

Herbal approach toward Vatarakta (Gout), a Metabolic Syndrome: a review

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Abstract

Gout is a multi-factorial disorder characterized by hyperuricemia, deposition of uric acid crystals in and around joints as well as in soft tissues. These days its prevalence is increasing due to changes in life style and therefore it has a noteworthy impact on the working population, their work, productivity and physical function. Conventional drugs used in the management of gout have some associated drawbacks. Therefore, it is essential to find out some alternative therapeutic approaches. The clinical features of gout such as sudden burning pain, swelling, redness and tenderness in joints come under the purview of *vatarakta* (gouty arthritis) in Ayurveda classics. Plant based medicine have gained upward attention in current scenario for the prevention and treatment of gout. In recent years many studies were done in search of new xanthine oxidase inhibitors with fewer side effects than available ones and have more precise effects. Therefore, this manuscript aims to perform an updated systematic review on the available information regarding medicinal plant as well as the classical Ayurvedic monoherbal therapy useful in the treatments of gout.

Keywords

Ayurveda, Gout, Hyperuricemia, Uricosuric, Vatarakta, Xanthine Oxidase.

INTRODUCTION

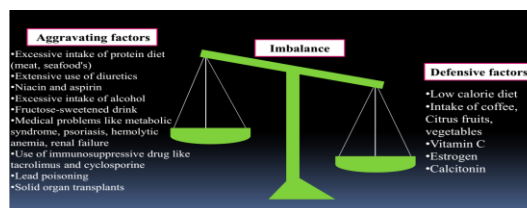
Gout is the most common form of inflammatory arthritis, with a prevalence of 1–2% in developed countries ^[1]. It is a disorder of purine metabolism associated with increase level of serum uric acid (serum uric acid >6.8 mg/dL) ^[2], crystallizes in the form of monosodium urate, deposit in joints, tendons and in the surrounding tissues ^[3], manifested as a sudden burning pain, swelling, redness and tenderness in joints. Initially, hyperuricemic persons have no prominent symptoms and they remain asymptomatic for long time ^[2] and gout develop only in about 10% of these people ^[4]. Gout is the common cause of arthritis in men aged over the fifty ^[5]. Incidence of gout in men is more than women ^[6] because before menopause, estrogen promotes urate wasting in the urine ^[7]. Gout has both modifiable (diet, alcohol, medications, co-morbidities, body mass index, physical fitness) and non-modifiable (genetics, age and gender) risk factors (Fig 1) ^[1, 8-10]. As the level of uric acid [in men (≤ 7 mg/dl) and women (≤ 6 mg/dl)] crosses its saturation thresholds in physiological fluids ^[11], urate crystals precipitation started in the joints and other tissues. Non steroidal anti-inflammatory drugs (NSAIDs), colchicine, glucocorticoids, xanthine oxidase inhibitor (like allopurinol, febuxostat) and uricosurics (like probenecid) are used in the

Maurya et al

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treatment of gout. These drugs have some side effects such as gastric ulcer, hypersensitivity; acute kidney injury and possibility of drug interaction with other prescribed drug such as erythromycin restrict their uses ^[12]. The major objectives in chronic gout management are to **keep** the serum uric acid level towards normal, prevent joint damage due to hyperuricemia and further occurrence as well as to promote the dissolution of existing uric acid crystals as well as prevent new crystal formation ^[13]. Some non pharmacological measures includes restricted protein diet, life style modification, weight loss, low alcohol consumption and ensuring sufficient fluid intake ^[14].

