



YARROW (*ACHILLEA MILLEFOLIUM* LINN.) A HERBAL MEDICINAL PLANT WITH BROAD THERAPEUTIC USE – A REVIEW.

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ABSTRACT

This review gives an account of the current knowledge on the morphology, phytochemistry, and pharmacological aspects of yarrow (*Achillea millefolium*). Yarrow (*Achillea millefolium*) is a flowering plant in the family Asteraceae, it is called *plumajillo*, or "little feather", for the shape of the leaves. A wide range of chemical compounds have been isolated, mainly isovaleric acid, salicylic acid, asparagin, sterols, flavonoids, bitters, tannins, and coumarins. Different parts of the plant have been used in traditional medicine as diaphoretic, astringent, tonic, stimulant and mild aromatic, cold and influenza, Amenorrhoea, antiphlogistic. The aerial parts of the plant are used for phlegm conditions, as a bitter digestive tonic to encourage bile flow, and as a diuretic. The alkaloids extracted from the leaves of yarrow (*Achillea millefolium*) are reported to have anti-inflammatory and analgesic activity. Yarrow (*Achillea millefolium*) shows several characteristic pharmacological effects like gastroprotective, Antibacterial, Antioxidant, Antiseptic, Expectorant, carminative activity which are consistent with the reported uses of the plant extracts in the indigenous system of medicine. Hence the present article includes the detailed exploration of morphology, phytochemistry, and pharmacological aspects of yarrow (*Achillea millefolium*) in an attempt to provide a direction for further research.

Keywords: Alkaloids, antibacterial, Antioxidant, *Achillea millefolium*, flavonoids.

INTRODUCTION

Plants have been used by men from prehistoric times to get rid of suffering & curing ailments. The folk medicines of almost around the world rely chiefly on herbal medicine even today¹. Plants are of the important sources of medicine & large numbers of drugs in use are derived from plants. The therapeutic uses of plant are safe & economical & effective as their ease of availability². In India the indigenous system of medicine namely Ayurvedic, Siddha & Unani have been in existence for several centuries. Yarrow, a member of the aster family, is closely related to chrysanthemums and chamomile. Yarrow (*Achillea millefolium*) was named after Achilles, the Greek mythical figure who used it to stop the bleeding wounds of his soldiers. Decoctions have been used to treat inflammations, such as hemorrhoids, and headaches. The most medicinally active part of the plant is the flowering tops. They also have a mild stimulant effect, and have been used as a snuff. Popular in European folk medicine, yarrow contains flavonoids (plant-based chemicals) that increase saliva and stomach acid, helping to improve digestion. Yarrow may also relax smooth muscle in the intestine and uterus, which can relieve stomach and menstrual cramps. The flowers are used to treat various allergic mucus problems, including hay fever. The dark blue essential oil, extracted by steam distillation of the flowers, is generally used as an anti-inflammatory³ or in chest rubs for colds and influenza. The leaves encourage clotting, so it can be used fresh for nosebleeds.⁴ The aerial parts of the plant are used for phlegm conditions, as a bitter digestive tonic to encourage bile flow, and as a diuretic.⁵ The aerial parts act as a tonic for the blood, stimulate the circulation, and

can be used for high blood pressure. It is also useful in menstrual disorders, and as an effective sweating remedy to bring down fevers. Yarrow intensifies the medicinal action of other herbs taken with it,⁶ and helps eliminate toxins from the body. It has Analgesic^{7,8} Amenorrhoea, antiphlogistic,^{9,10} anti-inflammatory agent, used to control bleeding, blood clots, blood pressure (lowers), blood purifier, blood vessels (tones), colds, chicken pox, circulation, cystitis, diabetes treatment, digestion (stimulates) gastro-intestinal disorders⁹, choleric¹¹ dyspepsia, eczema, fevers, flu's, gastritis, glandular system, gum ailments, heartbeat (slow), influenza, insect repellent, inflammation¹², emmenagogue,¹³ internal bleeding, liver (stimulates and regulates), lungs (hemorrhage), measles, menses (suppressed), menorrhagia, menstruation (regulates, relieves pain), nipples (soreness), nosebleeds, piles (bleeding), smallpox, stomach sickness, toothache, thrombosis, ulcers, urinary antiseptic, uterus (tighten and contract), gastroprotective¹⁴ varicose veins, vision, may reduce autoimmune responses¹⁵. A decoction of the whole plant is employed for bleeding piles, and is good for kidney disorders. It has the reputation also of being a preventative of baldness, if the head be washed with it. Internally it is used for loss of appetite and dyspepsia. Externally it is used as a sitz bath for female disorders¹⁶.

