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USE OF MEDICINAL PLANTS AS ALTERNATIVE FOR THE CONTROL OF INTESTINAL PARASITOSIS: ASSESSMENT AND PERSPECTIVES

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ABSTRACT

Intestinal parasitosis is a real health problem for animal husbandry which generates economic losses. In the treatment of helminths, synthetic anthelmintics have long been used. However, cases of parasite resistance to these anthelmintics have been reported worldwide. Solutions have been proposed to solve this problem. Among them is the use of medicinal plants with anthelmintic properties. This work proposes to synthesize the work carried out on the evaluation of anthelmintic properties of medicinal plants used in the treatment of intestinal parasitosis of small ruminants. According to the results of the ethnobotanical surveys reported, several medicinal plants are used by the populations in the treatment of intestinal parasitosis of small ruminants. Evaluations of the anthelmintic properties *in vitro* and or *in vivo* of some of them have confirmed their potential to be used as an alternative for the control of intestinal parasitosis. However, these results obtained depend on factors such as the organ of the species used, the type of extract and the application dose. Tannins, flavonoids and essential oils are the secondary metabolites responsible for the anthelmintic activity of these medicinal plants with anthelmintic potential. The efficacy of a plant extract (or powder) also depends on the type of parasite used in the tests. The results of previous studies confirm the use of medicinal plants in the fight against intestinal parasitosis.

Keywords: Anthelmintic, Intestinal parasitosis, Medicinal plants, Resistance

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1. INTRODUCTION

Gastrointestinal parasitosis remains a real health problem for small ruminant livestock, especially because of the resistance developed by parasites against synthetic anthelmintics (Akoto et al. 2019; Nath et al. 2019; Rehman et al. 2021). Indeed, this state of affairs compromises the effectiveness of these drugs. Small ruminant breeding is an income-generating activity and therefore contributes to the national economy in developing countries like Benin. In pastures, small ruminants are more vulnerable to strongyles *Oesophagostoma venulosum*, *Chabertia ovina* (superfamily Strongyloidea), *Cooperia curticei*, *Nematoridus battus*, *Trichostrongylus axei*, *Trichostrongylus colubriformis* and *Haemonchus contortus* (superfamily Trichostrongyloidea). The species of the superfamily Trichostrongyloidea are distinguished by their absent or rudimentary oral capsule and a highly developed copulatory bursa and are the most pathogenic strongyles (Aguerre 2019). Infections by these gastrointestinal parasites, lead to weight loss of animals, poor wool quality, generating economic losses and can compromise food security (Alowanou et al. 2015). It is then important to use other solutions to control gastrointestinal parasites. Among the proposed populations is the use of medicinal plants with anthelmintic potential. The knowledge about use of medicinal plants is a tradition that is perpetuated from one generation to another. Ecological zone, level of education and ethnicity are factors related to the knowledge and use of medicinal plants by herders in Benin (Dassou et al. 2015). As a result of exchanges with the populations, medicinal plants have been listed and some

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have already been studied to evaluate their effectiveness on gastrointestinal parasites. However, the following question must be asked. What are or will be the challenges related to the use of medicinal plants in the treatment of gastrointestinal parasitosis? The research will have found its outcome when the breeder will have found relief or satisfaction through an effective treatment of gastrointestinal parasitosis of these animals at lower cost. It can be translated by the indication of effective plants and or the provision of improved traditional medicines accessible and at lower cost. It is with regard to all these observations, that the present study proposes to make the synthesis of the works in order to bring out the limits for a better use of the medicinal plants endowed with anthelmintic properties.