Fig 1 Factors Affecting Gout



AYURVEDIC VIEW

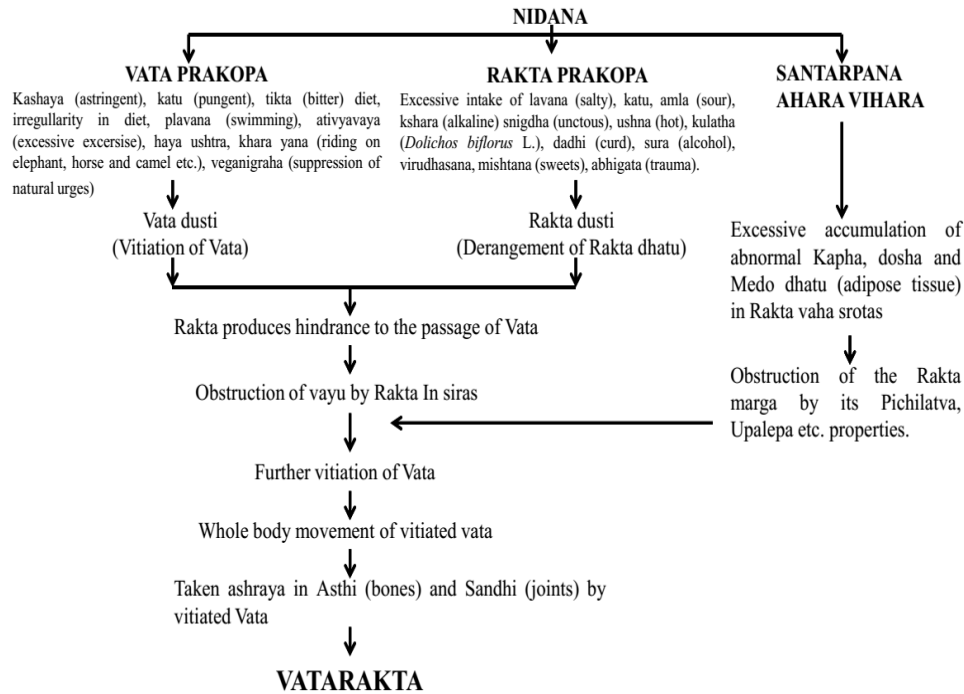
Tridoshas (three basic biological humors of body or Bio energy Principles), *vata* (the Air or Nervous System Humor), *pitta* (the biological fire) and *kapha* (The Water Humor or protective humors) are three physiological basic of the human body. *Vata*
Int J Ayu Pharm Chem Vol. 1, Issue 2, 2014

being predominant has the potential to cause more serious and long term diseases than the *Pitta* and *Kapha* [15]. It gets aggravated due to either *Avarana* (hindrance in the path) or *dhatukshaya* (deficiency of body tissue). *Vatarakta* is one of the unique disorders among the *Vatavyadhi* (a group of nervous disorder) which is the result of *avarana* of morbid *vata dosha* by vitiated *rakta* (blood) *dhatu* (tissue) [16]. This causes the derangement of *Rakta dhatu* resulting in *Vatashonita* (Fig 2). In addition to this, *Vatarakta* is also produced by the *Margavarana* of *Vayu* by *Kapha* and *Medas* [16]. In *Shabda kalpa druma* [17] definition of *Vatarakta* is given as “*Vata dushtiam raktam yatra roga vishesha*”, i.e. it is caused due to the vitiation of *Rakta* initiated by the morbid *Vata* is called *Vatarakta*. It is of two types. When there is involvement of *Twak* (skin) and *Mamsa* (muscle) dhatus only, it is known as *Uttana Vatarakta* (uncomplicated gout). This type of *vatarakta* has *Akunchana* (Contraction), *Ayama* (Dilatation of Vessels), *Beda* (Splitting type of Pain), *Daha* (Burning Sensation), *Gourava* (Heaviness), *Kandu* (Itching), *Rakta twak* (Reddish coloration of the skin), *Ruja*

(Pain), *Shayava twak* (Cyanosis of the skin), *Sphurana* (Trembling or throbbing sensation), *Suptata* (Numbness), *Toda* (Pricking pain). On the other hand, when symptoms like *Swayatu grathita* (Hard swelling), *Paka* (Suppuration), *Daha* (Burning sensation), *Kanjatwa* (Lameness), *Shyavatha* (Cyanosis or pallor), *Pangutwa* (Paraplegia), *Bhrishartha* (Excruciating deep pain), *Vidaha* (Internal burning sensation), *Tamra twak* (Coppery discoloration), *Ruja* (Pain), *Sphurana* (Throbbing sensation), *Adhika purvaruk* (Increased pain), *Toda* (Pricking type of pain), *Vatasya sarva Shareera charana* (Vitiated *vata* moves all over the body), *Angasya vakrikarana*

(Disfigurement of the parts), *Vatasya sandyasthi Majjasu chindanniva* (Aggravated *vayu* while causing pain-burning sensation constantly moves with high speed through the *Sandhi*, *Asthi* and *Majja*) along with discoloration and hardening of skin are the features of *Gambhira Vatarakta* (complicated gout). After one year *vatarakta* becomes *Yapya* (difficult to cure) [15, 16].

