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1 MINI REVIEW

2 Medicinal Uses and Pharmacological Actions of Five 3 Commonly Used Indian Medicinal Plants: A Mini- 4 Review

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9 ABSTRACT

10 Man depends heavily on various plant species for his survival. Indian traditional system of medicine is
11 based on empirical knowledge of the observations and the experience over millennia and more than 5000
12 plants are used by different ethnic communities in India. During the last few decades there has been an
13 increasing interest in the study of medicinal plants and their traditional use in different parts of India. The
14 present communication constitutes a review on the medicinal properties, ethnomedicinal uses and phar-
15 macological activities of five common medicinal plants (*Acalypha indica* L., *Achyranthes aspera* L., *Adha-
16 toda vasica* Medicus, *Coriandrum sativum* and *Centella asiatica*) used in Indian traditional medicine.
17 These plants are known to contain various active principles of therapeutic value and to possess biological
18 activity against a number of diseases.

19 **Keywords:** *India, Medicinal plants, Pharmacology, Phytochemistry, Traditional medicine*

20 Many of today's synthetic drugs originated from the 45 tions, warnings, precautions, potential adverse reactions,
21 plant kingdom, and only about 200 years ago our phar- 46 and posology, etc.
22 macopoeia was dominated by herbal medicines [1]. The 47 The Indian flora is extensively utilized as source of
23 largest research fields, as defined by the number of pub- 48 many drugs mentioned in the traditional systems of
24 lications describing bioactive plant-derived compounds 49 medicine. During the last few decades there has been an
25 in the last few years, are anti-tumour drugs, antibiotics, 50 increasing interest in the study of medicinal plants and
26 drugs active against tropical diseases, contraceptive 51 their traditional use in different parts of India. Indian
27 drugs, anti-inflammatory drugs, immunomodulators, 52 medicinal plants are widely used by all sections of the
28 kidney protectors and drugs for psychiatric use [2]. 53 population and it has been estimated that over 7500 spe-
29 Herbal drugs are being proved as effective as synthetic 54 cies of plants are used by several ethnic communities.
30 drugs with lesser side effects [3]. Current estimates sug- 55 India possesses more than 500 tribal communities and
31 gest that, in many developing countries, a large propor- 56 even today, tribals and certain local communities in
32 tion of the population relies heavily on traditional prac- 57 India practice herbal medicine to cure a variety of dis-
33 titioners and medicinal plants to meet primary health 58 eases and disorders [5]. During the last few decades
34 care needs. Although modern medicine may be avail- 59 there has been an increasing interest in the study of me-
35 able in these countries, herbal medicines have often 60 dicinal plants and their traditional use in different parts
36 maintained popularity for historical and cultural reasons 61 of India. There are many reports on the use of plants in
37 [4]. WHO encourages countries to provide safe and ef- 62 traditional healing by either tribal people or indigenous
38 fective traditional remedies and practices in public and 63 communities of India.
39 private health services and it also published two mono- 64 The focus of this review is to provide informations
40 graphs on medicinal plants with information on phar- 65 on the medicinal properties, ethnomedicinal uses and
41 macopoeial summaries for quality assurance: botanical 66 pharmacological activities of five medicinal plants
42 features, distribution, identity tests, purity requirements, 67 (*Acalypha indica*, *Achyranthes aspera*, *Adhatoda va-
43 chemical assays, and active or major chemical constitu- 68 sica*, *Coriandrum sativum* and *Centella asiatica*) com-
44 ents, clinical applications, pharmacology, contraindica- 69 monly used in Indian traditional medicine. These plants
70 are known to contain various active principles of thera-

peutic value and to possess biological activity against a number of diseases. No comprehensive account on these plants is available as a review except for *Adhatoda vasica* [6]. NCBI (Pubmed) and Medbioworld databases were used for the collection of pharmacological activities. As well as, ethnomedicinal information was extracted from the book on Dictionary of Indian Folk Medicine and Ethnobotany [7] and some related publications which are published on the ethnobotanical aspects. The medicinal properties and plant characteristics were collected from the published books on Indian Medicinal Plants and Indian Materia Medica.