1.2. Parasite resistance to synthetic anthelmintics

Parasite resistance is defined as: the ability of a parasite population to resist concentrations of antiparasitic drugs that are usually lethal to individuals of that species. It is a mutational preadaptation whose determinism is genetic and inherited (Okombe and Pongombo 2013). Isotype 1 of the beta-tubulin gene SNPs is thought to be linked to helminth resistance to benzimidazole (Furtado et al. 2019). Factors favoring parasite resistance to anthelmintics are: frequency of treatments per time interval, adherence to dosage (under-dosing), exclusive use of a single anthelmintic or family of anthelmintics, grazing management (small ruminants). Other so called intrinsic factors are related to the life cycle of the parasites (short cycle), their prolificity (high) and pathogenicity (highly pathogenic) (Aguerre 2019). *Haemonchus contortus* parasite of small ruminants has a life cycle of 20 days and the female has the capacity to lay 5,000 to 10,000 eggs per day. It lodges in the abomasum and is hematophagous (Emery et al. 2016). These characteristics justify its resistance to synthetic anthelmintics. Resistance of other helminths to synthetic anthelmintics has also been reported. The Fig. 1 shows the three main lines of thought and alternative solutions in solving the difficulties related to the resistance of parasites to synthetic anthelmintics in the management of gastrointestinal parasitosis of small ruminants.

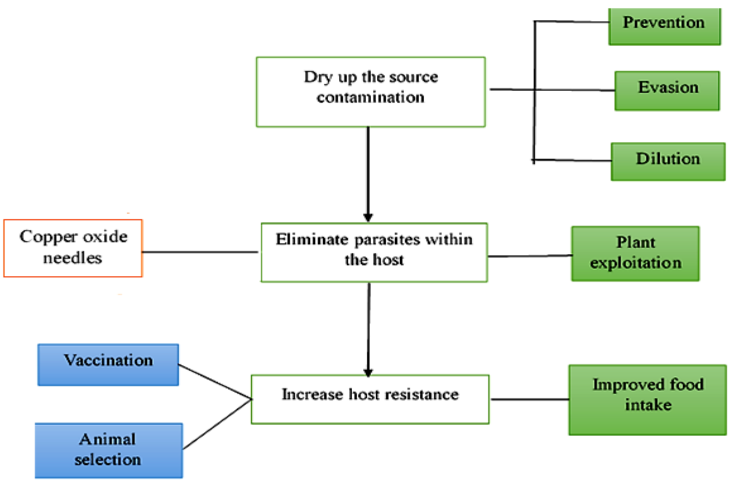

Fig. 1: Alternative solutions for the control of gastrointestinal parasitosis in small ruminants.

The interest of drying up the source of contamination is to block the biological cycle of the parasites in order to control the infestation of the pasture and reduce new infestations. It is done through prevention, i.e. healthy animals on clean pastures. In case of infections by gastrointestinal parasites, the treated animals will be transferred from contaminated pastures to clean pastures: this is the escape and finally the dilution. Another solution is to improve the host's resistance to parasites. This can be done by selecting NGIs resistant animals, by vaccination and or by improving the host's feed ration. The third alternative is to eliminate parasites within the host through the use of medicinal plants with anthelmintic properties (Kuiseu et al. 2021).

The use of medicinal plants with anthelmintic potentiality is the most promising alternative. The exploitation of medicinal plants will limit the presence of residues in the environment or in consumer products and would be more accessible to the population.

1.3. Medicinal plants with anthelmintic potential

Several medicinal plants are used by the populations in the treatment of gastrointestinal parasitosis of small ruminants (Table 1). These results are obtained on the basis of the endogenous knowledge of the populations. The knowledge and use of medicinal plants are a kind of tradition that is transmitted from one generation to another. Some of these plants with anthelmintic potential have been studied for their activities *in vitro* and / or *in vivo*. It is evaluated through tests on the different life stages (eggs, larvae and adult worms) of these parasites. *Haemonchus* *contortus* is the most studied nematode of small ruminants and is justified by its veterinary importance. It is one of the most pathogenic parasites infecting small ruminants. In Benin, its prevalence is 55.56%. (Attindehou et al. 2012). It is a hematophagous nematode that lodges in the abomasum of animals and 2000 females can puncture 30 ml of blood per day from a sheep (Coyne and Smith 1992). Also, cases of resistance of the *Haemonchus contortus* parasite to synthetic anthelmintics have been reported.

