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Mini Review

Anthelmintic Activities of Various Botanicals Used Against Gastrointestinal Helminth of Goat and Sheep

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Abstract

Small ruminants are considered to be best option in the fight against food insecurity and economic disparity for the marginalized communities in Nepal. Goat (*Capra hircus*) alone is ruminant with highest population with more than eleven million heads. Of the major challenges, gastrointestinal helminths are major health problem for reducing productivity. *Bunostomum, Gnathostoma, Acyclostoma, Ascaris, Haemonchus, Oesophagostomum, Capillaria, Chabertia, Oxyuris, Trichuris, Strongyloides, Trichostrongyloid, Nematodirus, Ostertagia , Dicrocoelium, Capillaria, Paramphistomum, Fasciola, Moniezia* and *Taenia* are reportedly prevalent. Farmers generally use anthelmintic twice in a year as routine deworming. Anthelmintic resistance is increasing due to various factors like under dosing, long term use of same anthelmintic and genetic factors of helminth. To counter anthelmintic resistance in future, alternatives to present drugs is being sought. Various plants like *Artemisia sp., Carica papaya, Calotropis procera, Zinziber officinale, Terminalia chebula, Swertia chirayita, Adathoda vesica, Nicotiana tabacum, Chenopodium album, Musa paradisiaca, Tagetes sp., Momordica charantia, Albizia anthelmintica, Cucurbita moschata* have been evaluated in in-vivo and in-vitro studies as anthelmintic. In controlled trials some botanical products have shown promising activity. This article reviews efficacy of botanicals on control of gastrointestinal helminths of goat and sheep.

Keywords: gastrointestinal helminths; botanical anthelmintic; Goat; Sheep

Introduction

Goats are one of the major sources of income in rural Nepal (Neupane *et al.*, 2018; Rauniyar *et al.*, 2000). There are 11,225,130 goats and 612,884 sheep reared in Nepal (MoLD, 2017). Parasites are major problem of goat and sheep farming causing low production and loss. In a study of District Livestock Service Office Syangja. and Tanahun, Regional Veterinary Diagnostic Laboratory, Pokhara and Agricultural Research Station in Bandipur 60% of clinical case presented was of parasitic disease (Khakural, 2003). In a study at Puranchaur VDC of Kaski district 91.82% prevalence of gastrointestinal helminth was found. (Purja & Maharjan, 2017). Prevalence of 90.3% in summer and 46% in winter was reported from Kalanki khasibazzar Kathmandu (Karki *et al.*, 2012). 13.89% and 14.5% prevalence of *Haemonchus contortus* was found in Chitwan and Kalanki khasibazzar respectively (Karki *et al.*, 2012; Khakural, 2003).

Bunostomum, Gnathostoma, Acyclostoma, Ascaris, Haemonchus, Oesophagostomum, Capillaria, Chabertia, Oxyuris, Trichuris, Strongyloides, Trichostrongyloid, Nematodirus, Ostertagia, Dicrocoelium, Capillaria, Paramphistomum, Fasciola, Moniezia are prevalent in goats, in Nepal (Karki *et al.*, 2012; Purja & Maharjan, 2017). Farmers use anthelmintic twice in a year or as symptoms develop, for deworming (Purja & Maharjan, 2015). Resistance to available anthelmintic drugs is in rise (Silvestre *et al.*, 2002). Factors attributable to increase anthelmintic resistance are: Use of same anthelmintic over

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long period of time, underdosing of anthelmintic, introduction of animal harboring resistant worms to herd, refugia worm population and genetic changes in worm population due to selection pressure (Silvestre *et al*., 2002).

As existing drugs are getting ineffective to control helminths, alternatives are being sought one of the promising alternatives is use of botanical plants, Plant extracts from various plants have been tested in vitro and in vivo for their anthelmintic properties, some of them have shown promising activity against gastrointestinal helminths. This article discusses about botanicals tested for anthelmintic property and their efficacy.

Botanicals Useful in Management of Gastrointestinal Helminths

Artemisia sp. (Titepati)

Methanolic extract of *Artemisia indica* at 50mg/ml concentration caused 85% egg hatch inhibition when incubated with extract for at 27°C for 48 hours, same extract caused 90% larval mortality and 85% adult mortality in 24 hours (Khan *et al*., 2015). Crude ethanolic extract of *A. absinthium* exhibited 94.7% inhibition of worm motility of *Haemonchus contortus* larvae at 25 mg/ml and 90.46% Fecal egg count reduction (FECR) at 2mg/kg dose (Tariq *et al*., 2009). Crude Aqueous extract caused 73.6% worm motility inhibition and 80.49% fecal egg count reduction at same dose (Tariq *et al*., 2009). Crude methanolic extract of *A. vestita* and *A. maritima* reduced fecal egg count by 86.63% and 82.2% respectively (Irum *et al*., 2015) .Essential oil extract of *Artemisia lancea* on *Haemonchus contortus* exhibited 93.6% egg hatch inhibition, 93.6% larval development inhibition, 79.6% inhibition of larval migration (Zhu *et al*., 2013). But in an experiment with H. contortus of gerbil no significant reduction of fecal egg count was reported after oral administration of essential oil, methanolic and aqueous extract of *A. annua* and *A. absinthium* (Squires *et al*., 2011).

