The plant kingdom has been a treasure house of potential drugs since ancient times. A large proportion of the world population reportedly relies on traditional plant-based remedies for primary health care needs of their own as well as their livestock. These remedies are used for the treatment of a wide range of diseases in animals. Further, a major part of the modern drugs are either derived from natural products or are their semi-synthetic and synthetic analogues (Kirby 1996). Unicellular eukaryotic organisms (protozoa) are the causal agents of several major diseases of global reach affecting both man and animals. Some of the most effective and prevalent remedies against devastating human disease are plant-based. The first anti-malarial drug was quinine, produced from bark of cinchona tree. The drug artemisin was introduced by Chinese scientists and is currently used extensively for treatment of malaria. Against cutaneous leishmaniasis endemic in many parts of the world use of emetine, obtained from the root of the plant Ipecac is a safe treatment. Herbs such as wild garlic, eucalyptus and thyme are some of the plants which can kill Giardia cysts, against which there is no satisfactory allopathic remedy. Medicinal plants such as Ipecac, mango and papaya possess anti-amoebic (Entamoeba histolytica) activity. Similarly, herbal medical systems were tapped for identifying new anti/protozoal drugs for veterinary usage, exemplified by Halofuginone derived from extract of Dichroa febrifuga. Synthetic chemicals and antiparasitic drugs which became popular as byproducts of industrialization and a ‘quick-fix’ culture, have seen erosion of their value due to emergence of resistance and concern for safety and sustainability. Renewal of interest in ethnobotanicals has prompted many researchers worldwide to subject natural plant products to systematic and scientific evaluation. For a number of plants documented in literature for activity in various parasitic conditions, validation based on rational evaluation was earlier lacking. This lacuna is now being filled through some newly developed isolation and characterization techniques together with pharmacological tests. Phyto-chemical analysis of medicinal plants provided evidence of the medicinally important bioactive compounds justifying their use in traditional medicine (Yadav and Agarwala 2011). At the same time, new and hitherto unexplored botanicals with potential for efficacy are re-inforcing the existing herbal antiparasitic armamentarium. Plant preparations are mostly extracts derived from various parts viz. leaves, seeds, bark, fruits, stem and roots. Bioactive substances contained in...
the plants include tannins, alkaloids, terpenoids, flavonoids and saponins. Numerous studies had carried out in vitro assays for screening and validation of plants, while in vivo assays were less frequent. In the Indian context, parasitic protozoa of livestock had received relatively less attention compared to helminths, and dedicated reviews are virtually non-existent. Of late, *Trypanosoma evansi* and to some extent avian coccidia, are emerging as frequent models for in vivo and field evaluations of medicinal plants/herbs, singly or as constituents of formulations.

An oxygenated chalcone isolated from the roots of Chinese licorice plant (*Piper longum* L.) was found to inhibit growth of both *Leishmania major* and *L. donovani*, in concentration non-toxic to host cells (Chen et al. 1993). The strong anti-leishmanial activity demonstrated in *Piper longum* A raised the possibility that appropriate substituted chalcones might become a new class of antileishmanial drugs, Curcumin, the bioactive compound in turmeric, was reported to have anti-*L. major* major effects (Chattopadhyay et al. 2004). Dimeric quinones 4 and 5 derived from the roots of *Diospyros assimilis* exhibited good activity against *L. donovani* with *IC*\(_{50}\) of 12.94 and 16.66 μM (Ganapaty et