Therapeutic efficacy of Curcumin, *Tamarindus indica* and *Zingiber officinale* against coccidiosis in sheep

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Abstract

The present study was conducted to evaluate the anti-coccidial activity of Curcumin (Turmeric/ Haldi), *Tamarindus indica* (Tamarind/ Imli), and *Zingiber officinale* (Ginger/ Adrak) in sheep infected with coccidiosis, as well as to assess the prevalence of coccidiosis in Parbhani. In this study, 40 lambs aged 0–3 months exhibiting clinical signs such as diarrhea and pale mucous membranes were randomly selected and divided into four groups. Group I was treated with Amprolium powder at 62.5 mg/kg BW PO for 7 days. Group II received Curcumin tablets at 4.3 mg/kg BW PO for 14 days. Group III was administered *T. indica* (seed coat powder) at 5 g/kg BW PO for 4 days, while Group IV was treated with *Z. officinale* powder at 300 mg/kg BW PO for 7 days. Faecal and blood samples were collected on the 7th, 14th, and 21st days post-treatment to evaluate therapeutic efficacy. All treatment groups showed significant improvements in clinical parameters, including temperature, heart rate, and respiration rate. Haematological indices (PCV, TEC, TLC, neutrophil, eosinophil, and monocyte counts) and biochemical parameters (total protein and AST levels) also improved significantly across all groups. Group I (Amprolium) demonstrated the highest efficacy (99.08%), closely followed by Group III (*T. indica* seed coat) at 94.06%, Group II (Curcumin) at 79.26%, and Group IV (*Z. officinale*) at 67.98%. These results indicate that Amprolium is the most effective in reducing coccidial oocysts, followed by *Tamarindus indica*, Curcumin, and *Zingiber officinale*, highlighting the potential of these herbal agents as alternative anti-coccidial treatments.

Keywords: *Tamarindus indica*, Curcumin, Coccidiosis, Sheep, *Zingiber officinale*, Amprolium

Introduction

Prevalence of gastro-intestinal parasitism among sheep populations is a serious problem (Kalwaghe et al., 2022) and affects profitability of sheep farming globally (Djimon et al., 2024). Coccidiosis is highly prevalent, disease of small ruminants in India and around the world which causes high morbidity and mortality. This intestinal disease causes large economic losses globally and is particularly dangerous to young lambs that are indicated that less than 1 year old sheep have greater infection ratio. The present study highlights the promising anti-coccidial effects of these herbal products, suggesting their potential as viable alternatives for controlling gastrointestinal parasitism in small ruminants (Adeniji et al., 2017). Notably, turmeric and ginger rhizomes possess bioactive properties that contribute to their effectiveness as anti-coccidial feed additives.

Curcumin is the active ingredient found in *Curcuma longa* (Turmeric/ Haldi). *Curcuma longa*, commonly known as turmeric, has been used to treat various conditions like biliary disorders, anorexia, cough, diabetic wounds, hepatic disorders, rheumatism and sinusitis. Curcumin (diferuloylmethane) has anticoccidial activity by inhibiting sporozoites formation and immune modulation (Chanda and Ramachandra 2019). Curcumin has antioxidant, antineoplastic, antiviral, anti-inflammatory, antibacterial, antifungal, antidiabetic, anticoagulant, antifertility, cardiovascular protective, hepatoprotective and immunostimulant activity.

Tamarind (Imli), seed coat powder (*Tamarindus indica*), a byproduct rich in bioactive compounds such as polyphenols, flavonoids and tannins, has shown promise as a natural remedy due to its antimicrobial and antioxidant properties (Sravanthi et al., 2017). Utilizing tamarind seed coat powder offers an environmentally friendly and sustainable approach to managing coccidiosis in sheep, potentially enhancing animal health and reducing reliance on synthetic drugs.

The rhizome of *Zingiber officinale* (Ginger/ Adrak) is used as a delicacy or spice and it is also widely used in medicine. It belongs to family Zingiberaceae. One advantage of employing natural extracts like ginger is that it reduces the possibility of developing resistance; also, the residues of such natural items in meat are safe for human consumption and have no negative health consequences. Numerous pharmacological properties of ginger have been identified, including analgesic, anti-inflammatory, gastrointestinal regulating agent, antibacterial and antioxidant properties Riaz et al. (2015). Also, *Z. officinale* was effective against some parasites like *Giardia duodenalis*, *Leishmania* (Mohammadi et al. 2021), *Schistosoma mansoni* and *Trypanosoma cruzi*. Ginger (*Z. officinale*) contains active ingredients such are gingerdoine, gingerdiol and gingerol.

