A comprehensive review on phytochemical, pharmacological and therapeutic properties of *Agrimonia eupatoria* L.

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**Implication for health policy/practice/research/medical education:** This review offers a comprehensive insight into the phytochemical, pharmacological, therapeutic activities, and safety of *Agrimonia eupatoria* L., and demonstrates that it can be used as a reliable source for preparation of new drugs.

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**Abstract**

*Agrimonia eupatoria* is a perennial herb belonging to the Rosaceae family that all its parts are used to treat various diseases. In this article, we aimed to present a comprehensive review on the phytochemical, pharmacological, and therapeutic effects of this plant. We searched various databases and summarized the data documented in literature from 1976 to 2020. *Agrimonia eupatoria* has effects on various kinds of cancer, oxidative stress, diabetes mellitus, hepatitis B, and liver damage. It also has anti-adhesive, antibacterial, antimicrobial, and wound healing properties. It induces nitric oxide and inhibits pro-inflammatory cytokines production. Phytochemical studies related to this plant has led to isolation and identification of tannins, coumarins, and flavonoids as the most active chemicals with biological effects. Based on this comprehensive review about *Agrimonia eupatoria*, there will be more opportunities for investigators to search and discover ways to use bioactive agents of this herb to develop new Agrimony based medicines.

**Introduction**

Compared to conventional drugs, medicinal plants usually have low toxicity. Furthermore, in spite of the availability of all kinds of medicines and all health facilities, due to the high costs of hospital care or because of cultural beliefs and historical customs in most of the undeveloped countries, people still trust herbal medicines and some of the herbs still have kept their popularities (1).

*Agrimonia eupatoria* from the Rosaceae family, known as "Common Agrimony", is an erect perennial plant (30–60 cm in height). It is native to mainland Europe and found across Asia Minor and North Africa (2).

It is traditionally used as an antiadhesive, antibacterial (3,4), antioxidant, astringent (5,6), anti-inflammatory (7-9), and hepatoprotective (10) agent. It is also used for bed-wetting (11), treatment of hemorrhagic colitis, liver and urinary diseases (6,12), cancer (13), acute diarrhea, diabetes mellitus, inflammation of oral and pharyngeal mucosa (14,15), and the hepatitis B virus (16). In this article we aimed to present a comprehensive review on phytochemical, pharmacological, and therapeutic properties of this plant.

**Botany**

**Scientific Classification**

The scientific classification of *A. eupatoria* (Figure 1) is as follows:

- Super kingdom: Eukaryota
- Kingdom: Viridiplantae
- Phylum: Streptophyta
- Subphylum: Streptophytina
- Class: Magnoliopsida
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Order: Rosales  
Family: Rosaceae  
Subfamily: Rosoideae  
Tribe: Sanguisorbeae  
Subtribe: Agrimoniinae  
Genus: Agrimonia  
Species: *Agrimonia eupatoria*  

Names of Aigremoine eupatoria in different languages  
Names of *A. eupatoria* in different languages are as follows:  
Anglo-Saxon: Garclive.  
Arabic: Eufātorion, Shajarat ol barāghith, Shawkat Montenah, A 'rang, Aghremun, Ghāfath, Hashisht ol ghāfath.  
Chinese: Da Hua Long Y a Cao.  
English: Common Agrimony, Cocklebur, Stickle wort, Liver Wort, Church, Steeples, Beggar's Ticks, White Tansy, Wild Tansy.  
Farsi: Moshkaniyeh, Dava-ye- Jegar, Gole Khole, Gol Roghane Kaah, Gole, Chasbak, Alafe Geloo Dard.  
French: Herbe d' eupatoire, Aigremoine commune, Eupatoire des anciens, Thé des bois, Souberiette, Aigremoine eupatoire, Herb de Saint Guillaume, Herb de la mère.  
Germany: Kleiner odermenning, Leberkraut, Agremomen.  
Greek: Eupatarios.  
Italian: Erba vetoonica, Santonia, Erba da andata, Agrimonia Eupatoria.  
Russian: Repenjček Aptechnyi (17).  
Slovak: Repik lekaršky, Repik, repiček, starček, konopínc, útrobnik, boží bič (18).  
Spanish: Agrimonia, Hierba bacera, Hierba del podabor.  
Swedish: Smáborre.  
Turkish: Egir otu, Kasik otu, Kızıl yaprak, Koyun otu (17).  

In Iranian traditional medicine (ITM), there are two plants that are called Ghafath; the amateur users usually do not notice this. Users should look for a description of the plant in each book before using it and should notice which one the writer means. The agrimonium sp. (Rosaceae) Ghafath has yellow flowers, but the second one has pink or reddish flowers with the scientific name of *Eupatorium cannabinum* L. (Asteraceae) (19). The second Ghafath named Ghafath e kanafi which means “hemp agrimony” in Persian (20), “hemp agrimony” is *Eupatorium cannabinum* common name in English.

Description  
*Agrimonia eupatoria* is a plant with bear pinnate, toothed alternate, leaves with undersides like velvet and small pairs between larger pairs with erect, reddish and pubescent stems (50–150 cm high). It has basal leaves as a rosette, and on its long, slender spikes grow five small petals of bright yellow flowers. The fruits are small, cone-shaped, enclosed in a calyx-tube with bristle. The bristles with hook enable the dispersal of the seeds on animal fur. It also spreads vegetatively by stout, woody, deep-lying rhizomes (21).

Some insects associate only with this herb like an eriophyoid mite, *Aculus castriferrei* n. sp (22) and *Stigmella aeneofasciella* Larvae (23). This is why Agrimony is called “Shajarat ol barāghith” in Arabic, which means the tree of fleas in English.

Related species  
*Agrimonia pilosa* and *A. viscidula* Bunge are used in China for comparable conditions (24). The German Commission E Pharmacopoeial Monograph enables the use of *A. procera* as a second precious source of Agrimoniae herba. Granica et al. have shown, based on their collected data, that a legitimate source of plant materials for drug preparation is *A. procera* (Fragrant agrimony) (25).

Cultivation and habitat  
Agrimony is a native European herb mostly found in marshes, on wasteland, and wet meadows (1). It is one of the most common species of dry grasslands in the ex-arable land of the SE Czech Republic (26) and Slovak Republic (18). Thus, it has been found in the Hindu Kush Mountains of Pakistan (27), as well as Western Himalaya, and India (28). It is harvested during its flowering stage in summer (1). *Agrimonia eupatoria* does not reach the edge of its distribution. It displayed dynamic changes in leaf morphology in response to tree shade and in elongation of stems and inflorescences because of herbaceous shade. Because of *A. eupatoria*’s high active plasticity, it can maintain constant shoot growth in a variety of light conditions (29). The normal distance in cultivation on seed yield is 4/m-2 (30). *A. eupatoria* best germination results obtained at 20°C at 12-hour daily photoperiod, 5.5 cm root cuttings develop stems and/or roots at 15°C and 25°C (31).