al. 2006) In vitro antileishmanial efficacy of *Aloe vera* leaf exudates (Dutta et al. 2007) was demonstrated with an *IC*\(_{50}\) of 6.0 μg/ml against promastigotes from strain responsible for visceral leishmaniasis. Data indicated that this activity can be further enhanced by activation of host macrophages. In vitro assay of an Indian medicinal herb *Selaginella bryopteris* revealed eleven bioflavonoids containing amentoflavone and linoflavone derivates (Kunert et al. 2008). Of these, the strongest activity against *L. donovani* was detected for 2,3-dihydrohinokiflavone (*IC*\(_{50}\)=1.6μM). In a study on traditional medicinal plants from Garhwal region of North-west Himalaya, India (Dua et al. 2011), the chloroform extracts of *Leucas cephalotes* and the petroleum ether extracts of *Viola canescens* exhibited substantial activities against *L. donovani* with *IC*\(_{50}\) values of 3.61 μg/ml (SI=8) and 6.40 μg/ml (SI=30) respectively. Plant extracts of *Agave americana*, *Acadira catta indica*, *Eclipta alba* and *Piper longum* induced significant promastigote and amastigote killing effect (Singh et al. 2011). Another study (Makwali et al. 2012) demonstrated that combination therapy using alternative administration of saponin, acriflavin, triflural and plumbagin is effective in treating *L. major* infection in mice. In this regard the authors suggested that efficacy of these combined therapies against other *Leishmania* strains should be explored. *Xanthium strumarium* (Chhota Gokbara) a gregarious weed distributed throughout tropical India possess anti-trypanosomal activity (Talakal et al. 1995a). Another plant *Parthenium hysterophorus* was found to significantly reduce parasitaemia and increase the survival time of *T. evansi* infected animals (Talakal et al. 1995b). Dwivedi (1997) screened 23 indigenous plants for antitrypanosomal activity. Of these, only the alcoholic extracts of three plants *X. strumarium* leaves, *Parthenium hysterophorus* flowers and *Nyctanthes arbor-tristis* leaves, were found effective both in vivo and in vitro. *Acacia* sp. was eminent among medicinal plants identified in Nigeria for trypanocidal activity (Adewummi et al. 2001). Naphthalene derivatives from *Diospyros assimilis* roots were evaluated for antiprotozoal activity (Ganapaty et al. 2006), and dimene quinones 4 and 5 exhibited good activity against *Trypanosoma brucei* with IC\(_{50}\) of 1–12 and 8.82 μM. Due to limited choice of trypanocides available in the market, high cost, toxicity and emergence of drug resistance, search for alternatives from ethno-medicine gained momentum (Shaba et al. 2006). Several medicinal plants were found to possess trypanocidal activity against *T. evansi* in a series of in vitro studies which may hold the key to developing anti-*T. evansi* drugs for future: 1) *Plumbago zelanica* root (Shaba et al. 2007), 2) *Terminalia chebula* dried fruits (Shaba et al. 2009), 3) *T. bellirica* dried fruits (Shyaba et al. 2009), 4) *Calotropis gigantea* leaves (Shaba et al. 2011a), 5) *Quercus boriae* leaves, 6) Zingiber officinale roots (Shaba et al. 2011b), 7) *Camellia sinensis* or green tea leaves (Shaba et al. 2011c), 8) *Ageratum houstonianum* flowers (Shaba et al. 2011d), 9) Khaya senegalseis tree bark (Shaba et al. 2011e), 10) *Zanthoxylum alatum* leaves, and 11) *Eugenia caryophyllata* fruit buds (Shaba et al. 2012a), 12) *Piper nigrum* Black pepper (Shaba et al. 2012 b), 13) *Centella asiatica* leaves (Shaba et al. 2012c), 14) *Eupatorium adonophorum* leaves (Shaba et al. 2012d), and 15) *Picrorhiza kurroa* rhizomes (Shaba et al. 2012e). Of these, some like *K. senegalseis* and *T. bellirica* indicated high promise. Methanol and chloroform extracts of some common medicinal plants of Sudan were evaluated for in vivo activity against *T. evansi* (Abdelrahman 2011). Good trypanocidal effect was found in *Tinospora bakis*, *Argemone mexicana* and *Aristolochia bracteolata*.

