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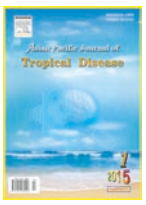

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Medicinal plants with potential antipyretic activity: A review

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ABSTRACT

Medicinal plants are the part and parcel of human society to combat against different diseases from the dawn of human civilization. According to World Health Organization, approximately 80% population of the developing countries are facing difficulties to afford synthetic drugs and are relying on traditional medicines mainly of plant origin in order to maintain their primary health care needs. Plants are being used in various disorders *e.g.*, gastrointestinal disorders, genitourinary problems, hepatobilliary discomforts and psychological and respiratory problems through time immemorial and people in western countries are now reverting back towards herbal medicines because of their extensive biological and medicinal activities, higher safety and lesser costs. Many plants are being traditionally used in the treatment of fever and their antipyretic activities have been confirmed scientifically. The current review clearly demonstrates the importance of medicinal plants in the treatment of fever. Furthermore, this review can help the scientists and researchers to find some new antipyretic agents from traditional medicinal plants.

1. Introduction

Mankind has used medicinal plants in order to cure diseases and relieve physical suffering from the earliest times. According to World Health Organization, about 80% population of the developing countries relies on traditional medicines, mostly plant originated drugs[1]. Medicinal plants are the source of primary health care throughout the world for thousands of years. However in the middle of 20th century, the use of medicinal plants was reduced one fourth because researchers favor the use of synthetic chemicals for curing diseases. But, now the trend is changing and people favor the medicinal plants as they contain natural products which are effective, chemically balanced and have fewer side effects as compared to synthetic chemicals[2].

Pyrexia or fever is the increase in body temperature above normal physiological range, which may results due to physiological stress such as during ovulation, increased thyroid secretion, excessive exercise, any lesions to central nervous system, due to leukemia and mostly in microbial infections. Natural defence system of the human body is activated whenever body finds any infectious agent in order to create an unfavourable environment for the survival of infectious agent. The infectious agent or damaged tissues initiate the increase production of pro-inflammatory mediators cytokines such as interleukin 1β, β, α and TNF-α which enhance the formation of prostaglandin E2 (PGE2) near the peptic hypothalamus area and the prostaglandin in turn act on the hypothalamus to elevate the body temperature (Figure 1). As the temperature of the body is controlled by nervous feedback mechanism so whenever body temperature will be high, blood vessels will be dilated and sweating will be increased to reduce the high temperature. But when the body temperature will be low then vasoconstriction occurs to protect the internal body temperature. Increase temperature as in case of fever leads to faster disease progression due to increased tissue catabolism, dehydration and persisting complaints as in case of HIV infection and other chronic infections[3,4].

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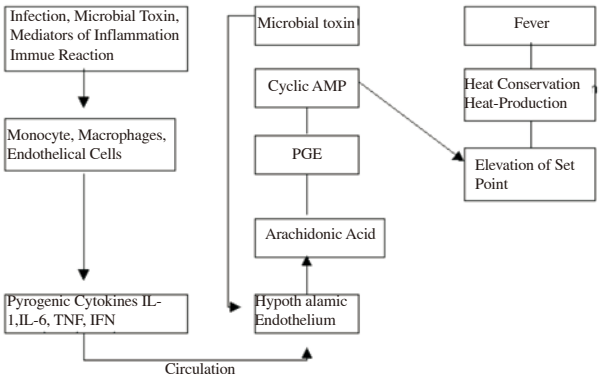

Figure 1. Pathogenesis of fever.

The elevated body temperature is reduced by antipyretic drugs which inhibit COX-2 expression thereby inhibiting prostaglandin synthesis. However these synthetic antipyretic agents inhibit the COX-2 with high selectivity but they have toxic effects on other organs like glomeruli, cortex of the brain, hepatic cells and heart muscles, whereas natural COX-2 inhibitors have lower selectivity with fewer side effects[5].

Plants are used as a source of antipyretic agents from a prolonged period of time for the treatment of fever. Therefore it is the need of time to search the herbal materials that have potential antipyretic activity with less toxicity, free from side effects and would act as substitutes of synthetic drugs *e.g.*, paracetamol[1,6]. It is assumed that the medicinal plants presented in this review will be useful for researchers and practitioners to find potential antipyretic natural agents.

