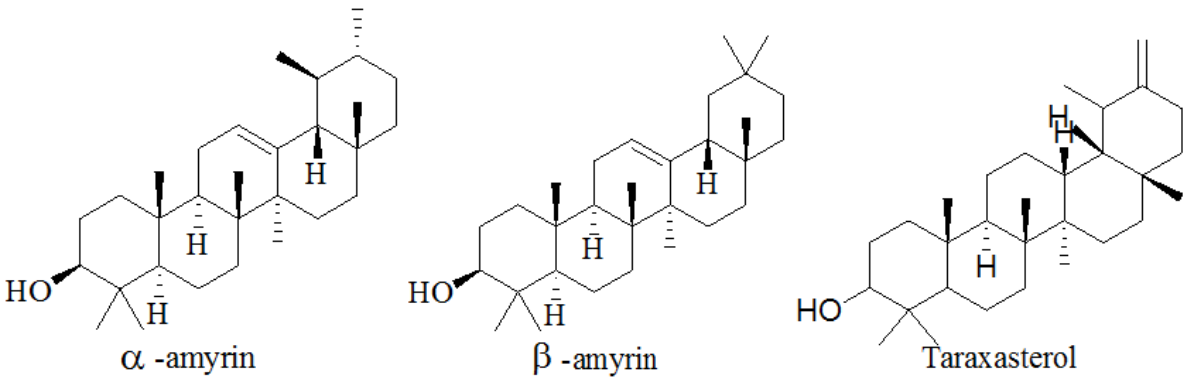
A plant contains, Steroids**:** Includes β-sitosterol, stigmasterol, cholesterol, campesterol [33].



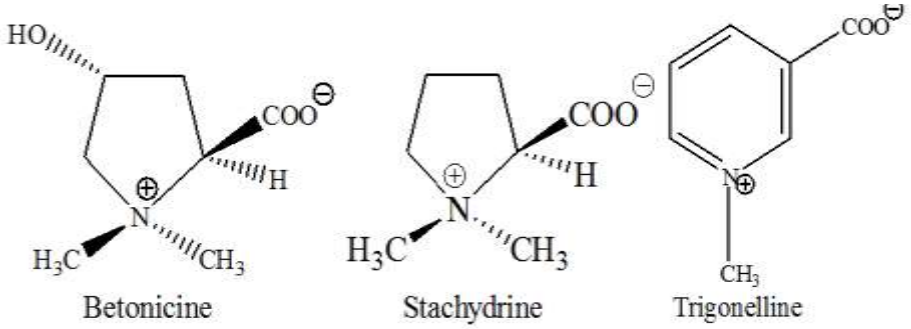
Flavanoids**:** Includes centaureidin, casticin, apigenin, luteolin, rutin, quercetin, acacetin, isorhamnetin and artemetin [33-36].



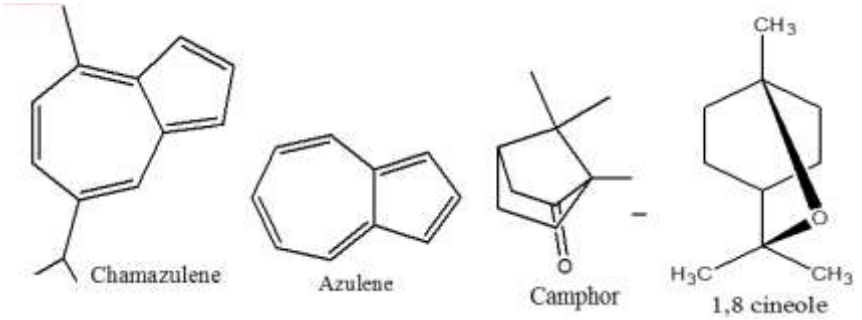
Triterpenes**:** Includes α-amyrin, β-amyrin, taraxasterol, pseudotaraxasterol [32].