Table 1: List of some medicinal plants traditionally used in the treatment of gastrointestinal parasitosis and tested in small ruminants

Family	Species	Pararsite studied	In vitro	In vivo	Comments	References
Annonaceae	*Annona senegalensis*	*H. contortus*	-	+	The leaves of *A. senegalensis* appear to be more effective than other parts of the plant. The parasite spectrum sensitive to the different extracts of *A. senegalensis* is composed of strongyles (*H. contortus, Trychostrongylus sp* ...) and probably coccidia	Nguessan et al. (2017)
Anacardiaceae	*Spondias mombin*	*H. contortus*	+	+	Ethanolic and methanolic extracts of *S. mombin* leaves inhibited the migration of L3 larvae and the motility of adult *H. contortus* worms. However, the adult worms were significantly more sensitive after 6 hours of exposure to ethanolic extracts than methanolic extracts. *In vivo*, *S. mombin* leaf powder reduced the rate of egg excretion in parasitized animals.	Akouedegni et al. (2019)
Bignoniaceae	*Newbouldia laevis*	*T. colubriformis*	+	+	The tannins contained in the leaves of *N. laevi* are responsible for inhibiting the migration of L3 larvae. After digestion in the rumen the leaves of *N. laevis* would retain their anthelmintic activities	Olounladé et al. (2017); Sidi et al. (2017b)
Caesalpinioideae	*Cassia alata*	*H. contortus*	+	-	The aqueous and hydroacetonic extract of *C. alata* leaves have ovicidal and larvicidal activities. The leaves are rich in steroidal and triterpenic compounds, anthracenosides, saponosides, polyphenols (tannins)	Tianhoun et al. (2020)
	Cassia italica	*H. contortus*	+	-	The aqueous and ethanolic extracts of the leaves of *S. italitica* contain polyphenols (flavonoid tannins). Aqueous and ethanolic extract of *S. italica* exhibited evidence of *in vitro* anthelmintic activity on eggs; infective larvae L3 and against adults of *H. contortus*.	Yongwa et al. (2020)
Chenopodiaceae	*Chenopodium ambrosioides*	*H. contortus; O. colombianum*	+	-	The leaf powder of *C. ambrosioides* is rich in tannins, flavonoids, alkaloids, saponosides. aqueous extract of the leaves of *C. ambrosioides* has strongylicidal effects against *H. contortus* and *O. columbianum.*	Maiga et al. (2020)
Combretaceae	*Combretum glutinosum*	*H. contortus*	+	+	The leaves of *C. glutinosum* are rich in tannins, saponins flavonoids, alkaloids, glycosides, anthraquinones terpenes, reducing compounds. Acetonic and methanolic extracts of *C. glutinosum* leaves inhibited egg hatching, larval migration and adult worm motility.	Alowanou et al. (2019b)
Euphorbiaceae	*Bridelia ferruginea*	*H. contortus*	+	+	The leaves of *B. ferruginea* are rich in tannins, saponins, flavonoids, alkaloids, glycosides, anthraquinones, terpenes, reducing compounds. Acetonic and methanolic extracts of *B. ferruginea* leaves inhibited egg hatching, larval migration and adult worm motility. Acetonic extract and tannins from *B. ferruginea* leaves inhibited the emergence of *H. contortus* L3 larvae	Alowanou et al. (2019a); Tchetan et al. (2020)
Fabaceae	*Pterocarpus erinaceus*	*H. contortus*	+	-	The leaves of *P. erinaceus* are rich in anthracene derivatives, tannins, flavonoids, saponosides. Acetonic and methanolic extracts inhibited the migration of L3 larvae and the motility of adult *H. contortus* worms	Dedehou et al. (2014)