Carica papaya (Mewa)

Latex of papaya *Carica papaya* reduced *H.contortus* by 98.1% after 4 days treatment with 117µmol of cysteine protease, it is considered as active ingredient of papaya latex responsible for anthelmintic property but same treatment did not have any effect on *Trichostrongylus colubriformis*, No toxicity was observed at this effective dose (Buttle *et al*., 2011).

There are mixed findings on efficacy of *C. papaya* seeds. In two separate studies in goat and sheep, aqueous extract of *C. papaya* has been reported to have efficacy of about 100% when fed for 3 days at 1000mg per animal, same 3 day dose repeated twice in 2 weeks interval (Ameen *et al*., 2018). One study has shown lack of efficacy against helminths of lamb while drenching 80g of seeds in 110 ml water orally once (Burke, Wells, Casey, & Miller, 2009).

Calotropis procera (Seto aank)

Ethyl acetate extract of *Calotropis procera* latex inhibited 88% motility of adult *H. contortus* at dose rate of 200mg/ml, 4mg/ml of the extract inhibited 91.8% hatching of eggs (Cavalcante *et al*., 2016). 49% reduction of live *H. contortus* was found after oral dosing of *C. procera* latex at 0.02 ml/kg bodyweight of sheep (Qarawi *et al*., 2001).

Oral 3g/kg dose of crude aqueous extract, crude powder and crude methanolic extract of *C. procera* flower in sheep reduced fecal egg count by 88.4%., 77.8% and 20.9% respectively (Iqbal *et al*., 2005). Crude aqueous extract of flower inhibited motility of 70% *H. contortus* in 6 hours exposure at 25 mg/ml, 50% of total initial worms regained motility on transferring to fresh phosphate buffer saline for 30 minutes (Iqbal *et al*., 2005).

Zinziber officinale (Aduwa)

In an in-vitro study, 24 hour exposure of *Fasciola hepatica* eggs to methanolic extract of *Zingiber officinale* at concentration of 5mg/ml and 10mg/ml caused 98.84% and 100% dead eggs respectively on observation after 14 days of incubation in dechlorinated tap water at 28°C , in same study exposure to 1mg/ml methanolic extract for 72 hours caused 100% dead eggs (Moazeni & Khademolhoseini, 2016).

In in-vivo test crude powder and crude aqueous extract at oral dose of 3g/kg bodyweight of sheep caused 25.6% and 66% reduction in fecal egg count after 10 days of treatment (Iqbal *et al*., 2006).

Terminalia chebula (Harro)

At concentration of 50mg/ml Ethyl acetate extract, acetone extract and methanol extract of *Terminalia chebula* seeds demonstrated 84.8%, 100% and 87.4% egg hatch inhibition and 88.8%, 100% and 93% larval development inhibition of *H. contortus* respectively (Kamaraj & Rahuman, 2011).

Swertia chirayita (Chiraito)

In an vivo study crude methanolic extract, crude powder and crude aqueous extract of *Swertia chirayita* whole plant at 3g/kg body weight orally demonstrated fecal egg count reduction of 58.8%, 58.2% and 34% respectively (Iqbal *et al*., 2006). In in-vitro Crude methanolic extract of *C. chirayita* 25mg/ml inhibited sheep H. contortus motility by 90% in 6 hours (Iqbal *et al*., 2006).

Adathoda vesica (Asuro)

In-vitro test 50mg\ml concentration of methanolic extract of *Adathoda vesica* leaf exhibited 75.33%-82.5% ovicidal activity, in in-vivo test 58.6% reduction of fecal egg count was seen at dose rate of 200mg/kg body weight (Pandey *et al*., 2013). In another study 25mg/ml crude aqueous extract and crude methanolic extract of *A. vesica* roots 54% and 44% demonstrated irreversible motility inhibition of adult *H. contortus* worms respectively. Crude aqueous extract, crude powder and crude methanolic extract of roots at 3g/kg body caused 37.4%, 33.05% and 25.6% fecal egg count reduction respectively, after 14 days of oral treatment orally in sheep (Lateef, Zafar, Khan, Muhammad Shoaib, & Jabbar, 2003).

Nicotiana tabacum (Surti)

Crude aqueous methanolic extract of *N. tabacum* leaves has shown potent anthelmintic activity against benzimidazole resistant *H. contortus* of sheep. 2g/kg Body weight and 4g/kg body weight had 87.5 and 88.6% reduction in fecal egg count, LC_{50} for egg hatch assay and adult motility test was 0.566 mg/ml and 1.91mg/ml respectively while in treatment with oxfendazole fecal egg count did not reduce and LC_{50} for egg hatch assay and adult motility test was much higher than standard for oxfendazole (Hamad *et al*., 2013). No signs of immediate toxicity were observed during in vivo treatment (Hamad *et al*., 2013). In another study, crude methanolic and crude aqueous extract of *N. tabacum* at 3g/kg BW showed 73.6% and 49.4 % reduction in fecal egg per gram respectively (Iqbal *et al*., 2006).