![Figure 1. Agrimonia eupatoria.](http://www.herbmedpharmacol.com)
Macroscopic Types
*Agrimonia eupatoria*’s characters are given in Table 1 (24).

Microscopic characters
*Agrimonia eupatoria*’s characters are given in Table 2 (32).

Ethnopharmacology
The plant has a “cool” and “drying” characteristics. All parts, mostly the aerial parts of the plant are used for various diseases (33).

History and folklore
*Agrimonia eupatoria* was named by Mithridates Eupator, a king of Pontus, a famous plant collector and botanical text author in Greek. Thus, Pliny records, ‘it has gotten credit and reputation by a king, as may appear by the name’. Many centuries later, Fuchs named it ‘Hepatorium’, because of its protective effects on the liver. Until the 18th century Agrimony was known in the Linnaean classification under the title ‘Eupatorion’, so Dioscorides (IV 41) named it the same (21).

Traditional uses
*Agrimonia eupatoria* was worshiped in the Kysuce region (18). Since then, people have found various methods for using Agrimony for almost all parts of the body illnesses as shown in Table 3. *A. eupatoria* has been used since Saxon times. It was the primary ingredient of a battlefield cure for bullet wounds called “Arquebusade water” in the 15th century. Agrimony healing power is now credited with the herb’s high silica content (33). *A. eupatoria*, known as Ghafath in Iranian traditional medicine (ITM), has been repeatedly used for liver strengthen and it was well documented as an outstanding liver tonic. It is very useful and extensively recommended in Iranian medical literature (34), and used mainly to treat liver disorders (35). It is one of the most important ingredients of ITM tablets like “Qurse Rewand” which means “Rhubarb tablet” in Iranian dialect. Its effects on rats have been recently documented as significant hepatocurative agent and showed signs of recovery and regeneration in damaged liver cells (36).

It is used as antibacterial, astringent, aggregant, antipyretic, diuretic, anti-inflammatory, antisepic, antiviral, candidicide, vermifuge, tonic, uricolytic, deputative, chologogue, emmenagogue, fungicide, hemostat, litholytic, stomachic, sedative, and vulnerary remedy (37).

Aerial parts/leaves applications of *A. eupatoria* are given in Table 3 (33). It has been reported that giving Tisane (cold) to lambs has an antidiarrhoeal effect and Tisane (hot) has laxative effects in lambs (38).

3.3 Recommendations on safety
It should be used with caution when there is a constipation (21,33). Side effects of nausea and constipation with excessive doses are likely (21).

Phytochemistry
The Agrimony plant contains tannins, volatile oil and coumarins (1), gum, a phytosterol (24), polysaccharides, etc.
and flavonoids such as luteolin. From its dried aerial parts, the polyphenolic-poly saccharide complex was isolated with $55 \times 10^3$ g/mol molecular weight. It consisted mainly of pectin-like polysaccharides and polyphenolic moieties, composed of lignin-related units, with the dominance of dimethoxyphenyl structures. Agrimonia complex specific carbohydrate composition rich in highly esterified galacturonic acid, constituting thus highly methylated pectin network in which, besides arabinogalactan type II, the highly esterified homogalacturonan and rhamnogalacturonan type I are present, while some units being partially methylated (39). Investigated samples have been shown to contain about 8.2–10.9 mg/g of various flavonoids, 6.3–10.9 mg/g of various tannins (mostly agrimoniin, 2.6–5.4 mg/g), and 0.6–0.9 mg/g of phenolic acids (40). The value of flavonoids determined in the leaves of agrimony (Agrimonia eupatoria) was 1.05 RU (41). Total phenolic compounds of more than 19.61 mg galic acid equivalent (GAE)/g to 220.31 mg GA (gallic acid)/g, flavonoids of 20.58 mg RU (rutin)/g to 97.06 mg RU/g, total tannins of 3.06 mg GA/g to 207.27 mg GA/g, and pro-anthocyanidins of 4.15 CChE (Cyanidin chloride equivalent)/g to 103.72 CChE/g have been identified (42), claiming that phenol compounds were the major group of constituents of this plant (40).

The primary metabolites
From the primary metabolites, the amino acid composition has been determined. Seventeen amino acids and their respective amounts were identified in A. eupatoria, which is shown in Table 4 (43).

The second metabolites
Sixty-eight out of 87 separated constituents of the volatile oil were quantified, which were more than 87.03% of the total contents. Isolated compounds from the leaf and root of A. eupatoria are shown in Table 5, isolated compounds from the leaf of A. eupatoria are shown in Table 6 (44), and the phenolic and flavonoid compounds isolated from free or glycosides of the leaf of A. eupatoria are shown in Table 7.

Antioxidant potential and scavenging activity
Agrimony’s anti-inflammatory ability may be clarified by its antioxidant activity. The plant has polyphenolic compounds capable of activating endogenous antioxidant defense mechanisms (51). The tests done on A. eupatoria extract and its polyphenol-enriched fractions against reactive species are shown in Table 8.

| Application | Method | For |
|-------------|--------|-----|
| Infusion    | A gentle remedy, especially in infants and children. Can be taken by breastfeeding mothers. | Diarrhea |
| Eyewash     | A weak infusion (10 g herb to 500 mL water) | Conjunctivitis |
| Gargle      | Use the infusion | Sore throats |
|             | | Nasal catarrh |
| Tincture    | More potent and drying than the infusion, and effective | Condition involves excess phlegm or mucus |
| Poultice    | Of the leaves | Migraines |
| Wash        | | Wounds |