2. Methodology

In the current review, we conducted a literature search using Elsevier, ScienceDirect, SpringerLink (Springer), PubMed and Google Scholar. The search included the keywords “plants”, “medicinal plants”, “plant extracts”, cross-referenced with the keywords “pyrexia” “antipyretic activity”. The references found in the search were later conferring with details on the models or bio-assays used for examining the plant extracts against pyrexia. Interest has been focused on experimental studies performed on antipyretic plants in this review. Studies with no experimental procedures, such as casual surveys or folk medicine are not reported. Moreover, studies based on preparations of mixtures of plants with unknown origin were not considered in this review.

3. Scientific evidences of medicinal plants possessing antipyretic activity

3.1. Melia azedarach (M. azedarach)

M. azedarach belongs to family Maliaceae and commonly known as Bakyain, is a large ever green tree distributed all over the world, especially in tropics because of its climatic tolerance. It is used widely against intestinal worms, in skin diseases, stomach discomfort, nausea/vomiting paroxysmal fever, sciatica, lumbago, piles, asthma, wounds, diabetes, post labor pain in uterus, amenorrhea and in leucoderma. Leaves of *M. azedarach* possess anthelmintic, diuretic, deobsturent and resolvent properties. Several chemical constituents have been detected from *M. azedarach* leaves which include kampherol, quercetin, stigmasterol, β-sitosterol, campesterol, phytol, beta-carotene, tocopherol and squalene, 1-eicosanol. The antipyretic effect of hydro-methanol extract of *M. azedarach* leaves (250 & 500 mg/kg, *p.o.*) was examined using yeast induced pyrexia method in rabbits. The study showed that hydro-methanol extract of *M. azedarach* leaves significantly ($P < 0.000\,1$) reduced the elevated body temperature in a dose dependent manner. The antipyretic effect of the extract at a dose of 500 mg/kg was similar to that of standard drug paracetamol. Therefore, it was concluded in this study that *M. azedarach* leaves at a dose of 500 mg/kg possess antipyretic activity supporting the folklore use of the plant in the management of fever[7].

3.2. Prosopis cineraria (P. cineraria)

P. cineraria (Leguminosae) commonly known as Kherji, Jandi or Ghaf distributed in various Middle East countries. Whole plant of *P. cineraria* is useful for the treatment of many diseases *e.g.*, skin diseases, piles, worms, coughs, vertigo dyspnoea and rheumatism. Flowers of plant are used in skin diseases and to prevent boils. Phytochemical evaluation of plant reveals that it contains heptacosanoate, β-sitosterol, ursolic acid, gallic acid, luteolin and β-sitosterol, 3-O-β-D-glucopyranoside, patulitrin (a glucoside of petuletin), sitosterol (steroid), spicigerine (alkaloid), prosogerine A & B, prosogerin C, and prosogerin E (flavones). Antipyretic activity of ethanolic extract of leaves and fruits of the *P. cineraria* was evaluated against brewer’s-yeast induced pyrexia in albino rats. Leaves and fruit extracts of *P. cineraria* reduced the temperature of rats to a significant level comparable to the standard control. The leaves extract showed significant effects in temperature reduction than fruits extract at 200 mg/kg while at dose of 300 mg/kg of both leaves and fruit extracts reduce pyrexia significantly[8].

3.3. Piper nigrum (P. nigrum)

P. nigrum L. belongs to family Piperaceae is commonly known as spices of king. It grows in tropical and subtropical rain forest regions. *P. nigrum* is a perennial plant with areal roots at the stem nodes, have shiny leaves. Phytochemical studies reveal the presence of various compounds, *viz.*, phenolics, lignans, terpenes, chalcones, flavonoids, alkaloids and steroids. The plant is used in many Asian countries for the treatment of colic, rheumatism, headache, diarrhea, dysentery, cholera, menstrual pains and diuretic. *P. nigrum* is traditionally used as a home remedy to reduce fever. Its antipyretic activity in alcoholic extract in Wistar albino rats was evaluated. Pyrexia was induced in rats by injecting 15% (w/v) Brewer’s yeast suspension. *P. nigrum* at doses of 250 and 500 mg/kg significantly reduced the body temperature and was comparable with standard [9].