ACHYRANTHES ASPERA L. (*Prickly Chaff-Flower*, *Amaranthaceae*)

An erect and much branched diffuse herb found throughout India along roadsides and waste places. The plant is acrid, bitter, thermogenic, expectorant, revulsive, carminative, digestive, stomachic, laxative, anodyne, depurative, anthelmintic, diuretic, linthotropic, sudorific, demulcent, haematinic and anti-inflammatory [7,8]. The plant is an indigenous medicinal plant of Asia, South America, and Africa and is commonly used by traditional healers for the treatment of fever, especially malarial fever, dysentery, hypertension, diabetes [9] and asthma [10]. The ash of the plant yields a large quantity of potash and it is used in asthma and cough. The whole plant is reported to be useful in indigenous system of medicine for the treatment of renal dropsy, bronchial affections and leprosy [7].

The leaves have been used for centuries in ethnomedicine for varied medicinal purposes [11]. Since time immemorial, it is in use as folk medicine. It holds a reputed position as medicinal herb in different systems of medicine in India. For example the various ethnic communities in India used the different parts of this plant to treat cold, cough, dysentery, eye complaints, headache, liver complaints, piles, rheumatism, scabies, burns, skin diseases, poison bites, toothache, stomachache spleen enlargement, pneumonia and kidney troubles [7,8,12-14].

Pharmacological activities of Achyranthes aspera

Chakraborty et al [9] have assessed the leaves for chemopreventive activity and suggested that, the leaf extract and the non-alkaloid fraction were valuable anti-tumor promoters in carcinogenesis. Gokhale et al [15] reported that the ethanolic extracts of the plant possessed anti-inflammatory and anti-arthritic properties and supported the rationale behind the use in treating inflammatory conditions as claimed in the traditional Indian system of medicine. The anti-inflammatory activity of an alcohol extract of the plant was further evaluated by Vetrichelvan and Jegadeesan [16] on carrageenin-induced hind paw oedema and cotton pellet granuloma models in albino male rats. The aqueous and methanolic extracts of the whole plant showed significant dose-related hypoglycaemic effect in normal as well as diabetic rabbits [17].

The composite extract of root of this plant possessed an immobilizing factor that probably reduced motility by causing sperm non-viability by disrupting the membrane architecture of the sperm cell and it proved that the plant possessed potential contraceptive spermicidal activity in vitro [18]. Decoctions of the plant have cardiovascular toxicity [19]; saponin isolated from the plant has cardiac stimulant activity [20] and extract of the whole plant have abortifacient property [21].

The leaves of this plant played a role in changes in serum thyroid hormone concentrations and glucose levels in male rats and they concluded that the leaf extract of this plant can be both prothyroidic and antiperoxidative in nature and may be used for the treatment of hypothyroidic subjects after standardization of the dose [22]. Immunomodulatory activity of the plant on the elicitation of antigenspecific murine antibody response was reported by Vasudeva et al [23]. The methanolic extract of leaves of the plant have anti-fertility activity and increased pituitary and uterine wet weights in ovariectomized rats, which might be exploited to prevent unwanted pregnancy and control the ever-increasing population explosion [24]. Vasudeva and Sharma [25] studied the ethanolic extract of the root for anti-fertility activity in proven fertile female albino rats and showed that, the extract possessed both anti-implantation and abortifacient activity and also exhibited estrogenic activity tested in immature ovariectomized animals.

Ethanolic extract of the plant also reduced sperm counts, weight of epididymis, serum level of testosterone and testicular activity of 3-beta-hydroxysteroid dehydrogenase, while motility of the sperm and activity of the HMG CoA reductase were not affected [26]. The cholesterol level in the testis, incorporation of labelled acetate into cholesterol, 17-ketosteroids in urine and hepatic and fecal bile acids were also increased and the results suggested that the plant caused reproductive toxicity in male rats by suppressing the synthesis of androgen.

ACALYPHA INDICA L. (*Indian Acalypha*, *Euphorbiaceae*)

An erect, annual herb found profusely throughout the plains of India as a weed. The plant is bitter, acrid, expectorant, purgative, emetic, gastrointestinal irritant and diuretic. It has been reported to be useful in treating pneumonia, asthma, rheumatism and the decoction of the leaves is useful in scabies, earache, syphilitic ulcers and snakebites [7,8]. A drug named Anna Pavala Sindhooram (APS), used in Sidha system of Indian medicine for the prevention and reversal of the atherosclerotic disease was prepared in combination of nine plants as ingredients including *Acalypha indica* [27]. Tribal communities in India used various parts of this plant for the treatment of diseases such as asthma, cough, dog bite, rheumatism, earache, scabies, scorpion bites snake bites and sting of centipedes, burns and eczema [7,8,12-14]. In homoeopathy, the plant is used to treat severe cough, haemoptysis and incipient phthisis, gastrointestinal and respiratory problems [28]