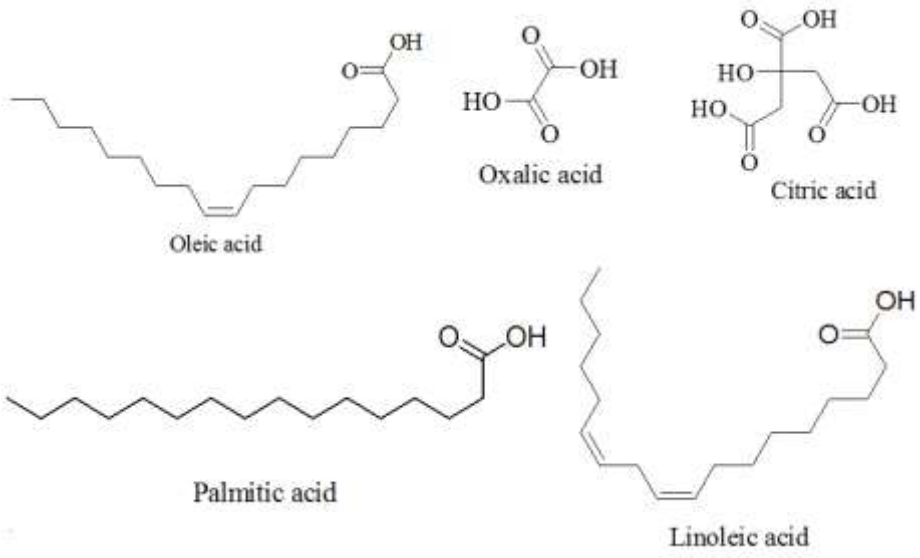
Alkaloid: Includes achilleine [36], stachydrine and betonicine, trigonelline, choline and betaine [37-39].



Essential oil: Includes cineole, borneol, pinenes, camphor, menthol, eugenol, azulene, and chamazulene [40-42].



Sesquiterpenes: Includes paulitin, isopaulitin, psilostachyin C, desacetylmatricarin, and sistenin [33,41]. Acids: Includes linoleic, palmitic, oleic, oxalic, quinic [42], citric, protocatechuic acid [43], succinic and fumaric acid [44].



Determination of phenolic compounds by HPLC technique [42]

The phenolic profile by HPLC of a wild sample of *A. millefolium* recorded at 280 and 370 nm and peak characteristics and identification are presented. Twenty-eight compounds were detected, eight of which were phenolic acid derivatives (hydroxycinnamic acid derivatives).

Table 2: Chemical composition of *Achillea millefolium* and its macronutrient [42]

S. No.		*Achillea millefolium*
1	Fat (g/100 g dw)	5.20 ± 0.13
2	Proteins (g/100 g dw)	12.53 ± 0.85
3	Ash (g/100 g dw)	6.43 ± 0.11
4	Carbohydrates (g/100 g dw)	75.84 ± 0.76
5	Energy (kcal/100 g dw)	400.28 ± 0.21
6	Fructose	1.11 ± 0.02
7	Glucose	0.66 ± 0.04
8	Sucrose	0.80 ± 0.03
9	Trehalose	0.42 ± 0.04
10	Raffinose	0.15 ± 0.00
11	Total sugars (g/100 g dw)	3.14 ± 0.08
12	Oxalic acid	1.08 ± 0.06
13	Quinic acid	0.69 ± 0.03
14	Malic acid	1.64 ± 0.04
15	Shikimic acid	0.02 ± 0.00
16	Citric acid	0.83 ± 0.03
17	Succinic acid	0.27 ± 0.03
18	Fumaric acid	0.03± 0.00
19	Total organic acids (g/100 g dw)	4.55 ± 0.10

Table 3: Chemical composition of essential oil of *Achillea millefolium* [13]

S. No.	Compounds listed in order of elution from a HP-5 MS column	Retention time (Min)	Composition (%)
1	Thujene	9.412	0.1
2	α-pinene	9.669	2.4
3	Camphene	10.323	2.4
4	Benzaldehyde	10.948	0.2
5	Sabinene	11.523	2.8
6	β-Pinene	11.592	4.2
7	2,3-Dehydro-1,8-cineole	12.335	0.6
8	α-Terpinene	13.545	0.5
9	Eucalyptol	14.496	24.6
10	γ-Terpinene	15.666	1.0
11	Terpinolene	17.123	0.2
12	Linalool	17.807	0.6
13	Camphor	20.166	16.7
14	Borneol	21.117	4.0
15	Terpinen-4-ol	21.692	2.8
16	α-Terpineol	22.515	10.2
17	Myrtenol	22.663	0.3

