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Anthelmintic evaluation of *Carica papaya* against gastrointestinal nematodes in goats

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Abstract
The research aimed to explore the effectiveness of an aqueous seed extract from *Carica papaya* in treating gastrointestinal helminths in goats. Goats with confirmed helminth infestations were chosen for the study, receiving the *Carica papaya* extract. Blood and biochemical parameters were analyzed. The *Carica papaya* extract led to a significant reduction in the average egg per gram (EPG) count in the infested goats. Over the course of treatment, the reduction in EPG was notable 84.9% on the third day, 96.6% on the seventh day, and 100% by the 14th day. Hematological parameters and biochemical parameters showed improvement, indicating that the extract had a positive impact on blood profiles. These findings suggest that the aqueous extract of *Carica papaya* possesses potent anthelmintic properties and could serve as an alternative treatment for gastrointestinal helminths in goats.

Keywords: Helminth, egg per gram, aqueous extract

Introduction
Gastrointestinal helminths pose significant economic challenges due to reduced growth rates, productivity, and increased mortality in small ruminants. Goats, in particular, are highly vulnerable to such infections due to their grazing behavior (Das *et al.*, 2016) [7]. India, historically rich in medicinal plants, harbors a wealth of natural resources, particularly within its forests, which are abundant with medicinal and aromatic plants collected for various purposes, including drug manufacturing and perfumery (Joy *et al.*, 1998) [9]. Relying solely on anthelmintic drugs for controlling internal parasites in livestock is not sustainable, especially in tropical and subtropical regions where high levels of anthelmintic resistance, especially among nematode parasites of small ruminants, are prevalent. Additionally, many farmers in these areas lack resources to afford or are hesitant to purchase drugs of potentially questionable quality (Krecek and Waller, 2006) [10].
Papaya (*Carica papaya* L.) is widely cultivated and esteemed as a fruit tree in tropical and subtropical regions across the globe. Utilizing dried papaya seeds combined with honey has demonstrated significant efficacy in treating human intestinal parasites, with minimal adverse effects. The primary anthelmintic agent in these seeds is Benzylisothiocynate, as identified by Vij and Prashar in 2015 [17]. Research suggests that the biochemical mechanism of action of Benzylisothiocynate, derived from *Carica papaya*, involves inhibiting glucose uptake and depleting glycogen content, as proposed by Kumar *et al.* in 2014 [11]. In this study, we assess the anthelmintic properties of an aqueous seed extract of *Carica papaya* against a variety of gastrointestinal helminths in goats.

Materials and Methods
Collection of plant materials and extraction
The seeds and its extract has been procured from National Ayurveda Research Institute for Panchkarma, Cheruthuruthy, Kerala, India.

Anthelminthic activity

The experimental doses of plant extracts used in this investigation were determined based on dosages reported to be effective in previous studies (Ameen *et al.*, 2010; Effendy *et al.*, 2014; Ameen *et al.*, 2018) [2, 8, 4]. A total of 10 goats aged between 6 to 12 months, exhibiting eggs per gram of feces (EPG) ranging from 600 to 800 before treatment, were selected in two groups. Group A were administered the aqueous seed extract of *Carica papaya* (Papaya) at a dosage of 100 mg/kg body weight orally once daily for 2 consecutive days, and group B were received Albendazole @7.5mg/kg bw. The efficacy of the anthelmintic plant extract was assessed by examining fecal samples for EPG before treatment (day 0) and on the 3rd, 7th, and 14th days post-treatment. Additionally, the body weights of the goats were recorded on day 0 before treatment and on the 15th day after treatment.

Estimation of haematological and biochemical parameters

Hematological and biochemical parameters were assessed by collecting blood samples from the goats under study. Samples were obtained from the jugular vein of each animal using 5 ml syringes and 24 gauge needles, and then deposited into properly labeled EDTA and clot activated vials. Haematological and biochemical parameters were analyzed following the methods outlined by Sastry (1989) [14].