Management of giardiasis (*Giardia lamblia*) by “Pippala Rasayana” an Indian Ayurvedic drug prepared from *Palash* (*Butea monosperma*) and *Pippali* (*Piper longum*) administered at 1g orally thrice daily for a period of 15 days (Agarwal et al. 1997) gave clinical and parasitological recovery in 23 of 25 patients. In vitro anti-giardial activity was documented in *Yucca schidigera* powder (Busatti et al. 2009). Against trichomoniasis of pigeons, 4 herbal and 5 commercial antiprotozoal drugs were evaluated (Biswas et al. 2010). Thakuni (*Centella asiatica*) 20% showed the highest efficacy in vitro and in vivo conditions but commercial drugs like metronidazole were more effective. Ethanol extracts of *Curcuma longa* (turmeric) rhizome contained antiprotozoal activity against *Entamoeba histolytica* (Chattopadhyay et al. 2004). Sequiterpene lactone (Incompetency A) from the leaves extract of *Decacheta incompta* was found to be a potent antiamoebic and antiangiardial compound (Calzada et al. 2009) with IC\(_{50}\) values of 2.6 μg/ml for *E. histolytica* and 18.1 μg/ml for *G. lamblia*. Piperine from *Piper longum* enhance the *in vivo* bioavailability of metronidazole when administered in combination to rabbits (Singh et al. 2010). Another herb *Berberis aristata* (*Daruharidra*) containing berberine exhibited antiamoebic properties (Patel et al. 2012). In in
vitro study antimalarial activity against Plasmodium falciparum was observed in phenylated chalcones isolated from Crotalaria genus (C. antidisaccharides). Those from two other species C. medicaginis and C. ramosissima also exhibited similar activity when evaluated at three concentrations (50, 10, and 2 μg/mL). Compound 3 exhibited 100% inhibition of schizont maturation at 2 μg/mL concentration (Narendran et al. 2005). The authors opined that provision of scientific rationale for the antiprotozoal activity of plants used in ethnomedicine may pave the way to develop a potent synthetic antimalarial drug derivative. In the Indian medicinal herb Salaginella bryopteris, eleven biflavonoids containing amentoflavone and hinokiflavone derivatives (Kunert et al. 2008) were investigated using in vitro assay for antiprotozoal activity. Against K1 strain of P. falciparum, the highest activity was displayed by a methylenomoflavone with an IC50 of 0.26 μM. The chloroform extract of Artemisia roxburghiana showed good antiplasmodial activity (Dua et al. 2011) with IC50 value of 0.42 μg/mL and was regarded as most selective (SI = 78) extract among 5 traditional medicinal plants from the Garhwal region of Northwester Himalayas. In vitro antiplasmodial activity of significant levels was recorded in aqueous and ethanol extracts of Diospyros melanoxylon bark from Uttaranchal against chloroquine resistant and susceptible variety of P. falciparum (Saxena et al. 2011).

Artemisinin derivative from the plant Artemisia was reported to have therapeutic activity against Babesia equi (Theileria equi) (Kumar et al. 2003). Antibalasial activity in Rhicissus tridentata extracts was ascribed to antioxidant compounds present in it (Naidoo et al. 2006). Bark extracts of 22 plants were evaluated for their anti-babalasial activity against Babesia gibsoni in vitro. Of these, the extracts of Calophyllum tetramerum, Garcinia rigida, Lithocarpus sp., Sandoricum emarginatum and Shorea balangeran were found effective. The results showed more than 90% inhibition of the parasite growth at a test concentration of 1000 μg/mL. (Subeki et al. 2005). Brucine A, a natural quassinoid compound extracted from the dried fruits of Brucea javanica was evaluated for its antimalarial activity in vitro and in vivo (Nakao et al. 2009). It was found to inhibit the in vitro growth of Babesia gibsoni in canine erythrocytes at lower concentration compared with the standard antibalasial drug and killed the parasites within 24 hr at a concentration of 25 nM. Oral administration of Brucine A at a dosage of 6.4 mg/kg/day for 5 days resulted in clinical cure in dogs infected with B. gibsoni, but untreated dog developed typical