Table 1: Scientific classification of Yarrow

Kingdom	Plantae
Family	Asteraceae
Genus	<i>Achillea</i>
Species	<i>A. millefolium</i>
Binomial Name	<i>Achillea millefolium</i> L.
References Species	Plantarum 2: 899 L





Fig 1: *Achillea millefolium*



Fig 2: Budding

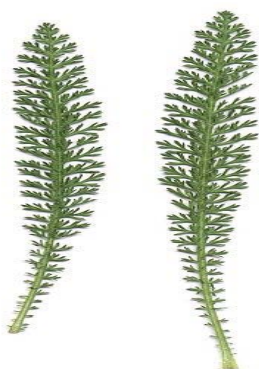


Fig 3

Leaves of Yarrow



Fig 4

Flowers of Yarrow

Table 2: Common Names of Yarrow

Green arrow	Milfoil
Noble yarrow	Nosebleed plant
Sanguinary	Solder's woundwort
Thousandleaf	Yarrow

Binomial Distribution¹⁷

Yarrow (*Achillea millefolium*) is an erect herbaceous perennial plant that produces one to several stems (0.2 to 1m tall) and has a rhizomatous growth form. Leaves are evenly distributed along the stem, with the leaves near the middle and bottom of the stem being the largest. The leaves have varying degrees of hairiness (pubescence). The leaves are 5–20 cm long, bipinnate or tripinnate, almost feathery, and arranged spirally on the stems. Yarrow grows up to 3500m above sea level. The plant commonly flowers from May through June, and is a frequent component in butterfly gardens. Common yarrow is frequently found in the mildly disturbed soil of grasslands and open forests. Active growth occurs in the spring. In North America, there are both native and introduced genotypes, and both diploid and polyploid plants.

Habitat¹⁸

Yarrow (*Achillea millefolium*) flourishes in a sunny and warm habitat, and is frequently found in meadows and along roadsides, as well as on dry, sunny slopes. It grows

as a simple, upright, and hairy stem, usually under 3 feet. Yarrow blooms between June and September. The flowers are typically white, but either pink or pale purple flowers are common in mountain areas. The petals are densely arranged in flattened clusters, and the leaves look like feathers. The plant spreads rapidly. Yarrows can be planted to combat soil erosion due to the plant's resistance to drought. It is Found in, Europe, North America northern Asia, and southern Australia.

Establishment¹⁹

Common Yarrow (*Achillea millefolium*) is a drought tolerant species of which there are several different ornamental cultivars. Seeds require light for germination, so optimal germination occurs when planted no deeper than ¼ inch. Seeds also require a germination temperature of 18–24°C (64–75°F). Common yarrow responds best to soil that is poorly developed and well drained. The plant has a relatively short life, but may be prolonged by dividing the plant every other year, and planting 12 to 18 inches apart. Common yarrow is a weedy species and can become invasive. It may suffer from mildew if not planted in well-drained soil.

Parts Used

The flowers, leaves, and stems of the Yarrow (*Achillea millefolium*) plant are used for medicinal purposes. It is collected while in bloom.