18	Fragranol	23.486	0.5
19	7-Methyl-3-methylene-6-octen-1-ol	23.694	0.2
20	3,7-Dimethyl-3,6-octadien-1-ol	24.408	0.6
21	Chrysanthenyl acetate	25.716	0.8
22	Bornyl acetate	26.866	0.1
23	Myrtenyl acetate	28.888	0.1
24	Eugenol	30.196	0.2
25	α-Copaene	31.019	0.1
26	Caryophyllene	32.991	0.4
27	β-Farnesene	34.002	0.3
28	γ-Curcumene	35.558	0.2
29	Zingiberene	36.262	0.3
30	Nerolidol	39.464	0.1
31	Caryophyllene oxide	40.604	0.7
32	γ-Eudesmol	43.647	1.8
33	β-Eudesmol	44.945	1.6
34	Bisabolol oxide II	45.381	3.8
35	Bisabolone oxide	47.354	3.3
36	α-Bisabolol	47.443	2.1
37	Others not identified (33)		9.2
Total=100			

Preclinical data

On preclinical study yarrow is considered to be of lower toxicity. In mice LD_{50} values have been reported up to 3.1 g/kg (by intraperitoneal injection), 3.65 g/kg (by mouth) and 1 g/kg (by subcutaneous injection) [44,45]. In rats, LD_{50} for subcutaneous injection has been recorded as 16.86 g/kg, with corresponding LD_{50} and LD_{100} values reported as 12 and 20 g/kg respectively [46].

Pharmacological activities

Antiulcer activity

Bais S., evaluated the antiulcer and antioxidant activity of methanolic extract of *A. millefolium* leaves by using pylorus ligation induced ulcers in rat stomach. Plant extract was used to assess Myeloperoxidase (MPO), Superoxide Dismutase (SOD), Thiobarbituric Acid Reactive Substances (TBARS), Glutathione (GSH) and Nitric Oxide (NO) levels in pylorus ligation induced ulcers in rat stomach. Results showed that the pretreatment of *A. millefolium* extract at the dose of (100 mg/kg/p.o. and 125 mg/kg/p.o) produced a dose dependent decrease in ulcer index in pylorus ligation-induced ulcers in Wistar rats. Pre-treatment with *A. millefolium* (100 mg/kg/p.o. and 125 mg/kg/p.o) markedly prevented the oxidative stress by improving the integrity of stomach, decreasing the level of TBARS and MPO and by increasing the concentration of tissue nitrite/nitrate, GSH, SOD in pylorus ligation induced ulcers models. *A. millefolium* (100 mg/kg/p.o and 125 mg/kg/p.o) improved the level of gastric adhesion mucus content in pylorus ligation-induced ulcers. *A. millefolium* improved the level of gastric adhesion mucus content in pylorus ligation-induced ulcers. The plant extract of *A. millefolium* (100 mg/kg/p.o and 125 mg/kg/p.o) (methanol) is a potential source of natural antioxidants for the treatment and prevention of disease in which oxidative stress is to be increased [12].

Antinociceptive

Pires et al., revealed the antinociceptive activity of hydroalcoholic extracts of *A. millefolium* and *Artemisia vulgaris* both belongs to the Asteraceae family, were evaluated by the hot plate, formalin, writhing and intestinal transit tests in an attempt to assure their use as anti-inflammatory, analgesic and antispasmodic agents in folk medicine. *A. millefolium* 500 and 1000 mg/kg significantly inhibits abdominal contortions by 65% and 23% respectively, whereas 48% and 59% abdominal contortions were inhibited by *A. vulgaris* 500 and 1000 mg/kg respectively. Both of the extract does not produce any differences in the response time in the hot plate, in the immediate or late responses in the formalin test and intestinal transit in mice. Fingerprint monitored at 360 and 270 nm in HPLC/DAD analyses, rutin as a principal constituent showed by both hydroalcoholic extract of *A. millefolium* and *A. vulgaris*. In both extracts high content of caeffic acid derivatives was also found. At 240 nm main differences were observed: Rutin content is higher in *A. millefolium* extract, while in *A. vulgaris* the major content was found to be hydroxybenzoic acid derivative [13].