acute babesiosis. Kazembe and Chinyuku (2012) showed that both the ethyl acetate and the methanol extracts of the root bark and pods of Swartzia madagascariensis were effective against Babesia bigemina and results of their fortification of chloroquine demonstrated that they might have a synergistic relationship with chloroquine. Herbal formulation prepared from extracts of Nyctanthes abortivarsis, 'Jagadrumis' (local name in Orissa), Soymida febrifusa, Lawsonia innermis (root) and entire plant of Vitex peduncularis and Comberutum daccandrom was administered at Vv@ 1 ml 20 kg–1 body weight for 5 days along with 50 ml water extracts of herbal material with honey and ginger orally once for 7 days to five calves experimentally infected with Theileria annulata. Improvement after 24–48 h and clinical normalcy by 10th day compared to five non-treated infected controls which died 20–25 days post-infection (Pradhan et al. 1998). Mirzaei (2007) treated 50 cattle naturally infected with T. annulata with the extract of the plant Peganum harmala @ 5 mg/kg for 5 days, and recorded a recovery of 78% in cattle, but 22% did not respond to the treatment and died. Further the comparative trials carried out (Durrani et al. 2009) with homogenized buds and flowers of herbal plant Calotropis procera and buparvaquone (Butalex) in crossbred cattle after experimental infection with T. annulata indicated that the efficacy of C. procera @ 0.3 mg/kg orally with 8 doses on alternate days was higher (92.5%) than buparvaquone @ 2.5 mg/kg body weight (b.w.) on alternate days (75.0%) on 21 day post treatment (pt). Natural infection of malignant ovine theileriosis in Iranian fat-tailed sheep was clinically cured with IV injection of 10 ml garlic (Allium sativum) extract, two injections at 48 hr interval (Nowroooz-Asi et al. 2010). Lambs were experimentally infected with Theileria hirci causative agent for malignant theileriosis through the bites of infected ticks Hyalomma anatolicum anatolicum and after development of disease they were treated with extract containing the alkaloids of Peganum harmala (wild rue). All treated animals recovered from infection while control sheep progressed with typical disease until their death (Derakhshanfar and Mirzaee, 2008). Investigations of in vitro activity of aqueous extract of Gardenia ternifolia fruit (Hayat et al. 2012) and Tinospora bakis root (Hayat et al. 2013) against Theileria lostoquardi, causative agent for malignant theileriosis in sheep. It was concluded that the plant extracts have high activity against this species.

Coccidiosis, particularly avian coccidiosis, is responsible for enormous economic losses to poultry industry worldwide. Commercial coccidiostats incorporated in feed was a satisfactory practice till the emergence of resistance and undesirable residues in animal products, vitiated the routine. In the current scenario, search for sustainable alternative strategies has resulted in evaluation of botanicals for anticoccidial, immunomodulatory and probiotic activities worldwide (Table 1). Dietary supplementation with flaxseed whole or oil added in starter ration from day 1 of age was observed to reduce lesions resulting from challenge infection with Eimeria tenella (Allen et al. 1997a). In India some of the plants with proven antiprotozoan activity, as mentioned by Kirtikar and Basu, are also shown to be effective in controlling coccidiosis in poultry. For example, G. ternifolia has been reported to be effective against E. coli in poultry when added to the diet (Dhillon et al. 1994). It has also been shown to be effective against E. tenella in a number of field trials (Mandal et al. 1994, Ashuma et al. 2005, Pangasa et al. 2007, Bal et al. 2008,
Table 1. Summary of some studies on plants/plant-based products for the control of coccidiosis

<table>
<thead>
<tr>
<th>Name of plant</th>
<th>Part used</th>
<th>Preparation (active principle)</th>
<th>Activity</th>
<th>Coccidian species</th>
<th>Efficacy criteria</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Melia azedarach (Backain)</td>