Phytochemical constituents of Yarrow (*Achillea millefolium*)²⁰

- Alkaloids (betonicine, stachydrine, trigonelline)
- Coumarins
- Flavonoids (apigenin, luteolin, quercetin)
- Salicylic acid
- Sesquiterpene lactones (achillin, achillicin)
- Polyacetylenes
- Volatile oil with variable content (linalool, camphor, sabinene, chamazulene)
- Triterpenes
- Tannins.
- Sterols and plant acids.

Ethanobotanical uses²¹

Various parts of the globe, use of plants has been mentioned by all the cultures. The physical evidence for the use of herbal remedies dates back to 60,000 years of a Neanderthal man uncovered in 1960. As per history of phytotherapy, Women of those days prepared herbal medicines every day and took care of the ills of the members of the family; while the men compiled the remedies used by the women and wrote it down. the ancient civilization of India, China, Greece and other countries of the world developed their own system of medicines India plants have been traditionally

independent of each other but all of them were predominantly plant based.

In India plants have been traditionally used for human and veterinary health care and also in the food and textile industry. 90% percent of the local food resources known to indigenous people were undocumented to nutritional literature, trade, cosmetics and perfumes: but India has a special position in area of herbal medicines *A. millefolium* Linn., Family composite used in various purposes such as leaves, flowers, Aerial parts, root, essential oil etc. are known to have potential pharmacological activity such as expectorant, analgesic, anticancer, hypotensive, and antiinflammatory agent. It also plays a significant role in treatment of fevers, arthritis, asthma, bronchitis, Cardio vascular complaints etc. in traditional medical practices.

Uses of whole plant

Yarrow (*Achillea millefolium*) plant has flexible medicinal use and it is very resourceful as a herbal medication is established from the fact that various parts of the plant can be used for healing different disorders. The flowers, essential oil, leaves as well as aerial parts are useful in some way or the other.

Flowers

Infusion: An infusion of yarrow flowers can be prepared by steeping the flowers into boiling water for some time. If taken internally, the infusion is useful for upper respiratory phlegm. It may also be useful to heal eczema when applied externally as a wash.

Inhalation: Fresh yarrow flowers may be added to boiling water and the aroma inhaled to cure hay fever and mild asthma.

Essential oil

Massage oil: With a view to get relief from swollen joints, dilute 5 to 10 drops of yarrow oil in 25 ml of permeated St. John's wort oil and massage the amalgamation on the affected areas.

Chest rub: To alleviate chesty colds and drive out influenza, dilute 20 drops of essential yarrow (*Achillea millefolium*) oil in 25 ml of almond or sunflower oil and blend it with eucalyptus, peppermint, hyssop or thyme oil and rub the mixture on the chest.

Leaves

Fresh: Inserting yarrow (*Achillea millefolium*) leaf into the nostril helps in curbing nose bleed. Poultice: Cuts and scratches on the body can be healed by wrapping cleansed fresh yarrow leaves on the affected regions.

Aerial parts

Infusion: An infusion prepared with the aerial parts of the yarrow plant is useful in reducing fevers. The infusion is also useful as a digestive stimulant.

Tincture: Yarrow (*Achillea millefolium*) tincture is useful for healing urinary disorders and menstrual problems. It is also recommended for cardiovascular complaints.

Compress: soak a pad in the yarrow infusion or dilute the yarrow tincture to get relief from varicose veins

PHARMACOLOGICAL ACTIONS

The volatile oils work as antibacterial, anti-inflammatory and diuretic agents. The tannins are aggressive astringents. The alkaloids are both hypotensive and hypoglycemic. Yarrow (*Achillea millefolium*) even has coumarin in its cells which works as an anti-thrombotic to reduce high blood pressure. The bitter compounds that the tongue detects are due to flavonoids such as saponins and unpleasant tasting but powerful alkaloids like achilleine, trigonelline and betonicine. These are the proven facts for yarrow's actions in the digestive system, tissues and the blood stream.