187 *Pharmacological activities of Acalypha indica*

188 The ethanol leaf extract was found to significantly
189 reduce the viper venom induced necrotic and haemor-
190 rhagic lesions and this proves that the plant possesses
191 potent snake venom neutralizing properties [29]. 10%
192 w/v of the extract of whole plant shows wound healing
193 activity in rats [30]. Hiremath et al tested the four suc-
194 cessive solvent extracts of the whole plant for post-
195 coital antifertility activity in female albino rats. Among
196 the four extracts tested at two different doses, the petro-
197 leum ether and ethanol extracts of the plant was found
198 to be most effective in causing significant anti-
199 implantation activity and the antifertility activity was
200 reversible on withdrawal of the treatment of the ex-
201 tracts. The leaf extract of the plant showed significant
202 antibacterial activity and highest inhibition zone was
203 observed against *Aeromonas hydrophilla* and *Pseudo-*
204 *monos aeruginosa* [31].

205 *ADHATODA VASICA MEDICUS (Malabar*
206 *Nut/Vasaka, Acanthaceae)*

207 It is a shrub growing throughout India especially in
208 lower Himalayan ranges. The plant is antiperiodic, as-
209 tringent, diuretic and purgative. It is a highly valued
210 Ayurvedic medicinal plant used for the treatment of
211 asthma, cough, bronchitis and tuberculosis [7,8] and the
212 flowers, leaves and root are possessed antispasmodic
213 property. The tubercular activities were reported by re-
214 searchers' quite early [32,33]. It has been used as herbal
215 medicine in treating a wide variety of diseases in India
216 and the leaves of the plant are the main source of drug
217 preparation. For example, the source of the drug 'va-
218 saka', is well known in the indigenous system of medi-
219 cine for its beneficial effects, particularly in bronchitis
220 [34].

221 Traditionally, *A. vasica* has been used for the treat-
222 ment of bronchial disorders such as acute and chronic
223 cough, bronchitis and asthma, and also as an expecto-
224 rant in the treatment of acute and chronic bronchial ca-
225 tarrh and broncho-pulmonary disease. The leaves as
226 well as flowers, fruits and roots are extensively used for
227 treating cold, whooping cough, asthma and as anti-
228 helminthic and the leaf juice is stated to cure diarrhoea,
229 dysentery and glandular tumor. The various parts of the
230 plant is used in Indian traditional medicine for the
231 treatment of asthma, joint pain, lumber pain and sprains,
232 cold, cough, eczema, malaria, rheumatism, swellings,
233 venereal diseases [7,8,12-14]. In homoeopathy, the plant
234 has been used in the treatment of cold, cough, pneumo-
235 nia, spitting of blood, fever, jaundice, catarrh, whooping
236 cough and asthma [28].

237 *Pharmacological activities of Adhatoda vasica*

238 The major data on traditional uses as well as ethno-
239 pharmacological and toxicological studies were re-
240 viewed by Claeson et al [6]. After that some more
241 pharmacological studies have also been carried out in
242 this plant. The leaf showed significant hepatoprotective
243 effect on liver damage induced by D-galactosamine in
244 rats [35]. The plant showed significant antitussive activ-

245 ity in guinea-pig and it may be due to the presence of
246 the specific site of action of vasicinone and vasicinol
247 (major alkaloids) which suppress coughing by its action
248 on the cough center or its neuronal system in the me-
249 dulla [36]. The radiomodulatory influence of ethanolic
250 extract of leaf against radiation-induced hematological
251 alterations in peripheral blood of Swiss albino mice was
252 studied by Kumar et al [34] and they showed significant
253 increase in the serum alkaline phosphatase activity and
254 decrease in acid phosphatase activity.

255 Anti-tubercular activity of the extract of the plant
256 was studied by Barry et al [32] and Gupta and Chopra
257 [33]. Vasicine isolated from this plant showed signifi-
258 cant role in the tuberculosis therapy [37]. Bromhexine
259 and ambroxol are semi-synthetic derivatives of vasicine.
260 The anti-inflammatory activity of the methanol extract
261 of the non-alkaloid fraction, the saponins and the alka-
262 loids was evaluated by the modified hen's egg chorioal-
263 lantoic membrane test and the results showed, potent
264 activity at a dose of 50 microg/pellet equivalent to that
265 of hydrocortisone while the MeOH extract and the other
266 fractions showed less activity [38] and unknown alka-
267 loids isolated from the plant showed pronounced protec-
268 tion against allergen-induced bronchial obstruction in
269 guinea pigs [39].