<td>Fruit</td>
<td>Extract</td>
<td>Anticoccidial</td>
<td>Natural Eimeria</td>
<td>Survival rate; oocyst excretion, Lesion score</td>
<td>Akhtar and Rifaat (1987)</td>
</tr>
<tr>
<td>Artemisia annua</td>
<td>Whole plant</td>
<td>Extract (Artemisinin)</td>
<td>Anticoccidial</td>
<td>Eimeria tenella</td>
<td>Lesion score, Body weight, oocyst count</td>
<td>Allen et al. (1997b)</td>
</tr>
<tr>
<td>Beta vulgaris</td>
<td></td>
<td>Glycine betane</td>
<td></td>
<td>Eimeria tenella</td>
<td>Growth promotion, Body weight, Oocyst output</td>
<td>Augustine et al. (1997)</td>
</tr>
<tr>
<td>Sophora flavescens</td>
<td>Root</td>
<td>Extract (in drinking water 6–30 g /1000 ml)</td>
<td>Anticoccidial</td>
<td>Eimeria tenella (experimental infection)</td>
<td>Survival rate, Bloody diarrhea, Weight gains</td>
<td>Youn et al. (2001)</td>
</tr>
<tr>
<td>Azadirachta indica (Neem)</td>
<td>Fruit</td>
<td>Feed additive (Azadirachtin)</td>
<td>Anticoccidial</td>
<td>Eimeria spp. (broilers)</td>
<td>Faecal oocyst, Feed conversion ratio (FCR), Lesions</td>
<td>Tipu et al. (2002)</td>
</tr>
<tr>
<td>Camellia sinensis (Green tea)</td>
<td>Leaf</td>
<td>Dietary supplement</td>
<td>Anti-oxidant Probiotic (contains polyphenolic compounds catechins)</td>
<td>E. maxima (broilers)</td>
<td>Reduced oocyst count</td>
<td>Jang et al. (2007)</td>
</tr>
<tr>
<td>Aegel marmelos (Bael)</td>
<td>Fruit rind</td>
<td>Extract (Marmelosin)</td>
<td>Anticoccidial</td>
<td>Eimeria spp. (Industrial broilers)</td>
<td>Faecal oocyst count</td>
<td>Khan et al. (2008)</td>
</tr>
<tr>
<td>Polygoum bistorta (Anjbar)</td>
<td>Extract</td>
<td>-do-</td>
<td></td>
<td></td>
<td>-do-</td>
<td>-do-</td>
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<table>
<thead>
<tr>
<th>Name of plant</th>
<th>Part used</th>
<th>Preparation (active principle)</th>
<th>Activity</th>
<th>Coccidian species</th>
<th>Efficacy criteria</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Tulbaghia violacea</em></td>
<td>Whole plant</td>
<td>Acetone extract (35mg/kg b. w.)</td>
<td>Antioxidant</td>
<td><em>E. tenella</em></td>
<td>Feed conversion ratio (FCR), Oocyst output</td>
<td><em>Naidoo et al.</em> (2008)</td>
</tr>
<tr>
<td><em>Ageratum conyzoides</em> (Billy goat weed)</td>
<td>Whole plant</td>
<td>Ethanol extract (500-1000 mg /kg b. w.)</td>
<td>Anticoccidial</td>
<td><em>E. tenella</em></td>
<td>Faecal oocysts, Body weight</td>
<td><em>Nweze and Obiwulu</em> (2009)</td>
</tr>
<tr>
<td><em>Pinus radiata</em> (Pine)</td>
<td>bark</td>
<td>Aqueous extract (condensed tannins) in drinking water</td>
<td>Anticoccidial</td>
<td>Three <em>Eimeria spp.</em> (including <em>E. tenella</em>)</td>
<td>Decreased sporulation</td>
<td><em>Molan et al.</em> (2009)</td>
</tr>
<tr>
<td><em>Carcuma longa</em> (Turmeric)</td>
<td>rhizome</td>
<td>&quot;</td>
<td>Anticoccidial</td>
<td><em>Eimeria spp.</em></td>
<td>Weight gain, FCR, Reduced mortality, Lesion score</td>
<td><em>Abbas et al.</em> (2010)</td>
</tr>
<tr>
<td><em>Saccharum officinarum</em> (Sugarcane)</td>
<td>Whole plant</td>
<td>Extract Dietary supplement</td>
<td>Immuno-therapeutic Neutroceutical</td>
<td>-do-</td>
<td>Weight gain, Faecal oocysts, Lesion score</td>
<td><em>Awais et al.</em> (2011)</td>
</tr>
<tr>
<td><em>Leucaena leucocephala</em> (Subabul)</td>
<td>Seed</td>
<td>Extract (Mimosin)Feed additive 10% concentration</td>
<td>Anticoccidial (growth promoter)</td>
<td><em>E. tenella</em> (experimentally infected broilers)</td>
<td>Body weight gains (Moderately effective)</td>
<td><em>Bal et al.</em> (2011)</td>
</tr>
<tr>
<td><em>Carica papaya</em> (Papaya)</td>
<td>Leaves powder</td>
<td>Feed supplement 15g/kg, 7g/kg</td>
<td>Anticoccidial</td>
<td><em>E. tenella</em> (experimentally infected broilers)</td>
<td>Weight gain, FCR, Oocyst count, Lesion scores IgY levels</td>
<td><em>Hadimani and Gupta</em> (2011)</td>
</tr>
</tbody>
</table>

Azadirachta indica Leaves powder " " Combination of two (*C. papaya* and *A. indica*) appeared to work as antagonist and beneficial effects were reduced as compared to single bio-agent.