Table 4. Amino acid content of Agrimonia eupatoria herb

| Substance | General formula | Content, mg/100 mg of the raw material | No. | Substance | General formula | Content, mg/100 mg of the raw material |
|-----------|----------------|----------------------------------------|-----|-----------|----------------|----------------------------------------|
| Aspartic acid | C4H6O4N | 0.93 | 10 | Methionine | C5H10O2N5 | 0.31 |
| Threonine | C4H9O2N | 0.39 | 11 | Isoleucine | C6H13O2N | 0.46 |
| Serine | C3H7O3N | 0.62 | 12 | Leucine | C6H13O2N | 0.46 |
| Glutamic acid | C5H8O4N | 0.15 | 13 | Tyrosine | C9H10O2N | 0.23 |
| Proline | C5H9O2N | 0.47 | 14 | Phenylalanine | C9H12O2N | 0.33 |
| Cysteine | C6H12N2O4S2 | 0.08 | 15 | Histidine | C6H11O2N3 | 0.23 |
| Glycine | C2H5O2N | 0.93 | 16 | Lysine | C6H13O2N2 | 0.53 |
| Alanine | C3H7O2N | 0.69 | 17 | Arginine | C6H15O2N4 | 0.15 |
| Valine | C5H11O2N | 0.69 | | | | |
### Table 5. The compounds isolated from the leaf and root essence of *Agrimonia eupatoria*

| No. | Compound Name                                      | Molecule structure | No. | Compound Name         | Molecule structure |
|-----|---------------------------------------------------|--------------------|-----|-----------------------|--------------------|
| 1   | 1-(2-Furyl)-1-hexanone                            | C10H14O2           | 35  | Geraniol acetate      | C12H20O2           |
| 2   | 2,4-Dimethylbenzaldehyde                         | C9H10O             | 36  | Geranyl acetone       | C13H22O            |
| 3   | 2-Cyclopropylidene-1,7,7-trimethyl-bicyclo[2,2,1]heptane | C13H20           | 37  | Hexanal               | C6H12O             |
| 4   | 2-Methyl-4-hydroxyacetophenone                    | C9H20O2            | 38  | L-Camphor             | C10H16O            |
| 5   | 3,4-Dimethylbenzaldehyde                         | C9H10O             | 39  | Linalool              | C10H18O            |
| 6   | 3-Octanol                                         | C10H18O            | 40  | Longofolene           | C15H24             |
| 7   | 4-Terpineol                                       | C10H18O            | 41  | Murolol               | C15H26O            |
| 8   | 6,10,14-Trimethyl-2-pentadecanone                 | C18H36O            | 42  | Myristicin            | C11H12O3           |
| 9   | Acoradiene                                        | C15H24             | 43  | Neryl acetate         | C12H20O2           |
| 10  | Anethole                                          | C10H12O            | 44  | Nonanoic acid         | C9H18O2            |
| 11  | Aromadendrene                                     | C15H24             | 45  | Patchoulool           | C15H26O            |
| 12  | Bergamot oil                                      | C12H20O2           | 46  | P-Menth-1-en-4-ol     | C10H18O            |
| 13  | Borneol                                           | C10H18O            | 47  | Pulegone              | C10H14O            |
| 14  | Bornyl acetate                                    | C12H20O2           | 48  | Phelipone             | C15H24             |
| 15  | Camphene                                          | C10H16             | 49  | Torreyol              | C15H26O            |
| 16  | Carvacrol                                         | C10H14O            | 50  | Trans-Nerolidol       | C15H26O            |
| 17  | Caryophyllene                                     | C15H24             | 51  | α-Bisabolene          | C15H24             |
| 18  | Caryophyllene oxide                               | C15H24O            | 52  | α-Cadinol             | C15H26O            |
| 19  | Cedrol                                            | C15H26O            | 53  | α-Campholenal         | C10H16O            |
| 20  | Cedryl acetate                                    | C17H28O2           | 54  | α-Cedrene             | C15H24             |
| 21  | Copaeene                                          | C15H24             | 55  | α-Eudesmol            | C15H26O            |
| 22  | Cubenol                                           | C15H26O            | 56  | α-Guaiene             | C15H24             |
| 23  | Cuparene                                          | C15H24             | 57  | α-Himachalene         | C15H24             |
| 24  | Curcumene                                         | C15H22             | 58  | α-Longipinene         | C15H24             |
| 25  | Cymene                                            | C10H14             | 59  | α-Pinene              | C10H16             |
| 26  | Decanoic acid                                     | C10H20O2           | 60  | α-Selinene            | C15H24             |
| 27  | D-Limonene                                        | C10H16             | 61  | α-Terpineol           | C10H18O            |
| 28  | E-Cadinen                                         | C15H24             | 62  | α-trans-Ocimene       | C10H16             |
| 29  | Epi-Cedrol                                        | C15H26O            | 63  | β-Cedrene             | C15H24             |
| 30  | Epiglobulol                                       | C15H26O            | 64  | β-Pinene              | C10H16             |
| 31  | Eucalyptol                                        | C10H18O            | 65  | β-Selinene            | C15H24             |
| 32  | Eugenol methyl ether                              | C11H14O2           | 66  | δ-Cadinene            | C15H24             |
| 33  | Farnesyl acetate                                  | C17H28O2           | 67  | δ-Guaiene             | C15H24             |
| 34  | Furan,2,5-dibutyl-                                 | C12H20O            | 68  | γ-Cadinene            | C15H24             |

### Table 6. The compounds isolated from the leaf essence of *Agrimonia eupatoria*

| No. | Compound Name                  | Molecule structure | No. | Compound Name                      | Molecule structure |
|-----|--------------------------------|--------------------|-----|------------------------------------|--------------------|
| 1   | 1-Hexanol                      | C6H14O             | 8   | Germacrene D                       | C15H24             |
| 2   | 4,4-Dimethyladamantan-2-ol    | C12H20O            | 9   | Hexahydrofarnesyl acetone          | C18H36O            |
| 3   | 4-Hydroxy-3-methylacetophenon  | C9H10O2            | 10  | Isomenthone                        | C10H18O            |
| 4   | Cadala-1[10],3,8-triene        | C15H22             | 11  | Longipinocarvone                   | C15H28O            |
| 5   | Carvone                        | C10H14O            | 12  | Phenmethyl acetate                 | C9H10O2            |
| 6   | Cis-7-Tetradecen-1-ol          | C14H28O            | 13  | Prenal                             | C5H8O              |
| 7   | Costunolide                    | C15H20O2           | 14  | β-Damascone                        | C13H18O            |
Table 7. The phenolic and flavonoid compounds isolated in a form of free or glycosidic from leaf of *Agrimonia eupatoria*.