Considering the above knowledge, the present research study was conducted to evaluate the therapeutic efficacy of utility of Curcumin, *T. indica* and *Z. officinale* against coccidiosis in sheep.

Material and Methods

Study Area and Animals

The present research was conducted at the Department of Veterinary Clinical Medicine, Ethics and Jurisprudence and the Department of Veterinary Parasitology, Livestock Farm Complex (LFC), College of Veterinary and Animal Sciences, MAFSU, Parbhani (latitude 19.27° N, longitude 76.77° E). A total of 40 naturally infected lambs, aged 0–3 months and under the ownership of the LFC and local farmers, were included to evaluate the anti-coccidial efficacy of Curcumin, *T. indica* (seed coat), and *Z. officinale*.

Screening and Selection of Animals

Lambs were screened for coccidiosis using the faecal flotation technique and selected based on clinical signs such as rough, dull hair coat, weakness, diarrhea, loss of appetite, weight loss, pale mucous membranes, and an oocyst per gram (OPG) count > 200. Selected lambs were randomly assigned into four treatment groups (n = 10 per group).

Treatment Protocol

Selected lambs were randomly assigned into four treatment groups (n = 10 per group). The treatment groups were administered as, Group I received Amprolium powder at 62.5 mg/kg body weight orally for 7 days; Group II was given Curcumin tablets at 4.3 mg/kg body weight orally for 14 days; Group III was treated with *T. indica* (seed coat powder) at 5 g/kg body weight orally for 4 days; and Group IV received *Z. officinale* powder at 300 mg/kg body weight orally for 7 days.

Procurement and Administration of Medicine

Curcumin powder was commercially obtained from Hi-Media Laboratories Pvt. Limited, Mumbai, Maharashtra, India, and Curcumin tablets (50 mg each) were prepared by LR Pharma Pvt. Limited, Parbhani, Maharashtra, India for oral administration at the prescribed dose. *T. indica* seed coat powder was procured from a private herbal medicine company in Ahmednagar, Maharashtra, India, while *Z. officinale* (dry powdered ginger) was purchased from an authentic medicine shop in the local market of Parbhani district, Maharashtra, India. The

herbal powders were administered orally to the sheep at the prescribed doses, mixed with an appropriate quantity of water to facilitate intake.

Sample Collection and Evaluation Parameters

Faecal and blood samples were collected on days 0 (pre-treatment), 7, 14, and 21 (post-treatment) to assess therapeutic efficacy. Clinical parameters recorded included rectal temperature, heart rate, respiratory rate, mucous membrane condition, general body condition, and fecal consistency. Haematological parameters included Hb, PCV, TEC, TLC and ALC. Biochemical parameters comprised serum total protein, albumin, globulin, BUN, creatinine, AST, ALT, and ALP. Parasitological evaluation was conducted through OPG count and fecal egg count reduction percentage.

Evaluation of Treatment Efficacy

Therapeutic efficacy was determined by improvements in clinical, haematological, and biochemical parameters, as well as reduction in parasitic load. All treatment groups showed significant improvement in clinical signs, including normalization of temperature, heart rate, and respiratory rate, confirming the efficacy of both conventional (Amprolium) and herbal treatments in coccidiosis-affected lambs.

Statistical Analysis

The analysis of the data of the present research work was carried by CRD using Wed Agri Stats Package (WASP 2.0) and values were expressed as Mean ± SE. mucous membrane, body condition, Faecal consistency was done by Kruskal Wallis test and judged based on the ranking.

Results

The therapeutic efficacy of Amprolium (Group I), Curcumin (Group II), *T. indica* (Group III), and *Z. officinale* (Group IV) against coccidiosis in sheep was evaluated over 21 days.

Rectal temperatures normalized in all groups by day 21. A significant ($p<0.05$) decrease in heart rate (Group I: 76.60±1.74 to 68.60±1.42 bpm; Group II: 80.70±2.03 to 69.40±2.37 bpm; Group III: 81.90±1.58 to 72.00±1.24 bpm) and respiration rate (Group I: 32.80±0.88 to 28.00±0.87; Group II: 31.20±1.15 to 26.30±0.67; Group III: 32.70±0.74 to 27.00±0.52 breaths/min) was observed in Groups I, II, and III from day 0 to 21.

The best body condition scores by day 21 were observed in Group III (12.80) and Group II (13.00), while the most significant reduction in diarrhea was seen in Group III (33.50 to 13.70) and Group IV (30.50 to 12.50).