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<table>
<thead>
<tr>
<th>Name of plant</th>
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<th>Efficacy criteria</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Eclipta alba</td>
<td>aerial parts</td>
<td>Extracts (coumestans) Phytotherapy in feed 120ppm</td>
<td>Anticoccidial Immuno-modulatory (Therapy &amp; prophylaxis)</td>
<td><em>E. tenella</em> (experimental infection)</td>
<td>Faecal oocytes, Body weight</td>
<td>Michels et al. (2011)</td>
</tr>
<tr>
<td>Anona senegalensis</td>
<td>Stem bark</td>
<td>Aqueous extract Orally or intra-peritoneally</td>
<td>Anticoccidial (Inhibition of oocyst production and sporulation)</td>
<td><em>Eimeria</em> spp. (avian coccidiosis)</td>
<td>Faecal oocytes</td>
<td>Nwosu et al. (2011)</td>
</tr>
<tr>
<td>Khaya senegalensis</td>
<td>Stembark</td>
<td>Aqueous extract Orally or intra-peritoneally</td>
<td>Anticoccidial (Inhibition of oocyst production and sporulation)</td>
<td><em>Eimeria</em> spp. (avian coccidiosis)</td>
<td>Faecal oocytes</td>
<td>Nwosu et al. (2011)</td>
</tr>
<tr>
<td>Aloe vera</td>
<td>Leaves pulp</td>
<td>Aqueous extract Ethanol extract Dietary supplement</td>
<td>Probiotic, Immuno-therapeutic (poeteniates cellular and humoral immune responses)</td>
<td>Mixed (<em>Eimeria</em> spp. <em>E. tenella</em> <em>E. nesartis</em> <em>E. aceruvulina</em>)</td>
<td>Weight gain, Oocysts per gram, Lesions score</td>
<td>Akhtar et al. (2012 a)</td>
</tr>
<tr>
<td>Triticum aestivum</td>
<td>Bran-derived Polysaccharides &amp; Arabinosyls</td>
<td>Extract Dietary supplement</td>
<td>Immuno modulatory (Coccidia protective)</td>
<td>Experimental mixed <em>E. maxima</em></td>
<td>Body weight, Development of lymphoid organs</td>
<td>Akhtar et al. (2012 b)</td>
</tr>
<tr>
<td>Artemisia annua</td>
<td>Leaves (dried)</td>
<td>Feed supplement</td>
<td>Coccidiostat</td>
<td>Mixed natural in free-range broilers</td>
<td>Faecal oocysts counts</td>
<td>de Almeida et al. (2012)</td>
</tr>
<tr>
<td>Argeratum conyzoides (goat weed)</td>
<td>Whole leaf</td>
<td>Aqueous extract Oral (10% concentration of whole extract)</td>
<td>Anticoccidial (useful as handy first line of control)</td>
<td><em>E. tenella</em></td>
<td>Faecal oocyst count</td>
<td>Annan-Prah et al. (2012)</td>
</tr>
<tr>
<td>Artemisia absinthum</td>
<td>Whole plant (dried)</td>
<td>Aqueous extract Oral graded doses 1,2, &amp; 3mg/kg/day (3mg/kg gave best result)</td>
<td>Anticoccidial</td>
<td><em>E. tenella</em> (experimental in broilers)</td>
<td>Bloody diarrhea</td>
<td>Kostadinovic et al. (2012)</td>
</tr>
<tr>
<td>Echinacea purpurea</td>
<td>Whole plant</td>
<td>Extract &amp; cinnamon aldehyde (alone or as adjuvant) Dietary supplement</td>
<td>Anticoccidial (moderately effective)</td>
<td><em>E. aceruvulina</em></td>
<td>Performance, Oocyst excretion, Lesion scores</td>
<td>Orengo et al. (2012)</td>
</tr>
<tr>
<td>Cinnamon</td>
<td>Bark</td>
<td>Volatile oil (cinnamaldehyde)</td>
<td>Anticoccidial (moderately effective)</td>
<td><em>E. aceruvulina</em> (experimental)</td>
<td>Performance lesion scores (grass and microscopic)</td>
<td>Orengo et al. (2012)</td>
</tr>
</tbody>
</table>