3.4. Plumeria rubra (P. rubra)

P. rubra L. (Hindi name: "Lal champa", English: true frangipani) of Apocynaceae family, widely cultivated in the tropical and subtropical regions throughout the world. Antipyretic activity of ethanol extract of the leaf of *P. rubra* was investigated. Pyrexia was induced by intraperitoneal administration of boiled milk at a dose of 0.5 mL/kg body weight in Albino rabbits. It was concluded that ethanol extract of the leaf of *P. rubra* at a dose of 200 mg/kg body weight significantly reduce the elevated body temperature of rabbits which was compared with aspirin (standard drug)[10].

3.5. Cadaba trifoliata (C. trifoliata)

*C. trifoliat*a (Roxb.) Wt.& Arn. of Capparaceae family is a shrub growing up to 3 m tall. The plant is used traditionally for the treatment of syphilis, sores and as an antiphlogistic, deobstruent, emmenagogue, anthelmintic, *etc*. Leaves of *C. trifoliat*a reported to possess antimicrobial activity. Phytochemical constituent cadabalone and cadabicine were isolated from the leaf part of the plant. The antipyretic potential of aqueous and ethanol extracts of *C. trifoliat*a on normal body temperature and yeast induced pyrexia in Wistar rats was evaluated. The aqueous and ethanol extracts showed significant reduction in normal body temperature and yeast induced pyrexia at 500 mg/kg body weights when compared to the standard antipyretic drug paracetamol (45 mg/kg, *p.o.*). The study therefore showed that *C. trifolia* possesses antipyretic potential[11].

3.6. Acacia leucophloea (A. leucophloea)

A. leucophloea Roxb. belongs to Fabaceae family. Traditionally, the bark is used in fever, cough, vomiting, wounds, ulcers, dirrhoea, bronchitis and stomatitis. Phytochemical screening and antipyretic activity of methanol extract of *A. leucophloea* was evaluated. *In vivo* evaluation of antipyretic activity of methanol extract by using yeast induced pyrexia method showed that different doses of bark cause lowering of body temperature up to 2 h of the administration of extract. The temperature was markedly elevated to 38.24 ˚C after the subcutaneous injection of yeast suspension, decreased to 37.97 ˚C within 30 min of the administration of bark extract. The study showed that extract exhibited significant antipyretic activity against the yeast induced pyrexia model[12].

3.7. Zizyphus jujuba (Z. jujuba)

Z. jujuba Lam. is also called as Badar, Baer, Bogari or Barihannu belonging to the family Rhamnaceae, is a small sub deciduous tree distributed throughout India, Iran, Afghanistan and in China. *Z. jujuba* possesses antioxidant and antilisterial effect, antisteroidogenic activity, antiobesity activity, sedative and hypnotic, anxiolytic and anticancer potential. The plant contains phytochemical like alkaloids jubanine-E, three flavones, C-glucosides-6"sinapoylspinosin, 6"-feruloylspinisin and 6-"p-coumaroylspinosin. The leaves and stems of *Z. jujuba* contains saponins 3-o-[2-α-Lfucopyrnosyl-3-o-β-D-glucopyranosyl-α-L-arabinopyranosyl] jujubogenin. The fruits of *Z. jujuba* contains zizyphus saponins I, II, III and jujuboside B, jujuboside D, and jujuboside. The bark of *Z. jujuba* contains 7% tannin. The antipyretic activity of *Z. jujuba* was evaluated against Brewer's yeast induced pyrexia in rats with respect to control group. The antipyretic effect of the extract was comparable to the standard prototype, paracetamol[13].

3.8. Marsilea trifolia (M. trifolia)

M. trifolia Blanco, commonly known as "Aamrul" is traditionally used for the treatment of fever and gastro-intestinal disturbance. Evaluation of analgesic and antipyretic activities of *M. trifolia* Blanco were revealed in a study and was concluded that fresh leaf aqueous extract of *M. trifolia* Blanco exhibited marked analgesic effect by reduction of writhing inducted by acetic acid at a dose of 100, 200 and 300 mg/kg in mice. Similarly the extract produced significant inhibition $P < 0.01$ in yeast induced pyrexia in rats. It was confirmed by the study for traditional use of *M. trifolia* as a remedy for fever[14].