Anxiolytic activity

Baretta et al., evaluate the anxiolytic-like effect of hydroalcoholic extract from the aerial parts of *A. millefolium* in mice subjected to Elevated plus maze, Open-field test and Marble- burying animal models. The GABAA/Benzodiazepine (BDZ) mediation of the effects of *A. millefolium* was evaluated by pretreatment with the noncompetitive GABAA receptor antagonist picrotoxin and the BDZ antagonist flumazenil and by [3H]-flunitrazepam binding to the BDZ site on the GABAA receptor. In the acute treatment groups, diazepam and the *A. millefolium* extract (300-600 mg/kg) increased the percentage of entries into and time spent on the open arms compared with vehicle and the lower doses (30 and 100 mg/kg) of the *A. millefolium* extract (all $P<0.05$). *A. millefolium* exerted anxiolytic-like effects in the elevated plus-maze and marble-burying test after acute and chronic (25 days) administration at doses that did not alter locomotor activity. The results indicate that the orally administered hydroalcoholic extract of *A. millefolium* exerted anxiolytic-like effects that likely were not mediated by GABAA/BDZ neurotransmission and did not present tolerance after short-term, repeated administration [14].

Anti-mutagenic activity

Dusman et al., evaluate the antimutagenic and cytotoxic potential of aqueous extracts of *A. millefolium* and *Bauhinia forficata* L. on bone marrow cells of Wistar rats treated *in vivo*. Both plant extracts possess considerable antioxidant activity due to the presence of phenolic compounds and flavonoids. These compounds were major determinants to non-cytotoxic and antimutagenic/protective action of these plants, that reduces statistically the percentage of chromosomal alterations induced by the chemotherapeutic agent cyclophosphamide in simultaneous (*A. millefolium*, 68%; *B. forficata*, 91%), pre-(*A. millefolium*, 68%; *B. forficata*, 71%), and post-treatment (*A. millefolium*, 67%; *B. forficata*, 95%). Therefore, the results indicate that extracts of *A. millefolium* and *B. forficata* have antimutagenic potential and that their consumption can benefit the health of those using them as an alternative therapy [15].

Antifibrinogenic activity

Jalali et al., revealed the antifibrinogenic effect of *A. millefolium* L. (Yarrow) hydroalcoholic extract on bleomycin-induced lung fibrosis in rat. Maceration method was used to prepare hydroalcoholic extract of yarrow. Single intratracheal instillation of bleomycin (7.5 IU/kg) or vehicle (saline) were given to Sprague Dawley rats weighing 180-220 g. Rats were treated with different doses of *A. millefolium* extract (400, 800 and 1600 mg/kg/day) for two weeks. On histopathological examination, marked alveolar thickening associated with myofibroblasts and fibroblast proliferation and production of collagen in intestinal tissue which finally leads to pulmonary fibrosis showed by bleomycin treated animals. With a dose dependent manner *A. millefolium* extract impaired damages in lung tissue. Lung parenchymal strips contractility was also studied. The generation of force by lung strips in response to sodium tungstate and potassium ions was recorded using an isometric transducer on a polygraph. The results shows more contractions will be generated significantly from lungs strips isolated from bleomycin-treated fibrotic lungs when compared to the animals that receive extract of yarrow after bleomycin. It can be concluded that extract of yarrow may be able to impair the rate of collagen deposition in lung tissue and fibroblast/myofibroblast proliferation due to bleomycin. The effect of *A. millefolium* may be due to the active ingredients of the plant with antioxidant and anti-inflammatory properties [16].