Fig 2. Pathogenesis of Gout according to Ayurveda



Principle of Ayurvedic management

In classics of *Ayurveda* both *Shodhana* and *Shamana chikitsa* are described for *vatarakta*. According to *Acharya Charaka*, *Raktadhika vatarakta* has to be treated with, *Virechana* (therapeutic purgation), *Ghrita ksheera pana* (intake of medicated ghee or milk), *Seka* (pouring of medicated decoctions over body), *Vasti* (medicated enema) and *Sita nirvapana* (application of pastes for cooling). Since *Gambhira vatarakta* falls into the category of *Madyama rogamarga* (intermediate path)), no other treatment is better parallel *vasti* in treating the disease. In case of *Vatarakta*, developed due to *margavarana* in the *Rakta vaha srotas* by morbid *Kapha dosha* and

Medo dhatu, the line of treatment in the initial stage is different, *snehana karma* is not recommended, the main purpose in this context is to remove the *Avarana* and to clear the *srotas* (body channels) in order to normalize the movement of *vata*. To achieve this goal *Kapha-medo shamaka / Rukshana chikitsa* is adopted first^[15, 16].

A. *Shodhana Chikitsa* (purification treatment)

Shodhana treatment includes *Raktamoksana* (bloodletting by leech or other method), *Langhana* (methods for effecting leanness, reduction of body bulk or resulting in lightness), *Vamana* (therapeutic emesis), *Virechana*, *Asthapana vasti* (decoction

enema), *Snehapana* (intake of medicated oils or ghee) ^[16, 18].

B. *Shamana* (pacifying treatment)

a. External application

It includes various treatment modalities like *Alepana* (application of medicated pastes), *Abhyanga* (massage), *Parisheka* (pouring of medicated decoction over body) and *Upanaha* (application of hot poultice). Following drugs are used for external application

1. Application of the paste of *Sigru* (*Moringa oleifera* Lam.) and *Varuna* (*Crataeva nurvala* Buch. -Ham.) with sour gruel removes pain in *vatarakta* (B. S. *Vatarakta* 68) ^[19].
2. Castor (*Ricinus communis* Linn) seed pounded with milk, applied over the affected part relieve pain in *Vatarakta* (C. S. Ci. 29/140) ^[16].
3. *Nimba* leaves pounded with sour gruel is applied externally in *vatarakta* (H. S. 3. 23/7-8) ^[20].
4. Extracted oil of the fresh stem of *Karira* (*Capparis deciduas* Edgew.) by *patala-yantra* when applied over the affected part, alleviates tingling sensation and *vatarakta* (S. B. 4/490)
5. Linseed (*Linum usitatissimum* Linn) and Castor seeds pounded with milk when applied on the affected part relieves pain (C. S. Ci. 29/140; A. H. Ci 22/34) ^[15, 16].
6. Oil cooked with *Guduchi* decoction and milk alleviates *vatarakta* (C. S. Ci. 29/121) ^[16].
7. Oil, prepared with the decoction of *Satapushpa* (*Anethum graveolens* Linn.), *Kustha* (*Saussurea lappa* C. B. Clarke.) and *Madhuka* separately, alleviates pain in *vatarakta* (B. P. Ci. 29/118) ^[22].
8. Paste of barley powder [*Yava* (*Hordeum vulgare* Linn.)] with *Yastimadhu*, milk and ghee removes pain and burning sensation of *vatarakta* (C. S. Ci. 29/132) ^[16].
9. Paste of linseed, castor seeds and *Satapushpa* pounded with milk is applied externally to remove pain in *vatarakta* predominant in vata (C. S. Ci. 29/140) ^[16].
10. Paste of wheat powder [*Godhuma* (*Triticum aestivum* Linn.)] mixed with goat's milk and ghee when applied over the *vatarakta* affected area reduces pain (C. S. Su. 3/23) ^[16].
11. Paste of yellow mustard (*Brassica campestris* Linn.); paste of tila (*Sesamum indicum* Linn.) and *ashwagandha* (*Withania somnifera* Dunal.); paste of *Priyala* (*Buchanania*

lanzan Spreng.), *Slesmataka* (*Cordia dichotoma* Forst. f.) and *Kapittha* (*Feronia limonia* (Linn.) Swingle.); paste of *Madhusigru* (*Moringa concanensis* Nimmo) and *Punarnava* (*Boerhaavia diffusa* Linn.) were prepared. These four pastes, pounded with alkaline water are used to alleviate *Vatarakta* (S. S. Ci. 5. 19) ^[18].