3.9. Tectona grandis (T. grandis)

T. grandis Linn. (Verbenaceae) commonly known as Sagwan in Hindi is a large deciduous tree. Traditionally used in the treatment of urea and urine retention. Lapachol is the main chemical constituent of this plant. Antipyretic effect of methanol extract of root of *T. grandis* was tested on yeast induced pyrexia in Wistar rats. The extract at a dose of 250 and 500 mg/kg body weight were used. It was concluded that both doses showed significant reduction in body temperature when compared to standard (Paracetamol 100mg/kg) [15].

3.10. Crataeva magna (C. magna)

C. magna (Lour.) DC. (Capparaceae) is a medium sized deciduous tree of tropical climate found in tropical regions of the world. *C. magna* is a potent medicinal plant and traditionally used for inflammation, fever, arthritis, bronchitis, urinary calculi and cough. Various parts of this plant, including the root, stem, flower and leaves are recommended for the treatment of fever. In India, the root juice is given for the relief of fever. It is also useful in urinary tract infections, pain, intermittent fever, asthma, bronchitis, renal and vesicle calculi. Bark possess triterpenoids (α and β-amyrin, ceryl alcohol, lupeol, friedelin, betulinic acid, 4-taraxasterol, lupenone), flavonoids (rutin, catechin, quercetin) and alkaloids (cadabicine). The alcohol extract derived from the aerial part of *C. magna* was evaluated for its antipyretic activity in experimental animals by TAB (Typhoid) vaccine-induced pyrexia in rabbits. In TAB vaccine-induced fever, the fever was significantly reduced and the body temperature was normalized by administration of 200 and 400 mg/kg dose orally and the effect was comparable to the reference drug. This study thus, justifies the anecdotal, folkloric and ethno-medicinal uses of this plant for fever[16].

3.11. Tecomaria capensis (T. capensis)

T. capensis (Family: Bignoniaceae) also known as Cape-honeysuckle is an evergreen plant of warm climate areas. Dried powdered bark infusions are taken to induce sleep. Methanol extract of the leaves of *T. capensis* was evaluated for antipyretic activity at a dose of (100, 200 and 500 mg/kg *p.o.*) using cow milk induced pyrexia model in rats. The extract exhibited marked antipyretic effect at a dose of 500 mg/kg when compared to standard aspirin[17].

3.12. Capparis zeylanica (C. zeylanica)

C. zeylanica Linn. (Capparaceae) is a climbing shrub grows in moist places and distributed in some part of Pakistan. Traditionally the plant is used as an antidote to snake bite, pneumonia and pleurisy. Whole plant contains phytoconstituents such as saponin, p-hydroxybenzoic, syringic, vanillic, ferulic and p-coumanic acid. In leaves & seeds β-carotene, thioglycoside, glycocapparin, n-tricortane, α-amyrin & fixed oil were present. Root bark contains alkaloid, phytosterol, a water soluble acid and a mucilaginous substance. Antipyretic effect of methanol extract of *C. zeylanica* at a dose of 100 mg/kg and 200 mg/kg was evaluated in Wister strain albino rats. Pyrexia was induced by Brewer's yeast. It was shown by the result that *C. zeylanica* extract possess a significant dose dependent antipyretic effect in yeast induced elevation of body temperature in experimental rats when compared with standard drug[18].

3.13. Chenopodium ambosioides (C. ambosioides)

C. ambosioides L. (Chenopodiaceae) traditionally used for the treatment of fever, gastrointestinal infections and typhoid fever. *C. ambosioides* known to contains alkaloids, saponins, monoterpenes and flavonol glycosides. The antipyretic and analgesic effects of aqueous extract of *C. ambrosioides* were evaluated. The extract produce the marked analgesic effect by reduction of writhing induced by acetic acid at dose of 100, 200 and 300 mg/kg, *p.o*) in mice. Moreover the extract exhibited significant inhibition ($P < 0.01$) in yeast induced pyrexia in rats. The study confirms the antipyretic activity of *C. ambrosioides*[19].