270 A structural analogue of vasicinone possessed potent
271 anti-allergic activity in mice, rats and guinea pigs [40].
272 Unknown alkaloids from this plant showed pronounced
273 protection against allergen-induced bronchial obstruc-
274 tion in guinea pigs. Chronic toxicity study was carried
275 out in vasicine isolated from this plant in rats and mon-
276 keys [41]. Methanolic extract of the plant showed 60-
277 70% anti-implantation activity in female albino rats
278 [42]. Extract of the plant showed minimum inhibition in
279 the growth of fungi, *Microsporium gypseum*, *Chrysospo-*
280 *rium tropicum* and *Trichophyton terrestre* [43].

281 Leaf of this plant showed 100% abortifacient activ-
282 ity in rats [44]. KanJang- an oral solution with a fixed
283 combination of standardised extracts of *Echinacea pur-*
284 *purea*, *Adhatoda vasica* and *Eleutherococcus senticosus*
285 has been used in the relief of symptoms associated with
286 the common cold (coughing and irritability of the
287 throat) with a well-established medical use comprising
288 over 50 million human daily doses [45]. The major effi-
289 cacy of this solution is mainly due to the presence of *A.*
290 *vasica*. Other constituents of KanJang have been
291 showed to have anti-stress effects, which might be occa-
292 sioned partly by an endocrine and partly by an immu-
293 nomodulatory mechanism of action.

294 *CENTELLA ASIATICA L. (Indian Penny Wort,*
295 *Apiaceae)*

296 A perennial creeping herb found throughout India on
297 moist soil, especially along bunds and canals. The plant
298 is bitter, acrid, sweet, cooling, soporific, cardio tonic,
299 nervic tonic, stomachic, carminative, antileprotic, diu-
300 retic and febrifuge. It is native to countries like Sri
301 Lanka, Madagascar, South Africa and Malaysia. It has
302 been used as a traditional herbal medicine in Asiatic
303 countries for hundreds of years as a tonic in skin dis-
304 eases and leprosy. It is used in the Ayurvedic system of

305 medicine to treat various diseases and it considered to 364 it exhibited an anti-oxidant property in cell line induced
306 be one of rejuvenator drugs and it is said to improve the 365 lymphoma-bearing mice. Effects of the water extract on
307 texture of skin, enhance memory and prolong life. The 366 the formation of azoxymethane (AOM)-induced aber-
308 whole plant has been showed to be beneficial in improv- 367 rant crypt foci (ACF) and intestinal tumorigenesis in
309 ing memory and is reported to improve the general men- 368 male F344 rats were investigated by Bunpo et al [54]
310 tal ability of mentally retarded [46].

311 In India, it is called "Mandukaparani" and used in 369 and they showed the extract has a chemopreventive ef-
312 folk medicine for leprosy, lumps, syphilis, and tubercu- 370 fect on colon tumorigenesis. Abdul Hamid et al [55]
313 losis and to improve mental function. Reports from dif- 371 studied the antioxidative activity of various extracts
314 ferent places have revealed that, this plant has been used 372 from different parts of the plant including leaves, peti-
315 for wound healing, memory improvement, treating men- 373 oles and roots, using three types of solvents (ethanol,
316 tal fatigue, bronchitis, asthma, dysentery, leucorrhoea, 374 water and light petroleum) using a linoleic acid model
317 kidney trouble, urethritis, antiallergic and anticancer 375 system and the thiobarbituric acid test and the study
318 purposes, curing leucorrhea and toxic fever [7, 8]. In 376 showed that ethanol is the best solvent for extracting
319 homoeopathy, the plant is used in ulceration of womb, 377 antioxidative compounds from different parts (roots,
320 eczema, elephantiasis, ascariasis and in granular cer- 378 petioles and leaves) of the plant.
321 viitis [28]. Active constituents of the plant are used as 379 Roots exhibited higher antioxidative activity than ei-
322 components of many drugs and cosmetic preparations 380 ther leaves or petioles with all types of solvent used.
323 worldwide in the field of skin care. In addition, Made- 381 Adriamycin, also known as doxorubicin, a potent anti-
324 cassol and Blastoestimulina are the most known phar- 382 tumor antibiotic used for the treatment of a variety of
325 maceutical products that contain constituents of this 383 soft and solid human malignancies. *C. asiatica* could
326 plant as active ingredients [47].