Shameem et al. 2010) has been claimed. A herbal anticoccidial powder containing Embelia ribes seeds and H. antidysemtretica with or without soda bicarb (to increase the pH of intestinal contents) was evaluated in experimentally infected broiler chicks (Singh et al. 2008). Supplemented group showed significant effect on growth performance, parasitological and haematological parameters. Soda bicarb as feed additive was highly effective against moderate mixed coccidial infections. Another proprietary formulation ‘Coxynil’ with composition of Allium sativum 15%, Cinnamonum camphora 15%, Elephantopus scaber 15%, Valeriana wallichii 15%, sulphur dioxide 25% and sodium chloride 15%, was evaluated in experimentally induced (Kurkure et al. 2006) and against natural clinical coccidiosis in broiler flock (Raut et al. 2012). Efficacy was indicated by recovery of birds post treatment, faecal oocyst counts and oocyst sporulation. A herbal complex containing Allium sativum, Salvia officinalis, Echinaeae purpurea, Thymus vulgaris and Origanum vulgare, was also found effective against many species of Eimeria in broiler chickens, in reducing oocyst output (Arcewska-Wlosek and Swiatkiewicz 2012).

Most of the ingredients have compounds with reported antioxidant properties indicative of the current trends in management of coccidiosis. Plant-expressed coccidial antigens as potential vaccine candidates in protecting chickens against coccidiosis (Sathish et al. 2012) is another potential plant-based alternative approach. Coccidiosis near weaning is a major cause of diarrhea, ill thrift and impaired performance in small ruminants. Markovics et al. (2012) reported that coccidiosis in young weaned kids could be alleviated by feeding them the tannin-rich foliage of Pistacia lentiscus L. (lentisk) or by tethering them close to lentisk bushes which they browse on. The positive effect is associated with intake of tannins. Most recently, in naturally infected goats (Iqbal et al. 2013), Artemisia absinthium at 2g/kg-1 single treatment proved moderately effective in comparison to conventional standard treatment with either amprolium or toltrazuril.

CONCLUSION

Phytherapy as component of integrated control of parasites is emerging as a realistic and sustainable measure. As such, there is need for large-scale experimental trials to establish the efficacy of alternative agents. However, critical appraisal and standardization of methods currently used for validation of antiparasitic activity is imperative. Since in vivo findings may not necessarily correlate with in vitro efficacy, more weightage should be given to in vitro field screening and replicability of studies. As a measure of confidence, evaluation of plants/bioactive compounds for anticoccidial activity, protocols should be formulated on the basis of standard procedures as described in the guidelines of the World Association for Advancement of Veterinary Parasitology-WAAVP (Holdsworth et al. 2004). The adjunct role of botanicals for enhancing and extending the efficacy - life span of existing anti-trypansoma and anticoccidials, should be explored. Neutroceuticals, immunomodulants and probiotics sourced from plants are a new class which should be promoted with the twin objectives of providing protection from parasitism as well as improved performance.

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