Lythraceae	*Punica granatum*	*H. contortus*	+	-	The roots of *P. granatum* contains Alkaloid, Saponin, Tannins, Flavonoids, Glycosides and Phenol. Methanolic extract of P. granatum inhibited egg hatch and motility of adult *H. contortus* worms	Ahmed et al. (2020)
Mimosoideae	*Parkia biglobosa*	*H. contortus*	+	-	Fruit pods are rich in alkaloids and tannins. The acetone extract of *P. biglobossa* fruit pods was more reactive on the migration of L3 larvae than the methanolic extract	Dedehou et al. (2014)
	Albizia adianthifolia	*H. contortus*	+	-	The hydroalcoholic extract of *A. adianthifolia* showed larvicidal activity on L3 larvae of *Haemonchus contortus*	Mesmin et al. (2018)
Moraceae	*Ficus exasperata*	*H. contortus*	+	-	Aqueous extract of *F. exasperarata* inhibited adult worms motility	Houngnimassoun et al. (2017)
	Ficus lutea	*H. contortus*	+	-	The hydroalcoholic extract of *F. lutea* showed larvicidal activity on L3 larvae of *H. contortus*	Mesmin et al. (2018)
	Morus Mesozygia	*H. contortus*	+	-	The hydroalcoholic extract of *A. adianthifolia* showed ovicidal activity on the larval eggs of *H. contortus*	Mesmin et al. (2018)
Rubiaceae	*Mitragyna inermis*	*H. contortus ; T. colubriformis*	+	+	The leaves of *M. inermis* are rich in tannins, saponins, flavonoids, alkaloids, glycosides, anthraquinones, terpenes, reducing compounds. Aqueous extract of *M. inermis* leaves inhibited the motility of adult *T. colubriformis* worms. Acetonic and methanolic extracts of *M. inermis* leaves inhibited egg hatching, larval migration and adult worm motility. Acetonic extract and tannins from the leaves of *M. inermis* inhibited the emergence of L3 larvae of *H. contortus*	Alowanou et al. (2019a, b); Tchetan et al. (2020); Toklo et al. (2021)
Rutaceae	*Zanthoxylum zanthoxyloïdes*	*H. contortus; T. Colubriformis*	+	+	The tannins contained in the leaves of *Z. zanthoxyloïdes* are responsible for inhibiting the migration of L3 larvae. After digestion in the rumen the leaves of *N. laevis* would retain their anthelmintic activities	Olounladé et al. (2017); Azando et al. (2017 Sidi et al. (2017b)
Combretaceae	*Terminalia Catappa*	*H. contortus*	+	-	Dichloromethane extract of *T. catappa* leaves inhibited the hatching of *H. contortus* eggs more than methanolic extract	Olukotun et al. (2018)
Asteraceae	*Artemisia herba-alba*	*H. contortus*	+	-	The flowers and aerial part of *A. herba-alba* contains alkaloid, saponin, tannins, flavonoids, glycosides and phenol. The methanolic extract of *A. herba-alba* inhibited egg hatch and motility of adult *H. contortus* worms	Ahmed et al. (2020)
Zingiberaceae	*Curcuma longa*	*H. contortus*	+	-	The hydroalcoholic extract of *C. longa* reduced the rate of egg excretion from infected animals	Nath et al. (2019)
Celastraceae	*Maytenus senegalensis*	*H. contortus*	+	-	Tannins are responsible for the anthelmintic activities of the aqueous extract of *M. senegalensis*	Zangueu et al. (2018)
Lamiaceae	*Thymus vulgaris L.*	*H. contortus*	+	+	Thymol, the main compound in the essential oil of *Thymus vulgaris* L, is believed to be responsible for its anthelmintic activity.	Ferreira et al. (2016)