327 Pharmacological activities of *Centella asiatica*

328 Methanol extracts of Whole plant parts of this plant 387 therapy by acting as a cardio protective agent and thus
329 was studied for immunomodulatory activity and the 388 prevented the extent of cardiac damage [56].
330 results showed that significant increases in the phago- 389 The total phenolic compounds found in the leaf, root
331 cytic index and total WBC count were observed and the 390 and petioles of *C. asiatica* are the major contributions to
332 F ratio of the phagocytic index was also significant and 391 the antioxidant activities [57]. The whole plant extracts
333 the study indicated that the plant has promising immu- 392 of *C. asiatica* was found to reduce gastric lesions in-
334 nomodulatory activity [48]. Cognitive-enhancing effect 393 duced by ethanol in both the ex-vivo and in-vivo mod-
335 has been observed in rats following oral administration 394 els. The accelerated recovery of potential difference
336 of an aqueous extract of *C. asiatica* and this effect was 395 after ethanol incubation in extract treated gastric mu-
337 associated with an antioxidant mechanism in the central 396 cosa with a concomitant reduction in ulcer lesion areas
338 nervous system [49].

339 The plant has also been used to treat rheumatic dis- 397 suggested that *C. asiatica* extract protects the gastric
340 orders, which suggested that it may have anti- 398 mucosa by improving the integrity of the mucosal lining
341 inflammatory effects [50]. Treatments with the extracts 399 and it may due to its strengthening action on gastric
342 of *C. asiatica* during the early postnatal developmental 400 mucosal lining and the suppression of damaging effects
343 stages in mice, when the higher brain centers are matur- 401 of free radicals [58]. Cheng et al [59] studied the heal-
344 ing, can produce long lasting beneficial effects on the 402 ing effects of water extract of the plant and the active
345 mouse brain. Beneficial effects on cognitive functions 403 constituent of *C. asiatica*, asiaticoside on acetic acid
346 are probably mediated through their effect on choliner- 404 induced gastric ulcers (kissing ulcers) in rats and they
347 gic system and by influencing the neuronal morphology 405 suggested that the potential use of *C. asiatica* and its
348 [51].

349 Wijeweera et al [52] reported that, several animal 406 active ingredient are used as anti-gastric ulcers drugs.
350 models of anxiety, provides strong support to the ay- 407 Shukla et al [60] also revealed that asiaticoside ex-
351urvedic claim that the plant has anxiolytic activity and 408 hibits significant wound healing activity in normal as
352 they suggest that this anxiolytic activity may be attribut- 409 well as delayed healing models. In their experiment they
353 able in part to triterpene rich fractions within the plant 410 studied in streptozotocin diabetic rats, where healing is
354 extracts. Asiaticoside is clearly one of the active triter- 411 delayed, topical application of 0.4% solution of asiati-
355 penes, and is found in the plant in the largest amount, 412 coside over punch wounds increased hydroxyproline
356 but there may be other active principles and some syn- 413 content, tensile strength, collagen content and epitheli-
357 ergy between them and the whole plant activity may be 414 sation thereby facilitating the healing. Wang et al [61]
358 important.

359 Jayashree et al [53] studied that the activities of anti- 415 isolated pectin from *C. asiatica* by anion-exchange and
360 oxidant enzymes and anti-oxidant levels were found to 416 gel-filtration chromatography with TLC and GLC
361 be increased significantly in both the liver and kidney 417 analysis. They showed that with deacetylation and car-
362 after oral treatment with crude methanolic extract of *C.* 418 boxyl-reduction, the pectin and its degraded product
363 *asiatica* on lymphoma-bearing mice and it indicated that 419 showed immunostimulating activity to different extent
420 in vitro and it indicated that the carboxyl and acetyl
421 groups play important roles in the expression of immu-
422 nological activity.