Antioxidant and antimicrobial activity

Candan et al., revealed the *in vitro* antioxidant and antimicrobial activities of the essential oil of *A. millefolium* methanolic extracts were investigated. 36 compounds were identified by the Gas Chromatography-Mass Spectrometry (GC-MS) analysis of the essential oil constituting 90.8% of the total oil. Camphor, eucalyptol, β-pinene, α-terpeniol and borneol were the chief components of the oil comprising 60.7%. The oil strongly decrease the 2,2-Diphenyl-1-Picrylhydrazyl (DPPH) radical (IC_{50})=1.56 μg/ml) and exhibited hydroxyl radical scavenging effect in the Fe^{3+}-EDTA-H_2O_2 deoxyribose system (IC_{50})=2.7 μg/ml). Non-enzymatic lipid peroxidation of rat liver homogenate (IC_{50})=13.5 micro g/ml) is also inhibited by *A. millefolium* essential oil. Antioxidant activity was basically showed by the polar phase of the extract. The antimicrobial activity showed by the oil against *Clostridium perfringens, Streptococcus pneumonia, Candida albicans, Acinetobacter lwoffii, Mycobacterium smegmatis* and *Candida krusei* while slight or no activity was exhibited by water-insoluble parts of the methanolic extracts. The study assures that the *A. millefolium* essential oil exhibits antimicrobial and antioxidant properties *in vitro* [17].

Muscle relaxant activity

Koushyar et al., revealed the stimulatory effect of *A. millefolium* hydroethanolic extract on β-adrenoceptor of the tracheal smooth muscle in order to investigate possible mechanism for its observed relaxant effect. Effect of three concentrations of hydroethanolic extract, saline on β-receptor, 10 nM propranolol was tested in two experimental groups including; (group 1) tracheal smooth muscles which are non-incubated and (group 2) incubated tracheal smooth muscles with chlorphenaramine. Concentration response curves were performed to isoprenaline in precontracted tracheal smooth muscles in the presence of the propranolol, saline and extract. EC_{50} and CR-1 values were measured. There is observation of leftward shifts of isoprenaline curves in the presence of high and medium concentrations of the extract compared with saline in both groups. The EC_{50} values were obtained in the presence of high and medium concentrations of the extract. Only in group 1 were lower than that of saline non-significantly. In both groups CR-1 values obtained in the presence of all concentrations of the extract were negative and differ significantly with that of propranolol. The results indicated that the extract have small stimulatory effect on β_2-adrenoreceptors [18].

Hepatoprotective and antispasmodic activity

Yaeesh et al., evaluate the hepatoprotective effect against Lipopolysaccharide (LPS) and d-Galactosamine (d-GaIN) induced hepatitis in mice and anti-spasmodic effect in isolated gut preparations to rationalize the folk use of the plant. 100% mortality was produced by co-administration of LPS (25 μg/kg) and d-GaIN (700 mg/kg) in mice. There was reduction of mortality to 40% by pre-treatment of animals with Am. Cr (300 mg/kg). LPS (1 μ/kg) and d-GalN (700 mg/kg) Co-administration will significantly increase the levels of Aspartate Aminotransferase (AST) and Alanine Aminotransferase (ALT) compared with values in the control group ($p<0.05$). Am. Cr (150-600 mg/kg) pre-treatment to mice significantly prevents the toxins induced rise in plasma AST and ALT ($p<0.05$). On histopathology of the liver hepatoprotective effect of Am. Cr was further verified, which showed improved architecture, decreased cellular swelling and apoptotic cells, absence of parenchymal congestion, compared with the toxin groups of animals. Concentration-dependent (0.3-10 mg/ml) relaxation of both K(+)-induced and spontaneous contractions as well as shifting the Ca(++) Concentration-Response Curves (CRCs) to the right caused by Am, Cr, similar to that caused by verapamil. These results showed that *A. millefolium* crude extract exhibits a hepatoprotective effect, which may be due to its observed calcium channel blocking activity [19].

Reproductive activity

Dalsentar et al., revealed the toxicity of the exposure to the aqueous extract from leaves (AE) of *A. millefolium* on Wistar rats reproductive endpoints. Adult male rats were treated daily with *A. millefolium* extract (0.3, 0.6 and 1.2 g/kg/day) during 90 days period by oral gavage. Endpoints including reproductive organ weights, sperm and spermatid numbers as well as morphology of sperm were evaluated. During the treatment period no clinical signs of toxicity were detected, and body weight gain was same in all groups. A significant increase in the abnormal sperm percentage in the group treated with the highest dose of *A. millefolium* extract was detected with no other important changes in the other reproductive endpoints studied in the male rats. Furthermore, a possible estrogenic/antiestrogenic activity of the *A. millefolium* extract screened after a 3-day treatment of immature female rats which did not show any uterotrophic effects [20].