Biological activity

Anti Microbial activity²²⁻³⁰

Yarrow (*A. millefolium*) is recognized as a powerful medicinal plant is widely distributed and has been used medicinally for thousands of years. In a study, *A. millefolium* showed antibacterial activity against *S. typhimurium* and *S. aureus* with predicted MICs on the order of 10 s of µg/mL or 10 s of mg/mL, respectively. A number of studies have investigated the antibacterial properties of this species and found similar results to those presented here. One difference, however, is that two studies found that ether-hexane-methanol extracts of Yarrow caused inhibition zones against *E. coli* in disc diffusion assays, whereas the study with aqueous extracts of flower, leaves, roots, and shoots and a separate study of essential oil and methanolic extracts did not. These differing results could be due to the different extraction methods used or regional variation in the chemical constituents of the plants. It is well known that Yarrow represents a diverse, polyploid complex that is probably composed of dozens of species with varying biochemical compositions. The biochemical diversity of this complex has been fairly well described, and it has been hypothesized that phenolic compounds such as flavonoids and phenolcarbonic acids may underlie the observed antimicrobial activity.

Cholagogue Activity

The cholagogue activity of yarrow (*Achillea millefolium*) may be due to the presence of unsaturated fatty acids. At the least, it has been observed unsaturated fatty acids have good cholagogue effects, and they are present in yarrow.

Anti Hypertensive activity³¹

The control of Hypertension is an important element in the management of cardiovascular diseases. Study showed that yarrow (*Achillea millefolium*) exhibits a high



angiotensin converting enzyme inhibition, hence used in the treatment of hypertension.

Anti Inflammatory activity³²

Yarrow oil (*Achillea millefolium*) possesses good Anti inflammatory activity and used to treat rheumatism, muscle aches and heal inflamed cuts or wounds. Its phytochemical constituent, Flavonoids, along with having an effect on prostaglandin production, possess anti-inflammatory. Another component of yarrow that is a powerful anti-inflammatory is azuline, which comprises almost half of yarrow's chemical composition.

Antioxidant Activity³³

In a Study the in vitro antimicrobial and antioxidant activities of the essential oil and methanol extracts of *Achillea millefolium* subsp. *millefolium* Afan. (Asteraceae) were investigated. GC-MS analysis of the essential oil resulted in the identification of 36 compounds constituting 90.8% of the total oil. Eucalyptol, camphor, alpha-terpineol, beta-pinene, and borneol were the principal components comprising 60.7% of the oil. The oil strongly reduced the diphenylpicrylhydrazyl radical (IC₅₀)=1.56 micro g/ml) and exhibited hydroxyl radical scavenging effect in the Fe(3+)-EDTA-H(2)O(2) deoxyribose system (IC₅₀)=2.7 micro g/ml). It also inhibited the nonenzymatic lipid peroxidation of rat liver homogenate (IC₅₀)=13.5 micro g/ml). The polar phase of the extract showed antioxidant activity. The oil showed antimicrobial activity against *Streptococcus pneumoniae*, *Clostridium perfringens*, *Candida albicans*, *Mycobacterium smegmatis*, *Acinetobacter woffii* and *Candida krusei* while water-insoluble parts of the methanolic extracts exhibited slight or no activity. This study confirms that the essential oil of yarrow (*Achillea millefolium*) possesses antioxidant and antimicrobial properties in vitro.

Anti nociceptive activity³⁴

In a study the hydroalcohol extracts of *Achillea millefolium* L. (AM) and *Artemisia vulgaris* L. (AV), both belonging to the Asteraceae family, were evaluated by the hot plate, writhing, formalin and intestinal transit tests in an attempt to confirm their folk use as analgesic, antiinflammatory and antispasmodic agents. AM 500 and 1000 mg/kg significantly inhibited abdominal contortions by 65% and 23%, respectively, whereas AV 500 and 1000 mg/kg inhibited them by 48% and 59%, respectively. None of the extracts produced differences in the intestinal transit in mice, nor in the response time in the hot plate or in the immediate or late responses in the formalin test. In HPLC/DAD analyses 'fingerprint', monitored at 360 and 270 nm, both hydroalcohol extracts showed the same flavonoid glycoside as a principal constituent, which was identified as rutin. A high content of caffeic acid derivatives were also found in both extracts. The main differences were observed at 240 nm: AM had a higher content of rutin, while in AV the

hydroxybenzoic acid derivative was the major component.