12. Seeds of *Madhusigru* mixed with sour gruel as paste is useful in *vatarakta* (C. S. Ci. 29/151) ^[16].
13. The Paste of *Kasmarya*, *Madhuka* and *Saktu* (roasted powder of gram) is useful in *vatarakta* (S. S. Ci. 05/12) ^[18].
14. Parched Tila (*Sesamum indicum* Linn.) pounded with milk is applied locally in *vatarakta* (A. H. Ci. 22/33-34) ^[15].

b. Internal application

1. Buffalo's milk, curdled with the powder of flower of *Agastya* (*Sesbania grandiflora* Pers.) and the butter extracted there from is useful in severe *Vatarakta* (V. M. 23/7) ^[23].
2. By the use of buttermilk and *Haritaki* (*Terminalia chebula* Retz.) *kapha* and *medas* are reduced (C. S. Ci. 29/157) ^[16].
3. Milk cooked with *Dashmool* decoction alleviates pain immediately (C. S. Ci. 29/124); (A. H. Ci. 22/23); (V. M. 23/11) ^[15, 16, 23].
4. Decoction of *Chandana* (*Santalum album* Linn.) sweetened with sugar and honey is effective in *vatarakta* (S. S. Ci. 5/8) ^[18].
5. Decoction of *Guduchi* (*Tinospora cordifolia* Willd Miers ex Hook. F. & Thoms.) is useful in *Vatarakta* (S. S. Ci. 5/8; (A. H. U. 40/59) ^[15, 17].
6. Decoction of *Guduchi* taken after intake of three or five *Haritaki* fruits with jaggery is effective in *vatarakta* (V. M. 23/7; BP. Ci. 29/44) ^[22, 23].
7. Decoction of *Guduchi*, Castor and *Vasa* (*Adhatoda vasica* Nees.) mixed with castor oil controls generalized *vatarakta* (S. G. 2/2135) ^[24].
8. Decoction of *Guduchi*, *Shunthi* (*Zingiber officinale* Rosc.) and *Dhanyaka* (*Coriandrum sativum* Linn.) alleviates *vatarakta*, *amavata* (rheumatoid arthritis) and all type of *kustha* (skin disorders) (V. M. 23/4; B. P. Ci. 29/42) ^[22, 23].
9. Decoction of *Haridra* (*Curcuma longa* Linn.) and *Guduchi* mixed with honey is useful in *vatarakta* predominant in *kapha* (B. P. Ci. 29/79) ^[22].
10. Decoction of *Haritaki* fried with ghee is effective in *vatarakta* (A. H. Ci. 22/12) ^[15].