Chenopodium album (Bethe)

In vivo aqueous methanolic extract of *C. album* demonstrated dose dependent reduction of fecal egg per gram, 82.2% reduction was noted at dose rate of 3g/kg body weight, when evaluated 5 days post treatment. LC_{50} for egg hatch inhibition for aqueous methanolic extract was found to be 0.449mg/ml (Jabbar *et al*., 2007).

Ethyl acetate, methanolic, and chloroform extracts of C. album inhibited 100% egg hatch of gastrointestinal nematode at 25mg/ml, 100mg/ml and 100mg/ml respectively, also ED_{50} and ED_{90} values of was calculated to be 2.73 and 8.31; 3.86 and 7.14; 4.41 and 20.11 mg/ml, respectively by log probit analysis (Sachan *et al*., 2013).

Musa paradisiaca (Kera)

Musa paradisiaca has demonstrated in-vitro larval development inhibition, 95% inhibition was demonstrated by methanol extract of stem (Marie-Magdeleine *et al*., 2014). One study reported no ovicidal activity of aqueous, methanol and dichloromethane extract of *M. paradisiaca* leaf and stem (Marie-Magdeleine *et al*., 2014). *M. paradisiaca* demonstrated 100% inhibition of egg hatch and 0% larval migration at 180mg/ml and 800mg/ml concentration of alcoholic extract of leaf respectively (Neuwirt *et al*., 2015). LC_{50} of aqueous and aqueous methanolic extract was reported to be 0.207mg/ml and 0.4813mg/ml respectively (A. Hussain *et al*., 2010). 80.7% reduction of egg per gram by crude aqueous methanolic extract of at dose rate of 8g/kg was seen (Hussain *et al*., 2011).

Tagetes sp. (Sayapatri)

Tagetes erecta flower n-hexane extract 40 mg/mL concentration, total dose of 100 µL to each gerbil caused 53.9% reduction in live *H. contortus* worm in gerbil in comparison to control group (Palacios Landín *et al*., 2016). The crude ethanolic extract of *Tagetes patula* showed an efficacy of 100% up to a concentration of 100 mg/ml in egg hatch inhibition test and 1.56 mg/mL in larval development inhibition test. The essential oil of the aerial parts of *Tagetes patula* was 100% effective up to 0.75 mg/ml in egg hatch inhibition test and up to 0.375 mg/ml in larval development inhibition test (Politi *et al*., 2018).

In one study aqueous, chloroform and petroleum ether extract were not found to possess any in vitro anthelmintic activity but methanolic extract of the flowers exhibited in-vitro anthelmintic activity (Singh *et al*., 2005).

Momordica charantia (Karela)

Whole plant extract, LC 50 for egg hatching of H. contortus was found to be 0.101 mg/mL (Batista *et al*., 1999). 100mg/ml of leaves and seed extract had 100% and 98% inhibition of motility in adult worm of cattle abomasum (Amin *et al*., 2009). 12.5, 25.0 and 50.0 mg/mL concentrations of *M. charantia* leaves crude extract and 100ug of hexane, di-chloromethane, butanol and aqueous extract inhibited miracidia development in 100% of *Fasciola hepatica* eggs (Amin *et al*., 2009).

Albizia anthelmintica

It is botanical anthelmintic distributed in southern and eastern Africa. *A. anthelmintica* bark aqueous extract was fed at dose of 3g/kg body weight for 3 days post infection resulted in 95% efficacy in reduction of experimentally infected *Fasciola gigantica* in goat which was comparable to albendazole (Koko *et al*., 2000). 78.3% reduction in fecal egg per gram was found at dose rate of 0.8g/ sheep (average dose of 58mg/kg body weight) but efficacy tended to decrease on increased doses, only 41.1% and 68% fecal egg count was reduced on 1.8g/sheep (135.5mg/kg on average) and 4.7g/ sheep (358.5mg/kg average) (Gradé *et al*., 2008).

Cucurbita moschata (Farsi)

Egg hatch assay on *C. moschata* seed extracts did not show effective ovicidal activity, larval development test showed effective development inhibition dichloromethane extract at 0.6mg/ml showed 100% inhibition, aqueous and methanolic seed extracts showed similarly effective results (Marie-Magdeleine, Hoste, Mahieu, Varo, & Archimede, 2009).

Conclusion

Study of botanical products have shown considerable anthelmintic property even encompassing some drug resistant helminths. But still varying reports of their efficacy is found depending on type of study, method of preparation and dosage. Some products showing in-vitro activity are not yet studied for in-vivo activities, which could have significant difference in helminth control due to pharmacokinetics and pharmacodynamics of active phytochemicals. Plants also differ in concentration of phytochemicals depending on environmental and genetic factors like season, temperature, climate, soil and variety. Therefore, Study on identification of phytochemicals responsible for anthelmintic activity, determination of proper dose, possible adverse effects and susceptibility of gastrointestinal helminth species is necessary for efficient control of gastrointestinal helminths using botanical products.

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