Anti cancer activity^{35,36}

Yarrow (*Achillea millefolium*) possesses good Anti cancer activity. The phytochemical constituent of yarrow that is the flavonoids and sesquiterpenoids have anti-proliferative effects against mouse P-388 leukemia cells and cervix epithelial adenocarcinoma (HeLa), breast epithelial adenocarcinoma (MCF-7) and skin epidermoid carcinoma (A431) cells³³.

Anti Diarrheal and Gastroprotective activity

The astringent feature of yarrow (*Achillea millefolium*) makes it a useful medication in stopping diarrhea and dysentery as well as impedes hemorrhage from the intestinal coatings. In addition, yarrow's sterile and anti-inflammatory qualities help in healing infections and swollen organs like in the case of gastritis and enteritis.

SAFETY FACTORS & TOXICITY³⁷

Yarrow (*Achillea millefolium*) causes Contact dermatitis, photosensitization, and other allergic reactions may occur in sensitive individuals. This herb has approval status by the German Commission E. Yarrow (*Achillea Millefolium*) Extract is an extract of the yarrow plant, *Achillea millefolium*, supplied in polypropylene glycol, which is reported to function as a "biological additive" in cosmetic products. Sesquiterpene lactones, polyacetylenes, simple coumarins, and flavonoids have been identified among the many components of *A. millefolium*. Yarrow Extract was reportedly used in 65 cosmetic formulations. Historically, Yarrow (*Achillea Millefolium*) Extract was reported to be used at concentrations of < or =25%, but recent data indicate that this ingredient is supplied with actual Yarrow (*Achillea Millefolium*).

Extract content of 2% to 25% and used at concentrations of 0.5% to 10%. Only limited toxicity data were available. Guinea pigs were sensitized to crude extracts of the whole plant and the flowers of *A. millefolium*. *A. millefolium* tea was weakly genotoxic in a somatic mutation and recombination test using *Drosophila melanogaster*. In clinical testing, product formulations containing 0.1% to 0.5% of ingredient that actually contained 2% of Yarrow Extract were generally not irritating. In provocative testing, patients reacted to a Composite mix that contained yarrow, as well as to yarrow itself. Also in clinical testing, a formulation containing 0.1% Yarrow (*Achillea Millefolium*) Extract (2% Yarrow in propylene glycol and water) was not a sensitizer in a maximization test and alcoholic extracts of dried leaves and stalks of *A. millefolium* did not produce a phototoxic response.

These data were not considered sufficient to support the safety of this ingredient in cosmetics. The types of data (all testing is to be performed on cosmetic-grade ingredients) still required include (1) ultraviolet (UV) absorption data, if absorption occurs in the UVA or UVB



range, photosensitization data are needed; (2) gross pathology and histopathology in skin and other major organ systems associated with repeated exposures; (3) reproductive and developmental toxicity data; (4) two genotoxicity studies, one using a mammalian system, if positive, a 2-year dermal carcinogenicity assay performed using National Toxicology Program (NTP) methods may be needed; and (5) clinical sensitization testing at maximum concentration of use. In the absence of these data, it was concluded that the available data are insufficient to support the safety of Yarrow (*Achillea Millefolium*) Extract for use in cosmetic products.