A significant ($p<0.05$) recovery from anemia was noted, with increased Hb (Group I: 6.62±0.26 to 8.00±0.23 g/dL; Group II: 7.18±0.29 to 8.78±0.30 g/dL; Group III: 6.87±0.16 to 8.48±0.11 g/dL) and PCV (Group I: 19.78±0.73 to 24.11±0.55%; Group II: 21.43±0.90 to 25.73±0.65%; Group III: 20.67±0.65 to 24.57±0.34%) in Groups I, II, and III. TEC increased significantly in all groups, with Group IV showing the highest final count (7.65±0.22 $x10^6/\mu L$).

TLC decreased significantly ($p<0.05$) in all groups by day 21 (Group I: 12.36±0.93 to 9.59±0.48; Group II: 12.61±0.75 to 10.26±0.36; Group III: 13.96±0.54 to 10.56±0.42; Group IV: 13.64±1.05 to 10.17±0.59 $x10^3/\mu L$), signifying resolution of infection. Differential counts further supported recovery, with a significant ($p<0.05$) decline in absolute neutrophils (e.g., Group III: 9.63±0.55 to 4.90±0.30 $x10^3/\mu L$) and concurrent rise in lymphocytes (e.g., Group III: 2.47±0.19 to 4.93±0.18 $x10^3/\mu L$). Total protein increased significantly ($p<0.05$) in Groups I, II, and III (Group I: 5.37±0.11 to 6.13±0.18; Group II: 5.31±0.16 to 6.26±0.11; Group III: 5.34±0.09 to 6.11±0.08 g/dL), with albumin following a similar trend.

Table 1. Results of oocyst per gram (OPG) count in coccidiosis positive sheep treated with Curcumin, *T. indica* and *Z. officinale* at different intervals

Group	0 days	7th day	14th day	21st day
I	$21560.00^{Bb} \pm 5960.0$	$7030.00^{a} \pm 3861.3$	$930.00^{Aa} \pm 293.27$	$200.00^{Aa} \pm 55.77$
II	$4580.00^{Ab} \pm 788.64$	$2090.00^{a} \pm 427.51$	$1310.00^{Aa} \pm 252.74$	$950.00^{Aa} \pm 152.93$
III	$3870.00^{Ab} \pm 993.54$	$970.00^{a} \pm 277.30$	$490.00^{Aa} \pm 115.90$	$230.00^{Aa} \pm 53.85$
IV	$6370.00^{Ab} \pm 1885.2$	$3710.00^{a} \pm 1133.4$	$2910.00^{Ba} \pm 891.12$	$2040.00^{Ba} \pm 566.70$

A similar superscript indicates a non-significant difference

Table 2. Results of faecal oocyte count reduction (FOCR) percentage in coccidiosis positive sheep treated with Curcumin, *T. indica* and *Z. officinale* at different intervals

Group	0 day	7th day	14th day	21st day
Group I (Amprolium)	0 %	67.40 %	95.69 %	99.08 %
Group II (Curcumin)	0 %	54.37 %	71.40 %	79.26 %
Group III (*Tamarindus indica*)	0 %	74.94 %	87.34 %	94.06 %
Group IV (*Zingiber officinale*)	0 %	41.76 %	54.32 %	67.98 %

Hepatic enzymes decreased significantly ($p<0.05$) across all groups (e.g., AST in Group III: 85.40±2.14 to 66.60±2.05 U/L; ALT in Group II: 40.57±1.41 to 34.52±1.22 U/L; ALP reduced in all groups). BUN and creatinine also decreased significantly ($p<0.05$) in all groups (e.g., Group III BUN: 36.90±1.38 to 30.90±1.34 mg/dL), indicating improved renal function.

The results of OPG counts and FOCR are presented in Tables 1-2. All treatments reduced oocyst counts over 21 days while the highest reduction was observed in Amprolium-treated sheep.

Discussion

The present study recorded an overall point prevalence of 73.52% coccidiosis in sheep in and around Parbhani district, which is comparable with the 72.45% prevalence reported by Sontakke et al. (2015). Coccidiosis-affected sheep treated with various anticoccidial preparations were evaluated for clinical, haemato-biochemical changes and OPG counts. Infected sheep showed decreased Hb, PCV, and TEC. Similar reductions in Hb associated with hemorrhagic enteritis in coccidiosis-infected lambs were reported by Al-Dujaily et al. (2017). Reduced Hb decreases the oxygen-carrying capacity of blood, leading to anemia (Raghvendra et al., 2018). Following treatment, a significant increase in Hb and TEC was observed in all treatment groups.