| No. | Compound Name                                      | Reference |
|-----|---------------------------------------------------|-----------|
| 1   | 1-O-Caffeoylquinic acid                          | (40)      |
| 2   | 3-O-Caffeoylquinic acid                          | (40)      |
| 3   | 3-O-p-Coumaroylquinic acid                       | (25)      |
| 4   | 3-O-p-Coumaroylquinic acid                       | (40)      |
| 5   | 4-O-caffeoylquinic acid                          | (25, 40)  |
| 6   | 5-Caffeoylquinic acid                            | (46)      |
| 7   | 5-O-caffeoylquinic acid (chlorogenic acid)        | (25, 40)  |
| 8   | Agrimonin                                         | (25, 40, 46) |
| 9   | Apigenin 7-O-glucoside (apigetrin)                | (25, 40, 46) |
| 10  | Apigenin 7-O-β-D-glucuronide                      | (25, 40, 45, 47) |
| 11  | Apigenin derivative                               | (45)      |
| 12  | Apigenin O-glucuronide                            | (46)      |
| 13  | Astragalin (Kaempferol 3-O-glucoside)             | (25, 40, 46-49) |
| 14  | Caffeoyl-hexoside                                 | (45)      |
| 15  | Catechin                                          | (25, 40, 45, 46, 48) |
| 16  | Ellagic acid                                      | (46)      |
| 17  | Hexahydroxydiphenoyl-glucose                     | (50)      |
| 18  | Isovitexin = Apigenin 6-C-glucoside              | (25, 40, 46, 48) |
| 19  | Kaempferide                                       | (49)      |
| 20  | Kaempferide 3-rhamnoside                         | (49)      |
| 21  | Kaempferide O-rhamnoside                         | (46)      |
| 22  | Kaempferol                                        | (49)      |
| 23  | Kaempferol 3-O-6'-O-p-coumaroyl-glucoside, (tiliroside) | (46-48) |
| 24  | Kaempferol 3-O-β-D-(2''-O-acetyl-6''- (E)-p-coumaroyl)-glucopyranoside (2''-acetyl-tiliroside) | (47) |
| 25  | Kaempferol 3-O-β-D-(2''-O-acetyl) glucopyranoside | (47) |
| 26  | Kaempferol 3-rhamnoside                           | (49)      |
| 27  | Kaempferol 3-rutinoside                          | (49)      |
| 28  | Kaempferol hexoside                               | (25, 40)  |
| 29  | Kaempferol malonylhexoside                        | (25, 40)  |
| 30  | Kaempferol O-acetyhexosyl-rhamnoside              | (46)      |
| 31  | Kaempferol Oacetyhexosyl-O-rhamnoside             | (46)      |
| 32  | Kaempferol O-(coumaroyl)-hexoside                 | (50)      |
| 33  | Kaempferol O-malonylhexoside                      | (46)      |
| 34  | Kaempferol-p-coumaroyl-hexoside                   | (45)      |
| 35  | Keampferol 3-O-rutinosid                          | (50)      |
| 36  | Luteolin 7-O-glucoside (cynaroside)               | (25, 40, 46) |
| 37  | Luteolin 7-O-B-D-glucopyranoside                  | (47)      |
| 38  | Luteolin 7-O-B-D-glucuronide                      | (25, 40, 45, 47) |
| 39  | Luteolin glucuronide isomer                       | (25, 40)  |
| 40  | Luteolin malonylhexoside                          | (25)      |
| 41  | Luteolin-acetyl-hexoside                          | (45)      |
| 42  | P-Coumaric acid                                   | (45, 46, 48) |
| 43  | p-Coumaroil quinic acid                           | (45)      |
| 44  | p-Coumaroyl acid hexoside                         | (40)      |
| 45  | Procyanidin B-1                                   | (45)      |
| 46  | Procyanidin B3= Procyanidin dimer B3= catechin-(4β→8)-catechin (B3) | (25, 40, 45, 48) |
| 47  | Procyanidin dimer B1= epicatechin-(4β→8)-catechin (B1) | (48) |
| 48  | Procyanidin dimer B2= epicatechin-(4β→8)-epicatechin (B2) | (48) |
| 49  | Procyanidin dimer B6= catechin-(4β→6)-catechin (B6) | (48) |
| 50  | Procyanidin dimer B7= epicatechin-(4β→6)-catechin (B7) | (48) |
| 51  | Procyanidin tetramer                              | (46, 48)  |
Table 7. Continued

| No. | Compound Name | Reference |
|-----|---------------|-----------|
| 52  | Procyanidin tetramer-B | (45) |
| 53  | Procyanidin trimer | (25, 40, 46, 48) |
| 54  | Procyanidin trimer C1= epicatechin-(4→8)-epicatechin-(4→8)-epicatechin (C1) | (48) |
| 55  | Procyanidin trimer C2= catechin- [4→ 8]-catechin- [4→ 8]- catechin (C2) | (48) |
| 56  | Procyanidin trimer EEC= epicatechin- [4→ 8]- epicatechin- [4→8]-catechin (EEC) | (48) |
| 57  | Procyanidin-trimer-B | (45) |
| 68  | Quercetin 3-O-galactoside (hyperoside) | (25, 40, 48) |
| 69  | Quercetin 3-O-glucoside (isoquercitrin) (isoquercetin) | (25, 40, 45-48) |
| 70  | Quercetin 3-O-rhamnoglucoside (rutin) | (25, 40) |
| 71  | Quercetin O-galloyl-hexoside | (46) |
| 72  | Quercetin 7-O-rhamnoside | (25, 40) |
| 73  | Quercetin-acetyl-hexoside | (45) |
| 74  | Quercetin-acetil-glucoside | (45) |
| 75  | Quercitrin | (47) |
| 76  | Quinic acid | (45) |
| 77  | Rutin | (25, 45, 47) |
| 78  | Vitexin (Apigenin 8-C-glucoside) | (40, 46) |

Table 8. Ex vivo measurements of antioxidant activity of Agrimonia eupatoria

| Phytochemical test | Reagent | Result |
|--------------------|---------|--------|
| Free radical scavenging activity or the antioxidant activity | DPPH (2,2-diphenyl-1-picrylhydrazyl) method | Indicating a general radical scavenging activity, with a dose-dependent ability (9.1-97.5%) [5,8], quite similar to ascorbic acid (EC\textsubscript{50} = 17 μg) and much higher than Catechin (EC\textsubscript{50} = 140 μg) [50]. The MeOH extract and two Sep–Pak fractions (30 and 60%) showed prominent free radical scavenging activity. RC\textsubscript{50}s were determined as 4.64×10\textsuperscript{-4}, 5.13×10\textsuperscript{-3} and 4.73×10\textsuperscript{-4} mg/mL (4). The antioxidant activity was highest for the acetone extract and ranged from 97.13% to 27.73% (42). |
| Reducing power | Extracts of A. eupatoria showed moderate reducing power compared with the positive control, and showed activity in all examined concentrations. Hence, concluded that reducing power depends on concentration (42). |
| Superoxide anion scavenging effect | Detected by Nitro Blue Tetrazolium (NBT) reduction | Inhibited the NBT reduction in a dose-dependent manner |
| Peroxyl and hydroxyl radicals | A very good scavenging capacity. The extract is an efficient scavenger of peroxyl radicals. |
| Oxidant species | Hydrogen peroxide (H\textsubscript{2}O\textsubscript{2}) assay | Exhibited H\textsubscript{2}O\textsubscript{2} scavenging activity (8). Agrimony extract (AE) decreased both the superoxide dismutase (SOD) and catalase (CAT) expressions (45). |
| Hypochlorous acid (Elastase (E) + α\textsubscript{1}-antitrypsin (α\textsubscript{1}) + Hypochlorous acid (HOCl)) and inhibition of Elastase | Extract abolished elastase activity; affected the α\textsubscript{1}-antitrypsin activity, but promoted some inhibition of Elastase activity. |
| Peroxynitrite | Inhibited the dihydrorhodamine 123 oxidation (8) |
| 2,2′-azinobis-(3-ethylbenzothiazoline-6-sulfonic acid) [ABTS] (+) radical decolourisation reaction system | 6.7-79.5% (5, 53) and RC\textsubscript{50} were determined as Agrimony = 0.79 mg/mL (45). |
| Trolox equivalent antioxidant capacity (TEAC) | Showed the scavenging activities (48), (TEAC 3.76+/-0.5mM/QE 702.29+/-6.82 microM) (6). |
| Thiobarbituric acid reactive substances (TBARS) method | The lipid peroxidation inhibition (48), 104.8±11.4 (% control) (53) |
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The relevant content of phenols and significant antioxidant activities were observed for the aqueous-alcoholic extract (49). Ascertained by High-performance liquid chromatography-diode array detection (HPLC-DAD) (55) ranged from 19.61 mgGA/g to 220.31 mgGA/g (43). Achieved by HPLC-PDA-ESI/MS\(^n\) (46).