3.14. Benincasa hispida (B. hispida)

B. hispida (Thunb). (Cucurbitaceae) is employed traditionally to treat disorders such as dry cough, fever, biliousness, thirst. The ethanol extract of seeds of *B. hispida* was evaluated for its acute toxicity, antinociceptive and anti-pyretic effects. The extract at a dose of 250 and 500 mg/kg body weight significantly ($P < 0.05$) increased the antinociceptive effect in a dose dependent manner in rats. Similarly, the extract significantly ($P < 0.05$) decreased yeast induced pyrexia in rats at a doses of 250 and 500 mg/kg body weight. It was shown by the results that ethanol extract of *B. hispida* seeds possesses the potent antinociceptive and antipyretic effects and thus justifying its folkloric use in a management of fever and pain conditions[20].

3.15. Taxus wallichiana (T. wallichiana)

T. wallichiana Zucc. (Taxaceae) is a small to medium sized evergreen tree, growing 10–20 m tall, exceptionally up to 28 m. It is often used in the northern area of Pakistan for the treatment of pyrexia, acute pain and epilepsy. It is well known to have famous anticancer agents with emphasis on taxol and docetaxel. Several pharmacological studies revealed the isolation of variety of taxoids shown to possess immunomodulatory, histamine release inhibitory activity, DPPH radical scavenging and nitric oxide (NO) inhibitory activities The pharmacological activities of the methanol leaf extract of *T. wallichiana* against convulsion, nociception and pyrexia were investigated in rodents. The activities were evaluated using acetic acid-induced nociception and pentylenetetrazole convulsions in mice, while formalin test and yeast induced pyrexia in rats. The result showed significant analgesic effect in acetic induced model at a dose of 100 and 200 mg/kg. In case of yeast induced pyrexia model, very significant ($P < 0.01$) result seen at a dose of 200 mg/kg, while significant result ($P < 0.05$) at a dose of 50 and 100 mg/kg[21].

3.16. Cleome rutidosperma (C. rutidosperma)

C. rutidosperma is a low growing herb found in waste grounds and grassy places. The plant is native to West Africa. The analgesic, anti- inflammatory and antipyretic activities of the ethanol extract of the aerial part of the *C. rutidosperma* at a dose of 200 and 400 mg/kg. The result showed that oral administration of the extract produce significant analgesic activity in acetic acid induced writhing and tail immersion tests, anti-inflammatory effect against carrageenin induced inflammation and adjuvant induced polyarthritis and antipyretic activity against yeast-induced pyrexia[22].

3.17. Zizyphus oxyphylla (Z. oxyphylla)

Z. oxyphylla Edgew. is a small medium sized tree from Rhamnaceae, distributed in the warm temperate and subtropical regions throughout the world. Antipyretic, analgesic activity of the methanol extract of leaves of *Z. oxyphylla* in adult Wister and Swiss albino mice were evaluated. The extract demonstrated that the methanol extract of *Z. oxyphylla* leaves possesses potent antipyretic and antinociceptive activities and thus validates its use in the treatment of pain and fever[23].

3.18. Phrygilanthus acutifolius

The anti-inflammatory, anti-nociceptive and antipyretic effects of aqueous and ethanol extracts of *Phrygilanthus acutifolius* flowers in several experimental standard models in rats were investigated. The result showed that the extract significantly reduced fever at dose greater than 200 mg/kg within 2 h yeast induced hyperthermia in rats[24].

3.19. Caesalpinia bonducella (C. bonducella)

C. bonducella, a plant from Caesalpiniaceae family, is a climbing shrub grown throughout hotter parts of India, Burma and Ceylon (Sri Lanka) particularly along the sea coast. Its seeds are known as fever nut, bonduc nut and physic nut find multiple uses in folk medicine. Phytochemical study of the seeds divulged the presence of flavonoids, terpenoids, glycosides, saponins, tannins and alkaloids. The antipyretic and antinociceptive activity of the 70% ethanol extract of *C. bonducella* seed kernel in Albino rats or mice using brewer's yeast induced pyrexia, hot plate and tail flick method respectively were evaluated. The study showed that ethanol extract of *C. bonducella* possesses potent antipyretic and antinociceptive activities[25].

3.20. Calotropis gigantean (C. gigantean)

C. gigantean Linn. (Asclepiadaeceae) founds in dry waste places. Its roots are used for the treatment of intermittent fever, painful joints, piles, leprosy, scabies and eczema. Antipyretic activity of ethanol extract of the root of *C. gigantea* using yeast-induced and TAB Typhoid vaccine-induced pyrexia in rabbits and rats was investigated. The statistical analysis of the result showed that the extract of *C. gigantean* has potential antipyretic activity[26].