Abortifacient activity³⁸

Yarrow (*Achillea millefolium*) also has traditionally been used as an abortifacient, emmenagogue, contraceptive, and for stimulating uterine contractions. For this reason, it is contra-indicated for use in pregnancy. There has, however, been little scientific research carried out to either confirm or refute this recommendation. Female rats were dosed, orally by gavage using 56 times the human dose of yarrow daily on either gestation days (GD) 1-8 or GD 8-15. Two groups of controls were included; the first received water and the second received an equivalent dose of ethanol to that found in the yarrow preparation over the two gestation periods. On GD 20, rats were sacrificed, placentae were weighed, and corpora lutea counted. The fetuses were weighed and examined for signs of external, internal or skeletal malformations.

In the study it was found that yarrow, when administered to rats at 56 times the human dose, was associated with reduced fetal weight and increased placental weight. In the absence of a no observable effect level for these variables it must be concluded that the consumption of yarrow is contraindicated during pregnancy until further investigations have been carried out.

CONCLUSION

Aromatic plants have a significant role to combat disease, from the dawn of civilization. The genus *Achillea* consists of about 140 perennial herbs native to the Northern hemisphere. The vast survey of literature showed that *A. millefolium* has an esteemed status in herbs with diverse pharmacological activity spectrum. Traditional indications of their use include digestive problems, liver and gall-bladder conditions, menstrual irregularities, cramps, fever, wound healing.

The Commission E approves its internal use for loss of appetite and dyspeptic ailments (gastric catarrh, spastic discomfort), externally it is used in form of sitz bath or as a compress against skin inflammation, slow healing wounds, bacterial or fungal infections. In the last decades, pharmacological studies became intensive, although human clinical investigations are still rare. Recent findings have confirmed several traditional uses.

The largest number of data accumulated for antioxidant and anti-inflammatory effects. There are positive results

on the analgesic, anti-ulcer, choleric, hepatoprotective and wound healing activities. First results on other interesting therapeutical areas - antihypertensive, antidiabetic, antitumor, antispermatogenic activities - need confirmation.

Yarrow can be used also as an insect repellent. Contact dermatitis as adverse effect may be connected to sesquiterpenes. The diversity and complexity of the effective compounds of yarrow species explains the broad spectrum of their activity. According to this literature the pharmacological effects are mainly due to the essential oil, proazulenes and other sesquiterpene lactones, dicaffeoylquinic acids and flavonoids. *Achillea* species have different chemical and therapeutical values. Despite of numerous data, correct evaluation of the results is difficult because of missing generally accepted taxonomical nomenclature. The used chemical-analytical methods and bio-assays are utmost diverse, making the comparison complicated. Further research on the activity is needed using exactly defined plant material, standardized methods and chemical analysis.

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REFERENCES

1. Trivedi P.C .Indian medicinal Plants, published by Avishkar publisher, distributor (Raj) 2009, pg. no7.
2. Fabricant DS, Farnsworth NR. "The value of plants used in traditional medicine for drug discovery". *Environ. Health Perspect.* (March 2001). 109 Suppl 1: 69–75. PMC 1240543. PMID 11250806.
3. Inhibitory effect of lactone fractions and individual components from three species of the *Achillea millefolium* complex of Bulgarian origin on the human neutrophils respiratory burst activity Choudhary M.I., Jalil S., Todorova M., Trendafilova A., Mikhova B., Duddeck H. *Natural Product Research* 2007 21:11 (1032-1036)
4. Herbal Medicine Past and Present: A reference guide to medicinal plants by J.K crellin, Jane Philpott,A.L Tommie Boss Pg no.464 Monograph.
5. Combining Western Herbs and Chinese Medicine (book), 2003, "Achillea", P.165-181. Jeremy Ross. ISBN 978-0-9728193-0-5.
6. Rodale's Illustrated Encyclopedia of Herbs, Kowalchik C & Hylton WH, Eds, "Companion Planting", P.108. ISBN 978-0-87596-964-0.
7. Rodale's Illustrated Encyclopedia of Herbs, Kowalchik C & Hylton WH, Eds, P.293, 367, 518. ISBN 978-0-87596-964-
8. Analgesic Effect of aqueous extract of *Achillea millefolium* L. on rat's formalin test Nouredini M., Rasta V.-R. *Pharmacologyonline* 2008 3 (659-664)
9. Xiao, S.; Knoll, A. H.; Yuan, X. "Morphological Reconstruction of Miaohephyton bifurcatum, a Possible Brown Alga from the Neoproterozoic Doushantuo Formation, South China". *Journal of Paleontology* (1998).