423 *CORIANDRUM SATIVUM L. (CORIANDER,*
424 *APIACEAE)*

425 A glabrous, aromatic annula herb cultivated
426 throughout India. The leaves are acrid, astringent, aro-
427 matic, analgesic, anti-inflammatory and styptic; fruits
428 are aromatic, bitter, sweet, acrid, astringent, emollient,
429 thermogenic, anti-inflammatory, anthelmintic, stom-
430 achic, carminative, digestive, appetiser, constipating,
431 diuretic, antipyretic, stimulant, expectorant and anodyne
432 (Nadkarni; Warriar et al). Coriander is widely distrib-
433 uted and mainly cultivated for the seeds. The seeds con-
434 tain an essential oil (up to 1%) and the monoterpenoid,
435 linalool, is the main component [62]. Coriander seed is
436 a popular spice and finely ground seed is a major ingre-
437 dient of curry powder. The seeds are mainly responsible
438 for the medical use of coriander and have been used as a
439 drug for indigestion, against worms, rheumatism and
440 pain in the joints [62]. In folk medicine, the seeds of
441 coriander are used as an aromatic, carminative, stom-
442 achic, antispasmodic and against gastrointestinal com-
443 plaints such as dyspepsia, flatulence and gastralgia. The
444 seeds are also used as an ingredient in the laxative
445 preparations to prevent stomach griping [7, 8]. In Mo-
446 rocco, coriander has been documented as a traditional
447 treatment of diabetes, indigestion, flatulence, insomnia,
448 renal disorders and loss of appetite, and as a diuretic and
449 all parts of the plant are edible, but the fresh leaves and
450 the dried seeds are the most common parts used in cook-
451 ing [63]

452 *Pharmacological activities of Coriandrum sativum*

453 The seeds of coriander showed significant hypogly-
454 cemic activity by enhanced glycogenesis, glycolysis and
455 decreased glycogenolysis and gluconeogenesis and may
456 be due to increased utilization of glucose in liver glyco-
457 gen synthesis and decreased degradation of glycogen to
458 give blood sugar [64]. The biochemical effect of cori-
459 ander seeds on lipid parameters in 1,2-dimethyl hydra-
460 zine (DMH) induced colon cancer in rats were studied
461 by Chitra and Leelamma [65] and they showed that the
462 concentrations of cholesterol and cholesterol to phos-
463 pholipids ratio decreased while the level of phosphol-
464 ipid increased significantly in the DMH control group
465 compared to the spice administered group. It proves that
466 coriander plays a protective role against the deleterious
467 effects in lipid metabolism in experimental colon can-
468 cer. The aqueous extract of seeds has anxiolytic effect
469 and may have potential sedative and muscle relaxant
470 effects [66].

471 Wangenstein et al [67] evaluated the extracts of dif-
472 ferent polarity from leaves and seeds of coriander and
473 coriander oil for their antioxidant activity and they
474 found between the total phenolic content in the extracts
475 and antioxidant activity. They also observed that the
476 coriander leaves showed stronger antioxidant activity
477 than the seeds, and in both parts of coriander, the ethyl
478 acetate extract contributed to the strongest activity and
479 coriander have a potential natural antioxidant and thus
480 inhibit unwanted oxidation processes. In the carotenoids
481 fractions obtained from coriander etheric extract, b-
482 carotene has been identified as the principal antioxidant

483 component and the greater antioxidant effect of the
484 whole coriander etheric extract in comparison to the
485 component fractions suggests a possible synergistic ef-
486 fect [68]. They suggest that the coriander etheric extract
487 could be considered as a promising source of bioactive
488 substances. Melo et al [69] studied that the leaves and
489 stem of coriander extracts contain phenolic acids and
490 they are principle components responsible for the anti-
491 oxidant activity.

492 Cortés-Eslava et al [70] investigated the an-
493 timutagenic activity of coriander juice against the
494 mutagenic activity of 4-nitro-*o*-phenylenediamine, *m*-
495 phenylenediamine and 2-aminofluorene using the Ames
496 reversion mutagenicity assay with the *S. typhimurium*
497 TA98 strain as indicator organism. In this study the
498 plant cell/microbe coinoculation assay was used as the
499 activating system for aromatic transformation and plant
500 extract interaction. They showed the aqueous crude co-
501 riander juice significantly decreased the mutagenicity of
502 metabolized aromatic amines and the chlorophyll con-
503 tent in vegetable juice was monitored and its concentra-
504 tion showed a positive correlation with the detected an-
505 timutagenic effect.