3.21. Clitoria terantea (C. terantea)

C. terantea L. (Family: Fabaceae) is a perennial, twining herb, found abundantly in Indochina, Philippines and Madagascar. The plant is used for the treatment of hectic fever, asthma and bronchitis. The methanol extract of *C. ternatea* root were evaluated for its anti-pyretic potential on normal body temperature and yeast induced pyrexia in albino rats. At doses of 200, 300 and 400 mg/kg body weight extract produced significant reduction in normal body temperature and yeast-provoked elevated temperature in a dose dependent manner. The extract showed comparable antipyretic effect to that of standard paracetamol[27].

3.22. Ocimum suave and Ocimum lamiifolium

Evaluation of the antipyretic properties of the aqueous and ethanol extracts of the leaves of *Ocimum suave* and *Ocimum lamiifolium* in mice were carried out. It was shown by the result that all the extract possesses antipyretic activity with reasonable onset and duration of action[28].

3.23. Vernonia cinerea (V. cinerea)

V. cinerea (Family: Compositae) is a common weed grows in the rainy season. In traditional system of medicine its flowers are used as a decoction to promote perspiration in febrile affection. Evaluation of antipyretic potential on normal body temperature and yeast induced pyrexia of methanol extract of whole plant of *V. cinerea* in rats was carried out in a study. The extract significantly reduced the normal body temperature at a dose of 250 and 500 mg/kg body weight and also showed the antipyretic activity in a dose dependent manner in animal's model. The extract at a dose of 500 mg/kg gave antipyretic effect similar to that of standard[29].

3.24. Tabernaemontana pandacaqui (T. pandacaqui)

T. pandacaqui Poir. known as "Phut" in Thialand from Apocynaceae family used in folklore medicine for the treatment of pain and inflammation and a rich source of indol alkaloids. The alcoholic extract of stems of *T. pandacaqui* on carrageenin-induced rat paw edema, yeast- induced hyperthermia in rat and writhing response induced by acetic acid in mice were evaluated. The result showed that the alcoholic extract of stems of *T. pandacaqui* possess significant anti-inflammatory, antipyretic and antinociceptive activities[30].

3.25. Leucas lavandulaefolia

The antipyretic potential of methanol extract of *Leucas lavandulaefolia* using yeast induced pyrexia methods in rats was determined. It was shown by the result that the extract at doses of 100, 200, 400 mg/kg produced significant dose dependent lowering of body temperature in yeast-provoked elevation of body temperature in rats[31].

3.26. Trigonella foenum-graecum (T. foenum-graecum)

T. foenum-graecum (Fenugreek), from Fabaceae family is widely cultivated in most Regions of the world and possesses several pharmacological effects. Phytochemical studies revealed that plant contain alkaloids, flavonoids, salicylates, and nicotinic acid. There are several reports concerning the antipyretic, anti-inflammatory and antinociceptives activities in Iranian traditional medicine. Its anti-inflammatory and antipyretic effects of the aqueous extract of the leaves of *T. foenum-graecum* have been confirmed on scientific basis[32].

3.27. Dodonaea angustifolia (D. angustifolia)/Salvia africana-lutea (S. africana-lutea)

The Western Cape Province in South Africa is endowed with several plant species which are used for the treatment of different ailments because of their medicinal properties. These include *D. angustifolia* and *S. africana-lutea*. These plants are extensively distributed and found in the wild and nature reserves. *D. angustifolia* belongs to the family, Compositae, and known locally in Afrikaans as "ysterhout". The leaves, bark and roots of the plant are used to treat diarrhea, croup, fever and painful conditions by traditional practitioners of medicines. *S. africana-lutea* belongs to the family, Labiatae. An infusion of the plant had been used for cold and is said to be diaphoretic. The analgesic and antipyretic activities of water extract of *D. angustifolia* and *S. africana-lutea* using acetic acid and writhing and hot plate tests, and lipopolysaccharide induced pyrexia

test in mice and rats, respectively were evaluated. Both significantly reduced the fever and also significantly inhibited the acetic acid writhing[33].