11. Decoction of *Kokilaksha* (*Astercantha longifolia* Nees.) on vegetable diet alleviates *vatarakta* (A. H. Ci. 22/18) [15].
12. Decoction of *Mustaka* (*Cyperus rotundus* Linn.), *Amalaki* (*Embllica officinalis* Gaertn.) and *Haridra* taken with honey alleviates *vatarakta* associated with *kapha* (B. P. Ci. 29/78) [22].
13. Decoction of *Patola* (*Trichosanthes dioica* Roxb.) and *Nimba* (*Azadirachta indica* A. Juss.) leaves mixed with honey pacifies *vataraka* (H. S. 3. 23/7-8) [20].
14. Decoction of *Rasna* (*Pluchea lanceolata* C. B. Clarke.), *Guduchi* and *Aragvadha* (*Cassia fistula* Linn.) mixed with castor oil alleviates all type of *vatarakta* (V. M. 25/6) [23].
15. Decoction of the bark of *Asvattha* (*Ficus religiosa* Linn.) is useful in *Vatarakta* (C. S. Ci. 29/158) [16].
16. Decoction of *Trivrit* (*Operculina turpethum* Linn.) and *Vidari* (*Pueraria tuberosa* DC.) cures *vatarakta* (B. P. Ci 29/40; B. S. Vatarakta. 40) [19, 22].
17. Dhanyaka one part and two part of *Jeerak* (*Cuminum cyminum* Linn.) cooked with jiggery alleviates *vatarakta* (H. S. 3/23/10) [20].
18. Ghee cooked with decoction of *Karvellaka* (*Momordica Charantia* Linn.) is useful in *Vatarakta* (S. S. Ci 5/12) [18].
19. Goat's milk cooked with *Prisniparni* (*Uraria picta* Desv.) and added with sugar and honey is useful (S. S. Ci. 5-7) [18].
20. Decoction of *Guduchi* is useful in *vatarakta* (C. K. 319) [25].
21. *Guggulu* (*Commiphora mukul* Hook ex Stocks Engl.) along with *Guduchi* decoction is effective in *vatarakta* (C. K. 314) [25].
22. *Haritaki* mixed with jaggery taken either with cow urine or water is found effective (S. S. Ci. 5. 10/12) [18].
23. *Haritaki* with jaggery or decoction of *Guduchi* or *Pippali* (*Piper longum* Linn.) *vardhamana* is used (V. M. 23/16) [23].
24. In *vata* predominant *vatarakta*, goat's milk mixed with half oil and *Yastimadhu* (*Glycyrriza glabra* Linn.) 10 g is effective (S. S. Ci. 05/07) [18].
25. Milk mixed with *Dhanyaka* and *shunthi* is effective in *vatarakta* (H. S. 3/23/6) [20].
26. Oil cooked with decoction of *Madhuka* (*Madhuca indica* J. F. Gmel.) and *Kasmarya* (*Gmelina arborea* Linn.) alleviates *vatarakta* (C. S. Ci. 29/121) [16].

27. Ghrita or milk cooked with *Guduchi* decoction is effective (H. S. Ci. 22/07) [20].
28. One taking *Munditika* (*Sphaeranthus indicus* Linn.) powder mixed with honey and ghee followed by intake of the decoction of *Guduchi* becomes free from severe *vatarakta* (C. D. 23/7) [26].
29. One who swallows paste of *Nimba patra* 80 g in morning keeping on diet of wholesome items and ghee becomes free from severe *vatarakta* (S. B. 4/37) [21].
30. *Triphala* powder mixed with *Trikatu* and honey is effective for the patients of *vatarakta* (S. S. Ci. 5/34) [18].
31. Regular use of *Guduchi* as juice, paste and decoction for longer period cure *vatarakta* (V. M. 23/10; B. P. Ci. 29/41) [22, 23].
32. Regular use of *Silajatu*, *Guggulu* and honey control *vatarakta* (C. S. Ci. 29/159) [16].
33. Root of *Saireyaka* (*Barleria Prionitis* Linn.) and *Jivanti* (*Leptadenia reticulata* W. & A.) pounded with goat's milk and mixed with ghee, applied locally as paste in *vatarakta* (A. H. Ci. 22/33) [15].
34. *Salparni* (*Desmodium gangeticum* DC.), *Prisniparni* or both type of *Brihati* (*Solanum indicum* Linn.) pounded with milk and mixed with saturating drink control *vatarakta* (S. S. Ci. 05/10) [18].
35. Vegetable of *Sunisannaka* (*Marsilea minuta* Linn.) useful in *vatarakta*. (C. S. Ci. 29/52) [16].
36. *Amalki* (*Emblica officinalis* Gaertn.) and *Haridra* sweetened with honey is used to alleviate *Vatarakta* (C. S. Ci. 05/10) [16].
37. Use of *Silajatu* and *Guggulu* along with milk is useful in *Vatarakta* (A. H. Ci. 22/65) [15].
38. *Vardhaman Pippali* (*Piper longum* Linn.) is useful in *vatarakta* (S. S. Ci. 05/12) [18].
39. *Vatarakta* predominant in *kapha*, decoction of *Mustaka* (*Cyperus rotundus* Linn.), *Draksha* (*Vitis vinifera* Linn.) and *Haridra* mixed with honey alleviate *Vatarakta* (A. H. Ci. 22/14) [15].
40. Vegetable of the upper end of *Vetra* (*Calamus tenuis* Roxb.) is wholesome in *vatarakta* (C. S. Ci. 29/52) [16].