Coccidiosis-infected sheep showed elevated TLC and differential leukocyte counts. Similar elevation in TLC in coccidiosis-infected sheep was reported by Abdulmageed et al. (2022). The increase in leukocyte counts may be due to the normal defensive response of the body against infection (Raghavendra et al., 2018). Comparable findings were also reported by Al-Dujaily et al. (2017), who observed increased TLC in coccidiosis-infected lambs, while Abdel-Saeed and Salem (2019) reported elevated neutrophil counts in affected lambs.

Sheep infected with coccidiosis showed decreased total protein, albumin, and globulin levels. The reduction in total protein may be attributed to enteritis and diarrhoea, leading to malabsorption and protein loss, thereby reducing serum protein concentration (Hashemnia et al., 2014). Treatment with amprolium resulted in improvement in clinical, physiological, haematological, and biochemical parameters. Significant improvement was recorded in rectal temperature, heart rate, respiration rate, mucous membrane colour, body condition, TEC, TLC, absolute eosinophil, neutrophil and monocyte counts, total protein, albumin, AST, ALT, ALP, and BUN. A significant reduction in OPG count was observed by day 21, with 99.08% reduction. Similar high efficacy of amprolium has been reported in sheep (Mahmoud et al., 2018) and in coccidiosis-infected buffalo (Raut et al., 2025; Navkar et al., 2022).

In the curcumin-treated sheep, significant improvement was recorded in rectal temperature, heart rate, respiration rate, mucous membrane colour, body condition, faecal consistency, Hb, PCV, TEC, TLC, ALC, eosinophil, neutrophil and monocyte counts, TP, albumin, AST, ALT, ALP, serum creatinine and BUN. A significant reduction in OPG count was observed by day 21, with 79.26% reduction. Similar findings were reported by Cervantes-Valencia et al. (2016), who observed a decrease in oocyst count in coccidiosis-infected lambs following curcumin treatment. The reduction in OPG may be attributed to inhibition of sporozoite development and immunomodulatory effects of curcumin (Raut et al., 2025; Khalafalla et al., 2011).

In *T. indica* (seed coat)-treated sheep, significant improvement occurred in clinical, haematological, and biochemical parameters. A significant reduction in OPG count (94.06%) was recorded by day 21. Similar findings were reported by Soundararajan et al. (2019), who observed a significant decrease in oocyst counts following treatment with *T. indica* seed coat powder in goats. Bunviboolvat et al. (2013) also reported significant anthelmintic activity of *T. indica* seed extract against gastrointestinal nematodes in lambs.

In *Z. officinale*-treated sheep, significant improvement occurred in rectal temperature, mucous membrane colour, body condition, faecal consistency, TEC, TLC, eosinophil, neutrophil, lymphocyte and monocyte counts, TP, albumin, AST, ALT, ALP, and BUN. A reduction in OPG count was also observed during the study period. Similar findings were reported by Ashraf et al. (2020), who observed significant reduction in oocyst counts with *Z. officinale,* showing a maximum efficacy of 63.01% on day 21. Furthermore, Ashraf et al. (2023) reported that while amprolium showed higher efficacy, natural alternatives such as *Curcuma longa* and *Z. officinale* exhibited moderate anticoccidial activity ranging from 38–64%.

Conclusion

The overall prevalence of coccidiosis in sheep around Parbhani was 73.52%, with 42.66% in males and 57.33% in females. Comparative efficacy based on faecal oocyst count reduction (FOCR) was Amprolium: 99.08%, Curcumin: 79.26%, *Tamarindus indica* (seed coat): 94.06%, and *Zingiber officinale*: 67.98%. *Tamarindus indica* (seed coat) demonstrated efficacy comparable to Amprolium, followed by Curcumin and Zingiber officinale.

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Authors' contributions

Conceptualization – Siddiqui M.F.M.F., Sakhare M.P.; Data curation & analysis –Ahire PC, Yeotikar PV, Shaikh SR; Methodology- Siddiqui MFMF, Lokhande SA, Sakhare MP, Jadhav N.D; Validation & Investigation- Ahire PC, Lokhande SA, Siddiqui M.F.M.F.; Writing, review & editing – Syed A.M., Ahire P.C, Siddiqui MFMF, Shaikh S.R.

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Data availability

Upon reasonable request, the datasets of this study can be available from the corresponding author.

Code availability

Not applicable

Ethics approval

All the experimental procedures and the study protocol have been approved by the Institutional Committee and Board of Studies of College of Veterinary & Animal Sciences, Parbhani, approved as on clinical cases (Resolution No: IAEC 147/25) and the experiments were performed in accordance with the internationally accepted standard ethical guidelines for animal use and care.

Conflict of Interests

No any conflict of interest relevant to this article was reported from all authors or any other source.

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