Chlorogenic acid remained stable after the stomach phase, Rutin was decreased after the stomach phase (52).

In vitro digestion upon Caco-2 cells via LC-MS/MS

3,4,5-Trihydroxybenzaldehyde was stable throughout the digestive process, whereas Xanthine oxidase activity Reacted 86.8±3.7 (% control)

| Table 8. Continued |
|----------------------------------------|
| **Phytochemical test** | **Reagent** | **Result** |
|-------------------------------------------------|
| The phenolic content | The relevant content of phenols and significant antioxidant activities were observed for the aqueous-alcoholic extract (49). Ascertained by High-performance liquid chromatography-diode array detection (HPLC-DAD) (55) ranged from 19.61 mgGA/g to 220.31 mgGA/g (43). Achieved by HPLC-PDA-ESI/MS\(^n\) (46). |
| The effect of in vitro digestion upon Caco-2 cells via LC-MS/MS | 3,4,5-Trihydroxybenzaldehyde was stable throughout the digestive process, whereas Chlorogenic acid remained stable after the stomach phase, Rutin was decreased after the stomach phase (52). |
| Capacity to inhibit lipid peroxidation | Uric acid formation  | A dose-dependent inhibition (8) |
| Carbonyl content | Protein oxidation | 86.8±3.7 (% control) |
| 8-ohdg | DNA oxidation | 149.6± 34.0 (% control) (53) |
| Oxidative damage | Plasmid DNA | Agrimony extract possesses better antioxidant properties to compare with rutin as standard. |
| Cytotoxicity test | 24 h incubation on THP-1 cell line | No cytotoxic effect was observed. |
| Skin flap viability | On male Sprague-Dawley rats | *A. eupatoria* extract has the capacity to act on damaged skin (45). |

**Pharmacological activities**

*Agrimonia eupatoria*’s physio-pharmacological activities are shown in Table 10.

**Toxicity**

The safety and efficacy of *A. eupatoria* have been confirmed during a very long period of its traditional application. Recent studies have shown that *A. eupatoria* aqueous extract (AEE) consumption by subjects was safe and generally well-tolerated without severe adverse events (65). Agrimony is an herbal medicine, which its safety is comparable with coffee (37). But, since Agrimony is an indication of geogenic contamination of flysch soils, elements like Ni, Co, Mn, Cu, Cr, V, and Mo typically concentrate in the roots and shoots of the plant. So, high uptake of these elements by Agrimony growing on similar soils is possible (69).

**Conclusion**

This review presents *A. eupatoria* description, history, and advances in phytochemistry and other aspects. Pharmacological studies carried out on its extracts and traditional uses revealed that it could be an important source for new drugs.

**Authors’ contributions**

MGP and NM conceived of the presented idea; MGP developed the article, performed the computations, wrote, and prepared the manuscript; NM encouraged; while author NM and SHM supervised the research and critical revision of the article. MRK and MRM made the final version. All authors read the manuscript and confirmed the publication of the final version.

**Conflict of interests**

There is no conflict of interest

**Ethical considerations**

Ethical issues including text plagiarism, misconduct, manipulation or appropriation, data fabrication,
### Physio-pharmacological activities of *Agrimonia eupatoria*

| Plant part/extract | Dose/model | Worked on | Standard drug | Result |
|--------------------|------------|-----------|---------------|--------|
| Aerial parts/Aqueous extract + extraction with ethyl acetate | For the aqueous extract single-dose of 199.18 mg/kg (mice) and 99.59 mg/kg (rats); for the fraction, single dose of 36.24 mg/kg (mice) and 18.12 mg/kg (rats) | Mice and rats | | The anti-inflammatory and peripheral analgesic properties of agrimony were confirmed. No signals of renal or hepatic toxicities detected (55). |
| Aerial parts/water infusion and ethyl acetate fraction | The mouse carrageenan-induced paw edema model for *in vitro* anti-inflammatory activity (rats received 99.59 mg/kg, and 199.18 mg/kg doses of infusion and 18.12 mg/kg, and 36.24 mg/kg for the fraction). The acetic acid-induced writhing and hot-plate tests for peripheral and central analgesic potential (mice received 199.18 mg/kg, and 398.26 mg/kg, for infusion and 36.24 mg/kg, and 72.48 mg/kg for the fraction) and formalin assay to assess both activities (mice received 72.48 mg/kg of the fraction). | Male Wistar rats and male mice | Diclofenac sodium and morphine | *In vivo* anti-inflammatory and analgesic activities were verified (46). |