Vasoprotective activity

Acqua et al., investigated the *in vitro* effects of *A. millefolium* extract on the growth of primary rat Vascular Smooth Muscle Cells (VSMCs) as well as the involvement of Estrogen Receptors (ERs) in this process. In addition, the ability of *A. millefolium* extract to modulate the NF-κB pathway was tested in Human Umbilical Vein Endothelial Cells (HUVECs). HPLC-DAD and LC-MSn techniques were used for fingerprinting of the extract and main constituents were dicaffeolylquinic acid derivatives (12%) and flavonoids (10%). The extract increases VSMC growth at least in part by acting through ERs and impaired NF-κB signaling in HUVECs. Final effect of the extract may be due to various compounds acts via different mode of actions. Therefore, *A. millefolium* may induce novel potential actions in the cardiovascular system [21].

Hypotensive activity

Souza et al., was used anaesthetized rats to evaluate the hypotensive effect of hydroethanolic extract of *A. millefolium* and its Dichloromethane (DCM), Butanolic (BT), Ethyl Acetate (EA) and dichloromethane-2 (DCM-2) fractions, besides the flavonoid artemetin, isolated from *A. millefolium*. Oral administration of HEAM (100-300 mg/kg), DCM (20 mg/kg), DCM-2 (10-30 mg/kg), but not EA (10 mg/kg) and BT (50 mg/kg) fractions remarkably reduced the mean arterial pressure (MAP) of normotensive rats. The phytochemical analysis of DCM and DCM-2

fractions by ^{1}H-NMR shows high amounts of artemetin, that was isolated and administered by either intravenous (0.15-1.5 mg/kg) or oral (1.5 mg/kg) routes in rats. This flavonoid was able to reduce MAP dose-dependently, up to 11.47 ± 1.5 mm Hg (1.5 mg/kg, i.v.). This study aims to investigate if artemetin-induced hypotension was related to angiotensin-converting enzyme inhibition, and to evaluate the influence of this flavonoid on the vascular effects of both bradykinin and angiotensin I. Intravenous injection of artemetin (0.75 mg/kg) increased the average length of bradykinin-induced hypotension while significantly reduced the hypertensive response to angiotensin I. Artemetin at the dose of 1.5 mg/kg, p.o. was also able to reduce plasma (about 37%) and vascular (up to 63%), ACE activity (*in vitro*). On the other hand, there was no change in angiotensin II-induced hypertension by artemetin. Results disclosed that hypotensive effect of *A. millefolium* may be, associated with high levels of artemetin and its potential to decrease angiotensin II generation *in vivo*, by ACE inhibition [22].

Antispermatogenic activity

Montanari et al., evaluate the effect of hydroalcoholic extract (300 mg/kg/day, orally, for 30 days) and ethanolic extract (200 mg/kg/day, intraperitoneally, for 20 days) of *A. millefolium* (yarrow) flowers on the spermatogenesis of Swiss mice. Morphological characters were examined with the light and electron microscopes. The alterations observed were exfoliation of immature germ cells, seminiferous tubule vacuolization and germ cell necrosis. Animals treated with the extracts had an increased number of metaphases in the germ epithelium that might be due to cytotoxic substances or substances stimulating cell proliferation [23].