MEDICINAL PLANTS EFFECTIVE IN GOUT

Medicinal plants have been known for millennia and are extremely respected worldwide as a wealthy source of healing agents for the prevention of a variety of diseases. Over 80 % of the world population depends on traditional medicine for their primary health care needs. Also, the overuse of synthetic drugs, which results in higher

incidence of adverse drug reactions, has motivated humans to return to nature for safe remedies. Many plants have been documented for their pharmacological effectiveness in case of gout. In the table no. 1 an attempt was made to compile the accessible data on the plant as anti-gout.

Table 1 Scientific validated of Medicinal plants in treatment of Gout

S. No.	Plant	Family	Compounds
1.	<i>Acacia confuse</i> Merr. ^[27, 28]	Fabaceae	Okanin, Melanoxetin
2.	<i>Ajuga bracteosa</i> Wall Ex Benth. ^[29]	Lamiaceae	6-Deoxyharpagide, Aajugarin I, Lupulin A, Withaferin A And Reptoside
3.	<i>Allium cepa</i> ^[30, 31]	Liliaceae	Quercetin, Morin, Myricetin, Kaempferol, Icariin, Apigenin, Luteolin, Baicalin, Silibinin, Naringenin
4.	<i>Amentotaxus formosana</i> Li ^[32]	Taxaceae	Sugiol
5.	<i>Biota orientalis</i> (L.) Endl ^[33]	Cupressaceae	Quercetin And Rutin
6.	<i>Blumea balsamifera</i> DC ^[34, 35]	Asteraceae	Luteolin, Quercetin, Tamarixetin, Dihydroflavonol
7.	<i>Buddleja globosa</i> Hope. ^[36]	Scrophulariaceae	
8.	<i>Caesalpinia sappan</i> L. ^[37]	Caesalpiniaceae	Neoprotosappanin
9.	<i>Cajanin stilbene</i> (L.) Millsp ^[38]	Fabaceae	Cajaninstilbene Acid
10.	<i>Chrysanthemum sinense</i> Sabine ^[39]	Asteraceae	Flavone Glucoside, Acacetin Luteolin, Quercetin
11.	<i>Cinnamomum cassia</i> (Blume) ^[40]	Lauraceae	Cassia Oil (Cinnamaldehyde Derivatives)
12.	<i>Cynara scolymus</i> Linn. ^[41]	Asteraceae	Caffeic Acid Derivatives And Flavones
13.	<i>Dioscorea</i> spp. ^[42, 43]	Dioscoreaceae	Saponin
14.	<i>Dioscoreae nipponicae</i> ^[44, 45]	Dioscoreaceae	Saponin
15.	<i>Dolichos falcate</i> Klein (DF) ^[46]	Fabaceae	Doliroside A, Medicagenic Acid-3-O-B-D-Glucopyranoside (MG)
16.	<i>Erythrina stricta</i> Roxb. ^[47]	Fabaceae	Chloroform Fraction