Statistical analysis

Data was collected and analyzed statistically by application of two way Factorial Completely Radomized Design and Completely Randomized Design (Snedecor and Cochran, 1994) [15]

Results and Discussions

Table 1 summarizes the results of the Anthelminthic activity of *C. Papaya* seeds extract and Albendazole. The mean eggs per gram (EPG) count on day 0 was 690, which significantly decreased to 0 on the 14th day post-treatment with the aqueous seed extract of *Carica papaya* at a dose rate of 100 mg/kg once a day for 2 days. The progressive percentage decrease in EPG was noted as 84.9% on the third day, 96.6% on the seventh day, and 100% by the 14th daypost-treatment. Similar findings were reported by Ameen *et al.* (2010) [2] and Ameen *et al.* (2018) [4], who also observed significant reductions in EPG count after administering aqueous seed extract of *Carica papaya*. They attributed this effect to the presence of papain and benzylisothiocynate, biologically active compounds found mainly in the seeds of *Carica papaya*.

Administering the aqueous seed extract of *Carica papaya* (Papaya) at a dosage of 100 mg/kg body weight orally once daily for 2 days resulted in noticeable improvements in body weight in the treated goats. This increase in body weight could be attributed to the reduction of parasitic load facilitated by the plant extracts, thereby enhancing weight gain through improved digestion, absorption, and metabolism of feed nutrients.

Table 1: Effect of *Carica papaya* aqueous seed extract and Albendazole on average EPG (Mean ±SE) and per cent faecal egg count reduction in goats infested with gastrointestinal nematodes

Interval	0th day	3rd day	% reduction	7th day	% reduction	14th day	% reduction
Group-A	690±47.02	104.2±7.58	84.9	23.2±5.55	96.6	0±0	100
Group-B	705±40.45	210±63.60	70.2	10±6.67	98.5	0±0	100

Effect of *C. papaya* on haematological and biochemical values of goats

The blood profile, including parameters such as Hemoglobin, Packed Cell Volume, and Total Erythrocyte Count, of animals treated with the aqueous seed extract of *Carica papaya* at a dosage of 100 mg/kg body weight orally once daily for 2 days, demonstrated an increase following treatment, with the highest levels observed on the 14th day post-treatment. Detailed results of the haematological parameters are presented in Table 2.

In terms of haematological parameters, the mean value of hemoglobin before treatment was 6.33±0.45, showing a significant increase to 8.41±0.38 on the 14th day post-treatment. Similarly, the mean value of Packed Cell Volume before treatment was 19.60±1.34, which significantly rose to 25.58±1.07 on the 14th day post-treatment. Additionally, the Total Erythrocyte Count mean value before treatment was 3.20±0.21, displaying a significant increase to 4.43±0.23 on the 14th day post-treatment. Conversely, the Total Leucocyte Count mean value before treatment was 17.09±0.92, showing a significant reduction to 16.38±1.55. Eosinophils exhibited a significant reduction from the 3rd to the 14th day, while monocyte levels increased on the 14th day. Neutrophil levels experienced a non-significant decrease from the 3rd to the 14th day. Lymphocyte levels showed a significant increase on the 7th and 14th days compared to pre-treatment levels. Similar results were documented by Ameen *et al.* (2010) [2] and Effendy *et al.* (2014) [8] regarding the efficacy of the aqueous seed extract of *Carica papaya*. Ameen *et al.* (2018) [4] observed analogous findings and attributed them to active compounds in *Carica papaya* seeds that stimulate the haemopoietic system. The significant increase in Total Erythrocyte Count values could be attributed to the stimulation of the haemopoietic system by minerals and vitamins contained in *Carica papaya* seeds, as suggested by Nwofia *et al.* (2012) [13].

In terms of biochemical parameters, the initial serum aspartate aminotransferase level was 84.14±4.55 before treatment, which notably decreased to 70.59±3.87 by the 14th day after treatment. Similarly, the total protein level before treatment was 4.59±0.13, showing a significant increase to 6.50±0.14 on the 14th day post-treatment. Additionally, albumin levels rose from 2.47±0.07 to 3.55±0.13, while globulin levels increased from 2.13±0.10 to 2.94±0.07 after treatment on the 14th day. Mean iron levels also significantly rose from 129.72±7.29 to 143.02±9.89 by the 7th day of treatment. Similar observations were made by Kumar *et al.* (2014b) [11], Effendy *et al.* (2014) [8] and Ameen *et al.* (2018) [4].

The increase in protein levels could potentially be attributed to certain antinutritional factors present in C. papaya seeds, such as trypsin inhibitors and oxalates. These enzymes inhibit trypsin and chymotrypsin activity in the gastrointestinal tract, thereby impeding protein digestion. Similarly, the decrease in AST levels after treatment may result from reduced traumatic damage to the abomasal and intestinal lining mucosa caused by adult parasites, as well as a decline in larval migration into hepatic cells.