3.28. Alstonia boonei (A. boonei)

A. boonei De wild (Apocynaceae) is a common plant used in malaria and listed in African Pharmacopeia as an anti-malarial drug. An infusion of the bark is used as anti-venom for snake bites, and in the treatment of arrow poisoning. The stem bark is also used as a febrifuge for relapsing fevers. The leaves and latex of plant are used topically to reduce swellings for the treatment of rheumatic pains, muscular pains and hypertension. The antipyretic activity, anti-inflammatory and analgesic activity of the methanol extract of the stem bark of *A. boonei* were evaluated. The extract exhibited the significant inhibition of the carrageenan-induced paw edema, cotton pellet granuloma, and anti-arthritic activity in rats. It also produced analgesic activity by reduction of writhing induced by acetic acid, as well as the early and late phases of paw licking in mice. However a significant reduction in hyperpyrexia in mice was also produced by the extract. The study therefore showed that the extract of the stem bark of *A. boonei* possess analgesic, anti inflammatory and antipyretic activities[34].

3.29. Clerodendron serratum (C. serratum)

C. serratum (Linn.) Moon (Verbenaceae), Known as Bharangi in Ayuverda system of medicine. It was evaluated by that the ethanol extract of *C. serratum* at a dose of (50, 100 and 200 mg/kg. *p.o*) roots produced a significant anti-nociceptive, anti inflammatory and antipyretic activities in animals models[35].

3.30. Mangifera indica (M. indica)

M. indica belongs to family Anacardiaceae used for the treatment of pain and fever associated with various diseases. The antipyretic and antiplasmodial activities of *M. indica* stem extract in mice were evaluated. It was concluded by the result that the extract reduced the fever in yeast induced pyrexia and also possesses a schizontocidal effect during early infection showing repository activity of the plant[36].

3.31. Teclea nobilis (T. nobilis)

T. nobilis Delile locally known as “Al-dhureim” used in African traditional medicine for the treatment of gonorrhea and also as an antipyretic and analgesic. Nicola *et al.* determined the antipyretic and analgesic properties from the ethyl acetate fraction from the residue of the 85% ethanol extract of *T. nobilis*. The result showed that ethyl acetate fraction exhibited a significant antipyretic effect in hyperthermic rats and rabbits[37].

3.32. Nelumbo nucifera (N. nucifera)

N. nucifera Gaertn (Nymphaeaceae) commonly known as kamala is the national flower of India. Antipyretic activity of rhizome extract of *N. nucifera* at doses of 200, 300, and 400 mg/kg body weight were studied on normal body temperature and yeast induced pyrexia in rats. It was observed that methanol extract of *N. nucifera* produced significant dose dependent lowering of body temperature and yeast induced elevation of body temperature in rats. The result was compared with standard antipyretic drug paracetamol (150 mg/kg, *i.p.*)[38].

3.33. Litchi chinensis

Pharmacological studies were conducted on the petroleum ether extract of leaves of the *Litchi chinensis* in experimental animals. The extract possesses antipyretic, anti-inflammatory and analgesic activities and study revealed that extract was non toxic up to the dose of 1 mg/kg (*i.p.*)[39].

3.34. Andrographis paniculata

Antipyretic, analgesic and antiulcerogenic effect of Andrographolide from *Andrographis paniculata* was determined. Significant ($P < 0.05$) antipyretic effects produced at a dose of 30, 100, 300 mg/kg but did not showed analgesic activity at this dose. Andrographolide showed marked anti-ulcerogenic activity at a dose of 100 and 300 mg/kg[40].

Plants are the largest reservoir of secondary metabolites which contribute in the management of different diseases from very earliest times. This review has shown that many plants like *M. azedarach, C. bonducella, T. wallichiana, etc*. which were used traditionally in different ailments also possess potential antipyretic effects. Many phytochemicals such as alkaloids, flavanoids, tannins and saponins in the plants materials are responsible for their antipyretic activity. Active compounds present in the diverse group of plants are still to be explored scientifically. So, to evaluate the potential antipyretic agent present in medicinal plants with proper methodology is in demand. This proper exploration would develop in introducing a site specific and safe antipyretic drug with potential therapeutic properties and act as a substitute of available synthetic antipyretic agent.

Conflict of interest statement

We declare that we have no conflict of interest.

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