- 72 (6): 1072–1086. doi:10.1007/s10354-007-0431-9. <http://jstor.org/stable/1306737>.
10. Aqueous extract of *Achillea millefolium* L. (Asteraceae) inflorescences suppresses lipopolysaccharide-induced inflammatory responses in RAW 264.7 murine macrophages Burk D.R., Cichacz Z.A., Daskalova S.M. *Journal of Medicinal Plant Research* 2010 4:3 (225-234)
 11. Choleric effects of yarrow (*Achilleamillefoliums.l.*) in the isolated perfused rat liver Benedek B., Geisz N., Jäger W., Thalhammer T., Kopp B. *Phytomedicine* 2006 13:9-10 (702-706)
 12. Effects of two *Achillea* species tinctures on experimental acute inflammation Popovici M., Pärvu A.E., Oniga I., Toiu A., Tămaş M., Benedec D. *Farmacica* 2008 56:1 (15-23)
 13. In vitro estrogenic activity of *Achillea millefolium* L. Innocenti G., Vegeto E., Dall'Acqua S., Ciana P., Giorgetti M., Agradi E., Sozzi A., Fico G., Tomè F. *Phytomedicine* 2007 14:2-3 (147-152)
 14. Aqueous extracts from bogbean and yarrow affect stimulation of human dendritic cells and their activation of allogeneic CD4+ T cells *In Vitro* Jonsdottir G., Hardardottir I., Omarsdottir S., Vikingsson A., Freysdottir J. *Scandinavian Journal of Immunology* 2010 71:6 (505)
 15. Shutler D, Campbell AA. "Experimental addition of greenery reduces flea loads in nests of a non-greenery using species, the tree swallow *Tachycineta bicolor*". *Journal of Avian Biology* (2007)38 (1): 7–12.
 16. Blumenthal, M (Ed.): *The Complete German Commission E Monographs: Therapeutic Guide to Herbal Medicines*. American Botanical Council. Austin, TX. 1998.
 17. Alan S. Weakley. "Flora of the Carolinas, Virginia, and Georgia, and Surrounding Areas". (April 2008). <http://www.herbarium.unc.edu/flora.html>.
 18. Trease GE, Evans WC..*Pharmacognosy*. 4th ed. London: BailliereTindall; 1972. Pg no.283.
 19. USDA, NRCS. The PLANTS Database (<http://plants.usda.gov>, 22 May 2006). National Plant Data Center, Baton Rouge, LA 70874-4490 USA.
 20. Chandler, R.F.; Hooper, S.N.; Harvey, M.J. *Ethnobotany and phytochemistry of yarrow, Achilleamillefolium*, Compositae. *Econ. Bot.* 36, 203-223, 1982
 21. T.E Wallis fifth edition *Text book of pharmacognosy* CBS publishers & Distributors Pg.No.168.
 22. Mitich LW: *Intriguing world of weeds: Yarrow - the herb of Achilles*. *Weed Technology* 1990, 4:451-453.
 23. Barel S, Segal R, Yashphe J: *The antimicrobial activity of the essential oil from Achillea fragrantissima*. *Journal of Ethnopharmacology* 1991, 33:187-191. PubMed Abstract
 24. Smith-Palmer A, Stewart J, Fyfe L: *Antimicrobial properties of plant essential oils and essences against 5 important food-borne pathogens*. *Letters in Applied Microbiology* 1998, 26:118-122. PubMed Abstract
 25. Candan F, Unlu M, Tepe B, Daferera D, Polissiou M, Sökmen A, Akpulat HS: *Antioxidant and antimicrobial activity of the essential oil and methanol extracts of Achilleamillefoliumsubsp. MillefoliumAfan. (Asteraceae)*. *Journal of Ethnopharmacology* 2003, 87:215-220. PubMed Abstract |