Egg hatch tests, inhibition of larval migration, and adult worm motility are all techniques used to evaluate the efficacy of extracts on gastrointestinal nematodes. The egg hatch test is a test that evaluates the ability of an extract to act on egg hatching. The inhibition of the survival of adult worms induced by an extract is an important factor in the control of these parasites. Indeed, the disruption of their motility would result in difficulties in feeding (thus less blood depletion for hematophagous parasites) and mating (thus less egg excretion) (Zinsou 2015; Sobhy et al. 2021). The decrease in larval migration, could disrupt their settlement in the mucosal wall of the digestive tract (Dedehou et al. 2014; Tchetan et al. 2020). The tests performed *in vitro* allow a rapid evaluation of the anthelmintic properties of the different plants tested and the analysis of the mechanisms of action of these plants on the parasites (Akouedegni et al. 2019). *Z. zanthoxyloides*, *N. laevis*, *S. monbin*, *C. italitica*, *B. ferruginea*, *A. herba-alba*, *C. longa* are some of the species that demonstrated their anthelmintic activities *in vitro* through egg hatching, larval migration inhibition and adult worm motility tests. Within the organism, several other components such as the metabolism of the medicinal plant (or its extract), the availability and concentration of the active principle(s) can influence the activity of the medicinal plant (or its extract), hence the importance of *in vivo* tests. Also, the doses and frequencies of ingestion of anthelmintic plants are important factors to control for good efficacy, as the concentrations in the digestate can vary from one portion of the digestive tract to another (Azando et al. 2011). Thus, results obtained during *in vitro* testing may not match the *in vivo* test (Akouedegni et al. 2019). *In vivo* tests performed on artificially infested sheep have demonstrated the therapeutic effect of extracts of *Z. zanthoxyloides, N. laevis, S. monbin, M. inermis A. senegalensis* (Azando et al. 2011; Azando et al. 2017; Akouedegni et al. 2019). *S. monbin* leaf powder and *Annona senegalensis* leaf extract administered to naturally infested sheep have been shown to be effective in reducing egg shedding with selectivity (Ademola et al. 2005; Nguessan et al. 2017). That is, the extracts are more active on some parasites than others. The aqueous extract of *Annona senegalensis* would not be effective on Taenia spp. (Nguessan et al. 2017). *Z. zanthoxyloides* and *N. laevis* powders would be more effective on *H. contortus* eggs than on *T. colubriformis* and *O. columbianum* eggs (Azando et al. 2011).

Table 2: List of some medicinal plants traditionally used in the treatment of gastrointestinal parasitosis and not yet tested in small ruminants

Family	Species	References
Acanthaceae	*Nelsonia canescens (Lam.)*	Dassou et al. (2015); Ogni et al. (2014)
Alliaceae	*Allium sativum*	Dassou et al. (2012); Ogni et al. (2014)
Amaranthaceae	*Amaranthus spinosus*	Ogni et al. (2014)
Anacardiaceae	*Anacardium occidentale*	Ogni et al. (2014)
	Lannea acida	Garba et al. (2019)
	Mangifera indica	Dassou et al. (2012); Ogni et al. (2014)
	Sclerocarya bierrea	Garba et al. (2019)
Apocynaceae	*Pleiocarpa pycnantha*	Dassou et al. (2012); Ogni et al. (2014)
Asclepiadaceae	*Leptadania hastata*	Garba et al. (2019)
Bignoniaceae	*Kigelia Africana*	Garba et al. (2019)
Bombacaceae	*Adansonia digitata*	Dassou et al. (2012); Ogni et al. (2014); Garba et al. (2019)
	Ceiba pentandra	Kabore et al. (2007)
Cachlospermaceae	*Cochlospermum planchonii*	Dassou et al. (2012); Ogni et al. (2014); Garba et al. (2019)
Caesalpinioideae	*Cassia sieberiana*	Dassou et al. (2012); Garba et al. (2019)
	Tamarindus indica	Ogni et al. (2014)
Capparaceae	*Boscia salicifolia*	Garba et al. (2019)
	Boscia senegalensis	Garba et al. (2019)
	Cadaba farinosa	Garba et al. (2019)
	Crateva adansonii	Dassou et al. (2012); Ogni et al. (2014)
	Maerua crassifolia	Garba et al. (2019)
Caricaceae	*Carica papaya*	Dassou et al. (2012); Attindehou et al. (2012); Sidi et al. (2017a); Islam et al. (2019)
Celtidaceae	*Celtis integrifolia*	Garba et al. (2019)
Cochlospermaceae	*Crotalaria rotusa*	Garba et al. (2019)
	Pilostigma reticulatum	Garba et al. (2019)
Combretaceae	*Anogeissus leiocarpa*	Dassou et al. (2012); Ogni et al. (2014); Garba et al. (2019);
	Combretum micranthum	Garba et al. (2019)
	Guiera senegalensis	Garba et al. (2019)
	Pteleopsis suberosa	Dassou et al. (2012); Ogni et al. (2014)
	Terminalia avicennioides	Dassou et al. (2012);
	Terminalia macroptera	Dassou et al. (2012); Ogni et al. (2014)
Convolvulacea	*Ipomoea asarifolia*	Dassou et al. (2012); Ogni et al. (2014)
	Ipomoea batatas	Dassou et al. (2012)
	Ipomoea eriocarpa	Dassou et al. (2012)
Crassulaceae	*Kalanchoe crenata*	Dassou et al. (2012)
Cucurbitaceae	*Adenopus breviflorus*	Dassou et al. (2012)
	Cucumis melo	Attindehou et al. (2012)
	Momordica charantia	Dassou et al. (2012)
Euphorbiaceae	*Croton zambesicus*	Garba et al. (2019)
	Euphorbia kamerunica	Dassou et al. (2012); Ogni et al. (2014)
	Jatropha curcas	Attindehou et al. (2012)
	Phyllanthus amarus	Attindehou et al. (2012)
	Acacia albida	Garba et al. (2019)
	Acacia nilotica	Garba et al. (2019)