**Analgesic and anti-inflammatory activity**

| Physio-pharmacological activities of *Agrimonia eupatoria* | | | | |
|---|---|---|---|---|
| Antiadhesive activity | Ethanol extract | Against *Campylobacter jejuni* | *Campylobacter jejuni* | No significant antiadhesion activity (IC$_{50}$ value >35 mg/mL) was found for *Agrimonia eupatoria* (56). |
| Antibacterial activities | Hydro ethanol extract | Modified microdilution assay | *Helicobacter pylori* and *Campylobacter jejuni* | Antibiotics | *Agrimonia eupatoria* was among the most active herbal extracts in inhibiting the growth of *Helicobacter pylori* (3). |
| | Seeds | n-Hexane, DCM and MeOH extracts and four Sep–Pak fractions of the MeOH extract. | *Bacillus cereus*, *Bacillus subtilis*, *Escherichia coli*, *Pseudomonas aeruginosa*, *Salmonella goldcoast*, and *Staphylococcus aureus* | | The n-Hexane extract showed an inhibitory effect against *Bacillus cereus* and *Bacillus subtilis*. Sep–Pak fractions eluted with 30, 60, and 80% MeOH in water showed significant antibacterial activity (4). |
| | Areal parts/aqueous extract and crude ethanolic extract | 10 mg/mL | *Staphylococcus aureus*, *Pseudomonas aeruginosa*, and *Escherichia coli* | Fucidin ointment | The ethanolic extract was more effective in inhibiting tested bacteria (57). |
| Antibiofilm activity | Aerial parts/ethanol, diethyl ether, water, and acetone extracts | | *P. mirabilis* and *P. aeruginosa* | Tetracycline | Biofilm inhibitory concentration required to reduce biofilm coverage by 50% values for acetone extract was 4315 mg/mL for *P. mirabilis* and 4469.5 mg/mL for *P. aeruginosa* (42). |
| Anticholinesterase activity | Aerial flowering parts/ Aqueous extracts | | | Displayed inhibition of butyrylcholinesterase (BuChE), acetylcholinesterase (AChE), and inhibition of cholinesterases by apigenin, luteolin, and quercetin glycosides (50). |
## Anticoagulant activity

Dried aerial parts

Human plasma-derived from healthy donors

The *A. eupatoria* complex prevents the development of plasma clots, primarily in the intrinsic blood coagulation cascade pathway. It is primarily an indirect inhibitor of thrombin, mediated by antithrombin or by heparin cofactor II (39).

## Anti-diabetic

### Aqueous extract

Into the diet (62.5 g/kg) and drinking water (2.5 g/L) or (1 mg/mL) on the abdominal muscle, 0.25-1 mg/mL on BRIN-BD11 cells/Streptozotocin (STZ)-diabetic

The presence of antihyperglycemic, insulin-releasing and insulin-like activity in *Agrimonia eupatoria* demonstrated (15).

### Water infusion

Streptozotocin-induced diabetes mellitus (DM) rat model/200 mg/L Male Wistar rats

In the avoidance and/or adjuvant treatment of developing cardiovascular problems linked to DM and sicknesses related to oxidative stress, *A. eupatoria* extract suggests its higher clinical potential (58).

### Treatments for diabetes mellitus

Dried leaves

Supplied in the diet (6.25% by weight) or as decoctions or infusions (1 g/400 mL) in place of drinking water/Streptozotocin (200 mg/kg i.p.) for 12 days Mice

Treatment with agrimony reduced the level of hyperglycemia during the development of streptozotocin diabetes but did not reduce the rate of body weight loss. Certain traditional plant treatment for diabetes, namely *Agrimonia* (14).

### Hydro-alcoholic extract and a polyphenol-enriched fraction

Against the reactive species/ 96-well microplate-based broth dilution assay

*Agrimonia eupatoria* anti-inflammatory activity mechanism could be its significant scavenging capacity of reactive species by its polyphenols (8).

## Anti-inflammatory Activity

Enzyme-linked immunosorbent assay, nitric oxide assay, and Western blotting. BV2 microglial cells

*Agrimoniae herba* suppressed lipopolysaccharide-induced nitric oxide production in BV2 microglial cells and lipopolysaccharide-induced production of proinflammatory cytokines such as interleukin 1 beta, tumor necrosis factor, and interleukin 6 in a dose-dependent manner had no cytotoxicity and inhibited the expression of inducible nitric oxide synthase. It may be used as a form of pharmaceutical acupuncture therapy in the treatment of brain inflammation (9).

| Table 10. Continued |
|---------------------|
| Plant part/ extract | Dose/ Model | Worked on | Standard drug | Result |
| Anticoagulant activity | Dried aerial parts | Human plasma-derived from healthy donors | | The A. eupatoria complex prevents the development of plasma clots, primarily in the intrinsic blood coagulation cascade pathway. It is primarily an indirect inhibitor of thrombin, mediated by antithrombin or by heparin cofactor II (39). |
| Anti-diabetic | Aqueous extract | Into the diet (62.5 g/kg) and drinking water (2.5 g/L), (1 mg/mL) on the abdominal muscle, 0.25-1 mg/mL on BRIN-BD11 cells/Streptozotocin (STZ)-diabetic | Mice, abdominal muscle, BRIN-BD11 pancreatic B-cell line | The presence of antihyperglycemic, insulin-releasing and insulin-like activity in *Agrimony eupatoria* demonstrated (15). |
| Anti-diabetic | Water infusion | Streptozotocin-induced diabetes mellitus (DM) rat model/200 mg/L Male Wistar rats | | In the avoidance and/or adjuvant treatment of developing cardiovascular problems linked to DM and sicknesses related to oxidative stress, *A. eupatoria* extract suggests its higher clinical potential (58). |
| Treatments for diabetes mellitus | Dried leaves | Supplied in the diet (6.25% by weight) or as decoctions or infusions (1 g/400 mL) in place of drinking water/Streptozotocin (200 mg/kg i.p.) for 12 days Mice | | Treatment with agrimony reduced the level of hyperglycemia during the development of streptozotocin diabetes but did not reduce the rate of body weight loss. Certain traditional plant treatment for diabetes, namely *Agrimonia* (14). |
| Anti-inflammatory Activity | Hydro-alcoholic extract and a polyphenol-enriched fraction | Against the reactive species/ 96-well microplate-based broth dilution assay | | *Agrimonia eupatoria* anti-inflammatory activity mechanism could be its significant scavenging capacity of reactive species by its polyphenols (8). |
| Anti-inflammatory Activity | Tea | One-month Healthy humans | | Has potential in improving markers of lipid metabolism and inflammation (7). |
Antimicrobial activity

Extracts

From 2 to 0.004 mg/mL/ 96 well plate microdilution method (200, 40, and 8 
μg/mL)

Selected gram-positive *Staphylococcus aureus* and gram-
negative *Pseudomonas aeruginosa* and *Escherichia coli*
bacteria of relevance in wounds

Moderate activity for *Potentilla reptans* L (59).

Aerial parts/ Hot water, aqueous extract

Primary human skin fibroblasts (line C688)

*Escherichia coli* ATCC 25922, *E. coli* O44, *Vibrio cholerae* O395-tacCTB strain, and *Lactobacillus rhamnosus*

Displayed modest bacteriostatic potentials. Suppressed the
binding of cholera toxin subunit B to the cell surface and
immobilized GM$_1$ ganglioside (60).