 26. Stojanović G, Radulović N, Hashimoto T, Palić R: *In vitro antimicrobial activity of extracts of four Achilleaspecies: The composition of Achilleaclavennael. (Asteraceae) extract*. *Journal of Ethnopharmacology* 2005, 101:185-190. PubMed Abstract .
 27. Tajik H, Jalali FSS, Sobhani A, Shahbazi Y, Zadeh MS: *In vitro assessment of antimicrobial efficacy of alcoholic extract of Achilleamillefoliumin comparison with penicillin derivatives*. *Journal of Animal and Veterinary Advances* 2008, 7:508-511.
 28. Guo YP, Saukel J, Mittermayr R, Ehrendorfer F: *AFLP analyses demonstrate genetic divergence, hybridization, and multiple polyploidization in the evolution of Achillea(Asteraceae-Anthemideae)* *New Phytol.* 2005 Apr;166(1):273-89
 29. Si XT, Zhang ML, Shi QW, Kiyota H: *Chemical constituents of the plants in the genus Achillea*. *Chemistry and Biodiversity* 2006, 3:1163-1180. PubMed Abstract
 30. Benedek B, Gjoncaj N, Saukel J, Kopp B: *Distribution of the phenolic compounds in Middleeuropean taxa of the AchilleamillefoliumL. aggregate*. *Chemistry and Biodiversity* 2007, 4:849-857. PubMed Abstract
 31. B.somanadhan et al., *Journal of Ethnopharmacology* 1999,65,103.
 32. Tunón H, Olavsdotter C, Bohlin L: *Evaluation of anti-inflammatory activity of some Swedish medicinal plants: Inhibition of prostaglandin biosynthesis and PAF-induced exocytosis*. *Journal of Ethnopharmacology* 1995, 48:61-76. PubMed Abstract
 33. *Antioxidant and antimicrobial activity of the essential oil and methanol extracts of Achillea millefolium subsp. millefolium Afan. (Asteraceae)*.Candan F, Unlu M, Tepe B, Daferera D, Polissiou M, Sökmen A, Akpulat HA. *J Ethnopharmacol.* 2003 Aug;87(2-3):215-20.
 34. Pires JM, Mendes FR, Negri G, Duarte-Almeida JM, Carlini EA: *Antinociceptive peripheral effect of AchilleamillefoliumL. andArtemisia vulgaris L.: Both plants known popularly by brand names of analgesic drugs* *Phytotherapy Research* 2009, 23:212-219. PubMed Abstract.
 35. Tozyo T, Yoshimura Y, Sakurai K, Uchida N, Takeda Y, Nakai H, Ishii H: *Novel antitumor sesquiterpenoids in Achilleamillefolium*. *Chemical and Pharmaceutical Bulletin* 1994, 42:1096-1100.
 36. Csupor-Löffler B, Hajdú Z, Zupkó I, Réthy B, Falkay G, Forgo P, Hohmann J: *Antiproliferative effect of flavonoids and sesquiterpenoids from Achilleamillefoliums.l. on cultured human tumour cell lines*. *Phytotherapy Research* 2009, 23:672-676. PubMed Abstract
 37. *Final report on the safety assessment of Yarrow (Achillea millefolium) Extract*. *Int J Toxicol.* 2001;20 Suppl 2:79-84. PMID: 11558643 [PubMed - indexed for MEDLINE]
 38. Boswell-Ruys CL, Ritchie HE, Brown-Woodman PD *Preliminary screening study of reproductive outcomes after exposure to yarrow in the pregnant rat*. *Birth Defects Res B Dev Reprod Toxicol.* 2003 Oct;68(5):416-20.