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Fabaceae	*Cajanus cajan*	Attindehou et al. (2012)
	Gliricidia sepium	Attindehou et al. (2012)
	Tephrosia purpurea	Garba et al. (2019)
Lamiaceae	*Ocimum canum*	Attindehou et al. (2012)
	Ocimum gratissimum	Attindehou et al. (2012)
Leguminosae	*Caesalpinia bonduc*	Dassou et al. (2012)
	Caesalpinia pulcherrima	Dassou et al. (2012)
	Detarium microcarpum	Dassou et al. (2012)
	Isoberlinia doka	Dassou et al. (2012); Ogni et al. (2014)
	Prosopis africana	Dassou et al. 2012; (Garba et al. 2019)
Lythraceae	*Lawsonia inermis*	Garba et al. (2019);
Meliaceae	*Khaya senegalensis*	Dassou et al. (2012); Garba et al. (2019)
	Trichilia prieuriana	Attindehou et al. (2012)
	Azadirachta indica	Dassou et al. (2012); Attindehou et al. (2012); Ogni et al. (2014);
Menispermaceae	*Rhigiocarya racemifera*	Dassou et al. (2012); Ogni et al. (2014)
Moraceae	*Ficus unibellata*	Attindehou et al. (2012)
Moringaceae	*Moringa oleifera*	Dassou et al. (2012); Attindehou et al. (2012); Sidi et al. (2017a); Ogni et al. (2014)
Myrtaceae	*Psidium guajava*	Dassou et al. (2012); Attindehou et al. (2012); Ogni et al. (2014); Silva et al. (2020)
Olacaceae	*Ximenia americana*	Dassou et al. (2012)
Phytolaccaceae	*Petiveria alliacea*	Attindehou et al. (2012)
Poaceae	*Eragrostis tremula*	Garba et al. (2019)
	Zea mays	Kpabi et al. (2020)
Polygalaceae	*Securidaca longepedunculata*	Garba et al. (2019)
Rhamnaceae	*Ziziphus mauritiana*	Garba et al. (2019)
Rubiaceae	*Gardenia erubescens*	Kabore et al. (2007)
	Macrosphyra longistyla	Dassou et al. (2012)
	Sarcocephalus latifolius	Dassou et al. (2012); Ogni et al. (2014)
	Spermacoce stachydea	Garba et al. (2019)
Rutaceae	*Citrus limon*	Dassou et al. (2012)
	Citrus sinensis	Ogni et al. (2014)
	Harrisonia abyssinica	Attindehou et al. (2012)
Salvadoraceae	*Salvadora persica*	Garba et al. (2019)
Scrophulariaceae	*Striga hermonthica*	Garba et al. (2019)
Zygophyllaceae	*Balanites aegyptiaca*	Garba et al. (2019)

1.4. Secondary metabolites responsible for the anthelmintic activity of medicinal plants

The presence of bioactive substances such as flavonoids, alkaloids, tannins and essential oils confer anthelmintic properties to medicinal plants (Williams et al. 2014; Azando et al. 2017; Olounladé et al. 2017; Saha and Lachance 2020; Castro et al. 2021), Tannins reportedly inhibit larval migration and egg hatching (Olounladé et al. 2017; Tianhoun et al. 2020; Tchetan et al. 2020). Tannins will bind to free proteins in the cuticle which will then result in physiological alteration of motility, nutrition, absorption and reproduction (Githiori et al. 2006). Fig. 2 describes the mechanisms and sites of action of secondary metabolites of medicinal plants with anthelmintic properties.