506 The aqueous extract of the seeds of coriander has a
507 significant decrease in serum progesterone levels and
508 anti-implantation effect on rats [71]. Seeds of coriander
509 confers a dose-dependent protection against gross dam-
510 aging action of ethanol and other necrotizing agents on
511 gastric mucosa of rats and the histopathological assess-
512 ment also revealed that pretreatment with coriander pre-
513 vented congestion, hemorrhage, edema, necrosis, in-
514 flammatory and dysplastic changes, erosions and ulcera-
515 tions caused by the destructive stimuli in the gastric
516 tissue in a dose-dependent manner [72]. The crude
517 aqueous extract of seeds increased diuresis, excretion of
518 electrolytes and glomerular filtration rate in a dose-
519 dependent way and furosemide was more potent as a
520 diuretic and saluretic [63].

521 Essential oils prepared from the seeds and immature
522 leaves of coriander inhibit the growth of *Pseudomonas*
523 *fragi*, *Escherichia coli*, *Salmonella typhimurium*, *Lis-*
524 *teria monocytogenes*, *Staphylococcus aureus* and *Sac-*
525 *charomyces cerevisiae* in individual and mixed fractions
526 such as essential oils of *Anethum graveolens* and *Euca-*
527 *lyptus dives* [73]. Eguale et al. [74] studied the *in vitro*
528 anthelmintic activities of crude aqueous and hydro-
529 alcoholic extracts of the seeds of *coriander* on the egg
530 and adult nematode parasite *Haemonchus contortus*.
531 They showed better *in vitro* activity against adult para-
532 sites than the aqueous one and reduction in male worms
533 was higher than female worms.

DISCUSSION AND CONCLUSION

535 Plants have formed the basis of sophisticated tradi-
536 tional medicine systems that have been in existence for
537 thousands of years and continue to provide mankind
538 with new remedies. From ancient literature to modern
539 scientific records of traditional medicinal knowledge,
540 there is evidence that plants supply the main medicinal
541 source for peoples' healthcare in developing Asian

542 countries [75]. According to the WHO, 80% of the
 543 world's population primarily those of developing coun-
 544 tries rely on plant-derived medicines for their healthcare
 545 needs [76].
 546 Research on medicinal plants and the search for
 547 plant-derived drugs require a multidisciplinary approach
 548 with integrated projects, financial and technical support,
 549 and a very carefully planned strategy. The aims should
 550 consider demands in terms of public health, preservation
 551 of biodiversity and the technical qualification of each
 552 laboratory or research group involved [2]. Renewed
 553 interest in traditional pharmacopoeias has meant that
 554 researchers are concerned not only with determining the
 555 scientific rationale for the plant's usage, but also with
 556 the discovery of novel compounds of pharmaceutical
 557 value [77]. Drug discovery from medicinal plants con-
 558 tinues to provide new and important leads against vari-
 559 ous pharmacological targets including cancer,
 560 HIV/AIDS, Alzheimer's, malaria, and pain. Several
 561 natural product drugs of plant origin have either recently
 562 been introduced to the United States market, including
 563 arteether, galantamine, nitisinone, and tiotropium, or are
 564 currently involved in late-phase clinical trials [78].
 565 Thus, the review ascertains the value of a great
 566 number of plants used in tribal medicine, which could
 567 be of considerable interest in the development of new
 568 drugs. The curative properties of drugs are due to the
 569 presence of complex chemical substances of varied
 570 composition (present as secondary plant metabolites) in
 571 one or more parts of these plants. This type of research
 572 must be promoted as a means for developing countries
 573 to understand the potential use of their plant resources,
 574 as well as a means to better promote basic healthcare.
 575 This review showed that, the different parts of *Aca-*
 576 *lypha indica*, *Achyranthes aspera*, *Adhatoda vasica*,
 577 *Coriandrum sativum* and *Centella asiatica* exhibited
 578 various pharmacological activities on the basis of their
 579 use in traditional medicine. The potent chemical com-
 580 pounds found in the above plants are exciting advance
 581 in the search for the novel drugs. These plants are also
 582 proven to be very valuable to the discovery and utiliza-
 583 tion of medicinal natural products. The potential for the
 584 development of leads from the above plants for exam-
 585 ple, wound healing activity (*Acalypha indica*), antimy-
 586 cobacterial activity (*Adhatoda vasica*), antidiabetic ac-
 587 tivity (*Coriandrum sativum* and *Centella asiatica*). It is
 588 also clear that much needs to be discovered, both as to
 589 the active ingredients and their biological effects. The
 590 information summarized here is intended to serve as a
 591 reference tool to researchers in the fields of ethnophar-
 592 macology.

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