Diuretic activity

Souza et al., evaluate the diuretic effect of aqueous and hydroethanolic extracts of *A. millefolium* in male Wistar rats. Aqueous extract of *A. millefolium*, 125-500 mg/kg), hydroethanolic extract of *A. millefolium*, 30-300 mg/kg), dichloromethane sub fractions (DCM-2, 10 and 30 mg/kg), or hydrochlorothiazide (10 mg/kg), were administered orally and the animals were kept in metabolic cages for urine collection for 8 h. To evaluate the involvement of prostaglandins and bradykinin in the diuretic action of *A. millefolium* selected groups of rats received HOE-140 (1.5 mg/kg, i.p.) or indomethacin (5 mg/kg, p.o.), before treatment with a DCM-2 sub fraction (30 mg/kg). The urinary volume, pH, conductivity, density and electrolyte excretion were measured. Similar to hydrochlorothiazide, both hydroethanolic extract of *A. millefolium* and DCM-2, but not Aqueous extract of *A. millefolium*, increased urinary volume and the excretion of Na+ and K+ when compared with the control group (vehicle). HOE-140 (a bradykinin B2 receptor antagonist) and Indomethacin (a cyclooxygenase inhibitor) both abolish the diuretic effect of DCM-2. The study shows that extracts obtained from *A. millefolium* are able to effectively increase dieresis when orally administered in rats. This effect depends on both the activation of bradykinin B2 receptors and the activity of cyclooxygenases [24].

Hypoglycaemic and hypolipidemic activity

Mustafa et al., evaluate the hypoglycemic and hypolipidemic effect of aqueous and methanolic extract of *A. millefolium* in diabetic rats. Diabetes was induced by single intraperitoneal injection of freshly prepared solution of alloxan monohydrate (150 mg.kg 1 body weight) in Wistar rats of 150-200 g body weight. The rats were divided into number of groups, serving as normal group, diabetic control group, diabetic treated with glibenclamide, methanolic extract and aqueous extract treated groups. The blood serum collected from the several groups of rats was analysed for its various biochemical parameters estimation like cholesterol, glucose, triglycerides, Serum Glutamic Oxaloacetic Transaminase (SGOT), Serum glutamic pyruvic transaminase (SGPT), Very Low Density Lipoprotein (VLDL) and Alkaline Phosphatase (ALP). Experimental rats were scarified and for histopathological studies, pancreas was collected on the 14th day of the experiment. The extracts of *A. millefolium* at dose levels of 250 and 500 mg.kg^{-1} body weight showed significant ($p \leq 0.05$) decrease in blood glucose level, VLDL, TGL, cholesterol, SGOT, SGPT, and ALP in diabetic rats. The extracts prevented the β-cells of pancreas from the cytotoxic effects of Alloxan monohydrate. The results indicate that the extracts are effective in hyperglycemia and can effectively protect against other various metabolic aberrations caused by alloxan monohydrate [25].

Antidiarrheal activity

Antidiarrheal activity of the methanolic extract of *A. millefolium* leaves was evaluated on castor oil-induced diarrhoea and assessment of gastrointestinal propulsion of charcoal meal in rats. *A. millefolium* commonly known as yarrow belonging to the family Asteraceae, is an ancient traditional herb native to Europe and is used to treat wounds, hepatic disorders, gastrointestinal disorders, spasmodic diseases, headaches, pain, inflammation and diarrhoea. The three doses of *A. millefolium* methanolic extract have been selected (150 mg/kg, 300 mg/kg and 450 mg/kg). Among three dosages of AM leaves, the two dosages (300 mg/kg-IIIb and 450 mg/kg IIIc) showed a significant reduction in various parameters like distance travelled (IIIb-25 ± 1.679 cm; IIIc-17 ± 2.534 cm) and % average travelled (IIIb-47.16; IIIc-32.69) travelled in charcoal meal model when compared to control group. Phytochemical screening of the plant extract revealed the presence of flavonoids, tannins, steroids and terpenes. Results showed that the methanolic extract of *A. millefolium* Leaves possess antidiarrhoeal activity possibly mediated by inhibiting the intestinal motility, hydro electrolyte secretion and by making intestinal mucosa more resistant to chemical alteration and hence reduce secretions [26].

Contraindications

In sensitive individuals yarrow can cause allergic reactions, especially to those with a pre-existing hypersensitivity to other members of the plant family Asteraceae/Compositae [46]. In pregnancy, yarrow should is contraindicated. It affects the menstrual cycle and is reputed to be an abortifacient and the volatile oil contains trace amounts of thujone which is used as an abortifacient [47].

CONCLUSION

The above literature survey revealed that *A. millefolium* is an important medicinal plant due to its traditional uses to treat diseases and presence of many active chemical constituents which are responsible for various medicinal and pharmacological properties so it can be used for the welfare of mankind.

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