17.	<i>Euonymus laxiflorus</i> , Champ. ex Benth ^[48]	Celastraceae	Methanol Extract
18.	<i>Flos Chrysanthemum</i> ^[49]	Asteraceae	Luteolin And Apigenin
19.	<i>Gardenia jasminoides</i> ^[48]	Rubiaceae	Methanol Extract
20.	<i>Geranium sibiricum</i> L. ^[50]	Geraniaceae	Geraniin
21.	<i>Gloriosa superba</i> L. ^[51]	Liliaceae	Colchicinoids
22.	<i>Hyoscyamus reticulatus</i> L. ^[52]	Solanaceae	Aqueous Extract
23.	<i>Isatis costata</i> Linn. ^[53]	Brassicaceae	Costinones A, B, Isatinones A, B, Indirubin And Trisindoline.
24.	<i>Jatropha isabellei</i> Mull Arg. ^[54]	Euphorbiaceae	Crude Extract Of <i>Jatropha Isabellei</i>
25.	<i>Lagerstroemia speciosa</i> (L.) Pers. ^[55]	Lythraceae	Valoneic Acid Dilactone
26.	<i>Lonicera hypoglauca</i> Miquel ^[56]	Caprifoliaceae	Ethanol Extract
27.	<i>Lychnophora trichocarpa</i> Spreng ^[57]	Asteraceae	Luteolin, Apigenin, Lupeol, Lychnopholide And Eremantholide
28.	<i>Lysimachia christinae</i> Hance ^[58]	Lysimachia	Aqueous Extract
29.	<i>Morinda citrifolia</i> L. ^[59]	Rubiaceae	Methanol Extract
30.	<i>Olea europaea</i> Ph. Eur. ^[60]	Oleaceae	Aglycone, Apigenin
31.	<i>Orthosiphon stamineus</i> Benth ^[61, 62]	Lamiaceae	Sinesetine, Eupatorine and Caffeic Acid Derivatives: Rosmarinic Acid, Cichoric Acid
32.	<i>Paederia scandens</i> (Lour.) Merrill ^[63, 64, 65, 66]	Rubiaceae	Asperuloside, Daphylloside, Scandoside Methyl Ester, Loganin, Deacetyl Asperulosidic Acid Methyl Ester, Geniposide And Geniposidic Acid

33.	<i>Palhinhaea cernua</i> (L.) Vasc. & Franco ^[67]	Lycopodiaceae	P-Coumaroylated Glycosides	Apigenin
34.	<i>Phellodendron amurense</i> Rupr. ^[68]	Rutaceae	Berberine	
35.	<i>Phyllanthus niruri</i> L. ^[69, 70]	Euphorbiaceae	Phyllanthin, hypophyllanthin and phylltetralin	
36.	<i>Piper betle</i> L. ^[71]	Piperaceae	Hydroxychavicol	
37.	<i>Pistacia integerrima</i> Stew. ex Brand ^[72]	Anacardiaceae	Ethyl acetate extract	
38.	<i>Proustia pyrifolia</i> DC ^[73]	Asteraceae	Arachidonic acid and phorbol 12-myristate 13-acetate	
39.	<i>Prunus avium</i> L. ^[74]	Rosaceae	Dehydroascorbic Acid	
40.	<i>Prunus avium</i> L. ^[75]	Rosaceae	Cyanogenic glycosides I	
41.	<i>Prunus mume</i> ^[76]	Rosaceae	Methanolextract	
42.	<i>Radix salviae</i> ^[77]	Lamiaceae	Extract	
43.	<i>Ramulus Mori</i> ^[78]	Moraceae	ethanol extract	
44.	<i>Rhus coriaria</i> L. ^[79]	Anacardiaceae	Methanolic extract	
45.	<i>Rubia lanceolata</i> Hayata ^[48]	Rubiaceae	Methanol Extract	
46.	<i>Salvia miltiorrhiza</i> Bunge ^[80]	Lamiaceae	Magnesium lithospermate	
47.	<i>Saraca ashoka</i> Roxb. ^[81]	Fabaceae	ethyl acetate fraction	
48.	<i>Scrophularia ningpoensis</i> Hemsl. ^[82]	Scrophulariaceae	Phenylpropanoid glycosides acteoside	
49.	<i>Semecarpus anacardium</i> L. ^[83]	Anacardiaceae	Tetra hydro amentoflavone (THA)	
50.	<i>Smilax china</i> L. ^[84]	Liliaceae	Caffeic acid, resveratrol, rutin and oxyresveratrol	
51.	<i>Smilax glabra</i> Roxb. ^[85]	Liliaceae	Palmitic acid, astilbin glucuronide, caffeic acid sulfate, glucuronide, resveratrol	

			glucuronide
52.	<i>Smilax riparia</i> ^[86, 87, 88]	Liliaceae	Smilaxchinoside A and Smilaxchinoside C Riparoside B and timosaponin J
53.	<i>Terminalia macroptera</i> Guill et Perr ^[89]	Combretaceae	cis-polyisoprene, chebulic acid trimethyl ester), methyl gallate, shikimic acid, corilagin, rutin, narcissin, chebulagic acid and chebulinic acid

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Maurya et al *Int J Ayu Pharm Chem Vol. 1, Issue 2, 2014*



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