Antimicrobial and antifungal activity

Aerial parts /ethanol, diethyl ether, water, and acetone extracts
the acetone extract demonstrated the highest activity

The antimicrobial activity was tested by
determining the minimum inhibitory
conzentration (MIC) using the
microdilution method with resazurin

24 microorganisms including 18 strains of bacteria (probiotics
strains: *Lactobacillus rhamnosus*, *Bacillus subtilis* IP 5832,
and *Bifidobacterium animalis* subsp. *lactis*; standard strains:
*Staphylococcus aureus* ATCC 25923, *Enterococcus faecalis*
ATCC 29212, *Escherichia coli* ATCC 25922, *B. subtilis* ATCC
6633, and *P. aeruginosa* ATCC 27853; and clinical isolates
*S. aureus*, *E. faecalis*, *Bacillus cereus*, *B. subtilis*, *E. coli*,
*Salmonella enterica*, *Salmonella typhimurium*, *Klebsiella
pneumoniae*, *P. mirabilis*, and *P. aeruginosa*) and six strains
of fungi (*Aspergillus niger*, *Aspergillus flavus*, *Penicillium
chrysogenum*, *Penicillium italicum*, *C. albicans* ATCC 10231,
and *Candida albicans*)

Tetracycline, ampicillin, amphotericin B, and itraconazole

The strongest antimicrobial activity was detected on G$^+$
bacteria, especially on probiotic species. The acetone
extract demonstrated the highest activity (42).

Anti-nociceptive effect

Aerial part/ Ethanolic extract

200 mg/kg/ cisplatin-induced neuropathic pain model

Male Sprague-Dawley rats

Gabapentin

In the pin-prick test and plantar test, *A. eupatoria* extract
displayed an antinociceptive property with a lower
withdrawal time and a higher withdrawal threshold in the
paw-withdrawal threshold test as compared to control
animals. In the case of cold-allodynia, increased paw-
withdrawal duration in the chemical test, and showed
superior activity to gabapentin. *A. eupatoria* extract found
to possess therapeutic potential for the treatment of
neuropathic pain (61).
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**Table 10. Continued**

| Physio-pharmacological activities of *Agrimonia eupatoria* | Plant part/ extract | Dose/ Model | Worked on | Standard drug | Result |
|----------------------------------------------------------|---------------------|-------------|-----------|---------------|--------|
| **Antioxidant activity**                                 | Acetone, methanol, aqueous, acetone-hexane, acetone-t-butyl methyl ether, acetone-n-BuOH, acetone-aqueous extracts | In DPPH radical scavenging, ABTS(+) radical decolorization reaction systems | Honeybush, rooibos, black and green tea | As compared to the foreign plants examined, it can be considered a rich source of water-soluble antioxidants (6). |
| Tea                                                      | Trolox equivalent antioxidant capacity (TEAC) | | | | |
| Aerial flowering parts/Aqueous extracts                  | | | | | |
| Arial parts/water, acetone, ethanol, and diethyl ether extracts | In DPPH radical scavenging and Reducing power | Ascorbic acid | Higher concentrations of acetone extract and vitamin C operated in a similar way, confirming the high antioxidant activity of *Agrimonia*. All tested extracts showed a concentration-dependent antiradical activity. Reducing the power of acetone extract was found to be the most active, followed by ethanol, water, and diethyl ether extracts (acetone > ethanol > water > diethyl ether) (42). | |
| Arial parts/infusion and ethyl acetate fraction          | DPPH, superoxide anion, hydroxyl radical, and SNAP assays | | Showed a significant antiradical activity against all tested radicals. Decreased NO levels in vitro. Fraction being more active than infusion. They are potential sources of antiradical and anti-inflammatory polyphenols (46). | |
| **Anti-oxidative potential**                            | Tea                 | One month   | Healthy humans | Has potential in improving markers oxidative status in healthy adults (7). |
| **Antioxidant status**                                  | 0.1% & 0.2% agrimony extract | Supplied through drinking water | Broiler chickens | Can beneficially influence the antioxidant status of thigh meat thus improve meat quality (62). |
| 0.2% agrimony extract                                   | Supplied with drinking water/(2:1000) | Broiler chickens at the age of 42 days | Clove (*Syzygium aromaticum* L.) Powder | It has a potential to increase the antioxidant status (63). |
Anti-tumor

Aqueous and methanol extracts of *Agrimonia eupatoria* at concentrations of 6.0, 12.0, 24.0, 48.0, and 96.0 µg/mL showed concentration-dependent anti-tumor properties. The methanol extract reported better growth inhibition percentage (PGI) values than the aqueous extract in human cervical cancer (Hela) and RD cell lines, while MEF cells reported lower PGI values. Among these concentrations, 96.0 µg/mL was the best in generating PGI in RD and Hela cancer cell lines.

Antiviral activity

Aerial parts (stems and leaves) of *Agrimonia eupatoria* showed antiviral activity against Hepatitis B virus (HBV). The extract prepared at 60 °C had the greatest effect, and the inhibitory activity was highest in mid-July.

Enzymatic and non-enzymatic antioxidants

Extracts from the crop tops of *Agrimonia eupatoria* were administered in water at a final concentration of 0.1% after 42 days of feeding. The level of reduced glutathione was measured in the plasma and in liver, heart, and kidney mitochondria. The activity of superoxide dismutase had a significant decrease, indicating the antioxidant effect against peroxidation of gamma-linolenic acid.

Growth performance, and selected indices of lipid profile

Aqueous extracts of *Agrimonia eupatoria* at 0.2% concentration were supplied with drinking water to broiler chickens at the age of 42 days. It was found that the extract failed to influence selected lipid metabolism indices or the growth performance.

Hepatic oxidative stress

Aqueous extracts of *Agrimonia eupatoria* at 10, 30, 100, and 300 mg/kg/day were administered by chronic ethanol-induced liver injury. Mice were used in this experiment, and it was observed that *Agrimonia eupatoria* water extract enhanced chronic ethanol-induced liver damage, likely because of oxidative stress suppression and Toll-like receptor (TLR)-mediated inflammatory signals.

Hepatoprotective effects

Water extracts of *Agrimonia eupatoria* at 10, 30, 100, and 300 mg/kg/day were administered to rats with chronic ethanol-induced liver injury. Aqueous extract at 160 mg/d for 8 weeks was given to subjects aged between 20 and 70 years who were diagnosed with mild to moderately elevated ALT levels. A significant reduction in elevated alanine transaminase (ALT) and serum triglyceride (TG) was observed.