Table 2: Effect of *Carica papaya* aqueous seed extract on average values (Mean ±SE) of haematological and biochemical parameters in goats infested with gastrointestinal helminths.

Blood Parameter	Interval	0th day	3rd day	7th day	14th day
Haemoglobin	Group-A	6.33±0.45	6.82±0.42	7.46±0.40	8.41±0.38
	Group-B	6.05±0.22	6.17±0.22	6.17±0.23	6.20±0.19
Total leukocyte count	Group-A	17.09±0.921	16.16±1.30	16.61±1.39	16.38±1.55
	Group-B	16.89±0.65	16.49±0.80	16.37±0.57	17.09±0.59
Total erythrocyte count	Group-A	3.20±0.21	3.59±0.22	3.96±0.22	4.43±0.23
	Group-B	2.89±0.11	2.88±0.11	2.93±0.10	2.95±0.11
PCV	Group-A	19.60±1.34	21.44±1.22	23.09±1.15	25.58±1.07
	Group-B	17.89±0.55	17.85±0.54	17.89±0.50	17.98±0.52
AST	Group-A	84.14±4.55	83.51±4.42	80.81±4.47	70.59±3.87
	Group-B	83.20±3.34	79.13±3.33	74.14±3.11	68.67±3.01
Total Protein	Group-A	4.59±0.13	5.62±0.23	6.09±0.20	6.50±0.14
	Group-B	4.36±0.10	4.47±0.10	4.50±0.10	4.54±0.12
Albumin	Group-A	2.47±0.07	2.91±0.10	3.25±0.11	3.55±0.13
	Group-B	2.27±0.08	2.29±0.07	2.31±0.05	2.32±0.05
Globulin	Group-A	2.13±0.10	2.71±0.16	2.84±0.11	2.94±0.07
	Group-C	2.08±0.04	2.18±0.06	2.19±0.06	2.22±0.08
Neutrophils	Group-A	41.6±2.36	41.9±3.10	41±1.67	39.8±2.10
	Group-B	40.3±1.92	38.1±2.03	36±1.45	34.3±1.61
Lymphocyte	Group-A	48.00±2.12	48.80±2.87	52.50±1.77	54.30±2.32
	Group-B	49.60±2.02	53.00±2.23	57.40±1.44	60.30±1.71
Eosinphils	Group-A	8.2±0.72	5.5±0.71	4.4±0.4	2.9±0.31
	Group-B	8.1±0.54	6±0.49	4.6±0.30	2.8±0.29
Monocyte	Group-A	2.2±0.38	3.8±0.53	2.1±0.31	3.00±0.33
	Group-B	2.00±0.21	2.9±0.27	2.00±0.29	2.6±0.26
Iron	Group-A	129.72±7.29	129.44±7.28	143.02±9.89	
	Group-B	126.25±7.23	125.89±7.13	136.25±6.10	

Group A - C. papaya and Group B- Albendazole

The study concluded that administering an oral dose of 100 mg/kg body weight of aqueous seed extract of *Carica papaya* once daily for 2 days proved highly effective as an anthelmintic, based on changes observed in body weight, fecal egg counts (EPG), and hematological and biochemical parameters. This suggests that identifying novel and promising anthelmintic plant extracts like *Carica papaya* could contribute significantly to the development of phytotherapeutic products. Such products could potentially offer greater cost-effectiveness, safety, accessibility, and reduced risk of resistance compared to conventional anthelmintic treatments currently in use.

Conclusion

In conclusion, the study highlights the remarkable anthelmintic efficacy of *Carica papaya* seed extract, as evidenced by significant reductions in fecal egg counts and improvements in hematological and biochemical parameters in treated animals. Notably, the administration of a 100 mg/kg oral dose of the extract for two days yielded impressive results, indicating its potential as a cost-effective and safe alternative to conventional anthelmintic treatments. These findings underscore the importance of exploring plant-based remedies like *Carica papaya* for developing effective phytotherapeutic products with reduced risks of resistance. This research contributes to the ongoing quest for novel solutions in combating parasitic infections in livestock, offering promising avenues for future developments in veterinary medicine and livestock management.

Conflict of Interest

Not available

Financial Support

Not available

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