1.5. Factors that may influence the anthelmintic activity of medicinal plants

The results obtained on the effectiveness of plant extracts on gastrointestinal parasites, depend on several parameters such as: the species part used; the type of extract; the dose of extract applied, and the parasite used (life stage). According to the work of Akouedegni et al. (2019), the ethanolic extract of *S. monbin* leaves is more effective on larval motility than the methanolic extract. Similar observations are reported by Ademola et al. (2005), according to which the aqueous extract of the same *S. monbin* plant is more effective on larvae than the ethanolic extract. The acetone extract of *P. biglobossa* is more effective on larval migration than methanolic extract (Dedehou et al. 2014); the acetonic extract of *Cassia alata* is more effective than the aqueous extract on egg hatching (Tianhoun et al. 2020). This difference in the activity of one extract of the same plant compared to another would be related to the presence or absence of certain secondary metabolites in one extract compared to the other (Tianhoun et al. 2020). Indeed, depending on affinities, a solvent has the potential to extract in majority certain secondary metabolites. However, the production of secondary metabolites in plant species is correlated to geographical, climatic and genetic factors of the species (Maiga et al. 2020). Essential oils extracted from medicinal plants are also subject to much variation in their chemical compositions. They can vary depending on the geographical site,

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time of day, season and genetic factors specific to the species itself. For a better use of anthelmintic medicinal plants, it is therefore necessary to master the factors of variation of secondary metabolites responsible for anthelmintic activities. It is also important to focus on the bioavailability of the species for a better exploitation of these medicinal plants.

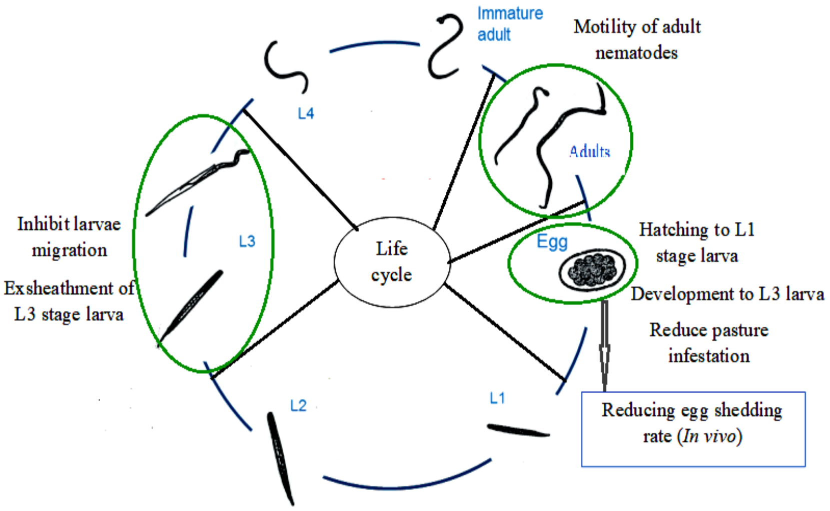

Fig. 2: Potential mechanisms of action of secondary metabolites (essential oil; tannins flavonoids, alkaloids, phenol) from medicinal plants on gastrointestinal parasites of small ruminants.

Conclusion: Through previous studies, medicinal plants have demonstrated their ability to be used in the control of gastrointestinal parasitosis in small ruminants. However, the anthelmintic activities of these plants depend on several factors that must be controlled. The secondary metabolites: flavonoids, alkaloids, tannins and essential oils responsible for the anthelmintic activity of medicinal plants are subject to variations according to geographical and intrinsic factors of the plants. Also, the secondary metabolites present in a given medicinal plant extract depend on the solvent used for extraction. Anthelmintic medicinal plants (or their extracts) do not have the same efficacy on parasitic nematodes, and small ruminants and even humans are often confronted with polyparasitism. In short, anthelmintic medicinal plants are good candidates in the fight against intestinal parasitosis.

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