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**Table 10. Continued**

| Physio-pharmacological activities of *Agrimonia eupatoria* | Plant part/extract | Dose/Model | Worked on | Standard drug | Result |
|----------------------------------------------------------|--------------------|------------|-----------|---------------|--------|
| Anti-tumor                                               | Aqueous and methanol extracts | 6.0, 12.0, 24.0, 48.0 and 96.0 µg/mL | Human cervical cancer; Hela and Rhabdomyosarcoma (RD); RD cell lines and a primary cell culture; mouse embryo fibroblast; MEF | Five plant extracts concentrations showed concentration-dependent anti-tumor properties, and the methanol extract reported better growth inhibition percentage (PGI) values than aqueous extract in Hela and RD cell lines, while MEF cells reported lower PGI values. Among these concentrations, the three examined timespans, 96.0 µg/mL was the best in generating PGI in RD and Hela cancer cell lines (13). |
| Antiviral activity                                       | Aerial parts (stems and leaves)/ Aqueous extract | | Hepatitis B virus (HBV) | The extract prepared at 60 °C has the greatest effect. The inhibitory activity was the highest at mid-July. *Agrimonia* genus plants contain potential antiviral activity against HBV (16). |
| Enzymatic and non-enzymatic antioxidants                | Extracts from the crop tops | Administered in the water at a final concentration of 0.1% after 42 days of feeding the level of reduced glutathione was measured in the plasma and in liver, heart, and kidney mitochondria | 120 one-day-old broilers COBB500 | The activity of superoxide dismutase had a significant decrease. The application of agrimony extract appears to be suitable for the antioxidant effect against peroxidation of gamma-linolenic acid (63). |
| Growth performance, and selected indices of lipid profile| 0.2% agrimony extract | Supplied with drinking water/ (2:1000) | Broiler chickens at the age of 42 days | Clove (*Syzygium aromaticum*) L. powder | It fails to influence either the selected lipid metabolism indices or the growth performance (64). |
| Hepatic oxidative stress                                | Aqueous extracts (leaves) | For 4 weeks | Mice | Water | Led to a decrease in catalase activity produced a decrease in SOD activity. In general, agrimony appeared to be a promising extract in protection; and was even slightly toxic (53). |
| Hepatoprotective effects                                | Water extract | 10, 30, 100, and 300 mg/kg/d/ chronic ethanol-induced liver injury | Rats | *Agrimonia eupatoria* water extract enhanced chronic ethanol-induced liver damage, likely because of oxidative stress suppression and Toll-like receptor (TLR) -mediated inflammatory signals (10). |
|                                                         | Aqueous extract | (160 mg/d)/ two capsules twice a day for 8 weeks | Subjects aged between 20 and 70 years who were diagnosed with mild to moderately elevated ALT levels (between 45 and 135 IU/L). | A significant reduction in elevated alanine transaminase (ALT) and serum triglyceride (TG) was observed (65). |
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Irritable bowel syndrome (IBS)

Aerial parts

The diarrhea-predominant and alternating bowel habit IBS (DA-IBS) formula containing Agrimony was tested on patients who fulfilled the Rome II criteria for irritable bowel syndrome. The DA-IBS formula was not effective in alternating bowel habit IBS or improving bowel habit in individuals with diarrhea-predominant but it improved a number of IBS symptoms significantly (66).

Neuroprotective

Methanolic extract

Glutamate-injured HT22 cells

HT22 hippocampal cells

Astragalin, isoquercitrin, querctin, and luteolin 7-O-β-D-glucuronide compounds showed neuroprotective effects on glutamate-induced toxicity in HT22 cells (47).

Oxidative stability

0.1% & 0.2% agrimony extract

Supplied with drinking water

Broiler chickens

Can beneficially influence the oxidative stability of thigh meat thus improve meat quality (62).

Oxidative stress

Aqueous-alcoholic extract

1%, 2.5%, 5%, 7.5%, 10%, 12.5% and 15% /24 h

Cell culture model 3T3-L1 pre-adipocytes

Pretreatment of cells with extract significantly reduced the stimulatory effect of the oxidizing agent on gene expression (6).

Wound healing activity

Areal parts/aqueous extract and crude ethanolic extract

10 mg/mL

Staphylococcus aureus, Pseudomonas aeruginosa, and Escherichia coli

Fucidin ointment

The wound healing was completed in 10 days by using the ethanolic extract ointment (57).

Wound healing scar formation inhibition

Pulverized in combination with three more herbs Agrimonia eupatoria (A) & Nelumbo nucifera Gaertn (N) & Boswellia carterii (B) and Pollen Typhae angustifolii (P) (ANBP)

New Zealand white rabbits

ANBP plays dual roles, promoting wound healing and alleviating scar formation (68).

| Physio-pharmacological activities of Agrimonia eupatoria | Plant part/extract | Dose/Model | Worked on | Standard drug | Result |
|----------------------------------------------------------|--------------------|------------|-----------|---------------|--------|
| Irritable bowel syndrome (IBS)                           | Aerial parts       | The diarrhea-predominant and alternating bowel habit IBS (DA-IBS) formula containing Agrimony | Patients who fulfilled the Rome II criteria for irritable bowel syndrome. | The DA-IBS formula was not effective in alternating bowel habit IBS or improving bowel habit in individuals with diarrhea-predominant but it improved a number of IBS symptoms significantly (66). |
| Neuroprotective                                           | Methanolic extract | Glutamate-injured HT22 cells | HT22 hippocampal cells | Astragalin, isoquercitrin, querctin, and luteolin 7-O-β-D-glucuronide compounds showed neuroprotective effects on glutamate-induced toxicity in HT22 cells (47). |
| Oxidative stability                                       | 0.1% & 0.2% agrimony extract | Supplied with drinking water | Broiler chickens | Can beneficially influence the oxidative stability of thigh meat thus improve meat quality (62). |
| Oxidative stress                                          | Aqueous-alcoholic extract | 1%, 2.5%, 5%, 7.5%, 10%, 12.5% and 15% /24 h | Cell culture model 3T3-L1 pre-adipocytes | Pretreatment of cells with extract significantly reduced the stimulatory effect of the oxidizing agent on gene expression (6). |
| Wound healing activity                                   | Areal parts/aqueous extract and crude ethanolic extract | 10 mg/mL | Staphylococcus aureus, Pseudomonas aeruginosa, and Escherichia coli | Fucidin ointment | The wound healing was completed in 10 days by using the ethanolic extract ointment (57). |
| Wound healing scar formation inhibition                  | Pulverized in combination with three more herbs Agrimonia eupatoria (A) & Nelumbo nucifera Gaertn (N) & Boswellia carterii (B) and Pollen Typhae angustifolii (P) (ANBP) | | New Zealand white rabbits | ANBP plays dual roles, promoting wound healing and alleviating scar formation (68). |
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