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Anthelmintic Activity of Aqueous and Alcoholic Extracts of *Carica papaya* Seeds in Naturally Infested Goats

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ABSTRACT

Background: Gastro-intestinal parasitism is an important worldwide animal ailment causing heavy production losses in grazing animals and it is more prevalent in developing countries like India, mainly due to warm temperature in association with poor management practices and inadequate control measures. It can affect production through weight loss, diarrhoea, anaemia, reduction in milk and wool production, reproduction changes and mortality in case of heavy infestations. The current study was planned to evaluate the *in vivo* anthelmintic activity of extracts of *Carica papaya* seeds in naturally-infested goats.

Methods: Twenty-four helminth-infested goats of either sex were randomly divided into four treatment groups (T_1-T_4); each having six goats and T_1 served as untreated control while T_2 received a single dose of albendazole @ 7.5 mg/kg body weight on day zero. Group T_3 and T_4 were respectively treated with aqueous and alcoholic extracts of *Carica papaya* seeds @ 100 mg/kg body weight orally daily for 30 days. Faecal egg count, haematological estimations and biochemical estimations were conducted on the zero, 10th, 20th and 30th day of the experiment.

Result: Group T_2, T_3 and T_4, showed a significant reduction in EPG count following treatment. All treated animals showed a significant increase in Hb, TEC, PCV and lymphocytes and a significant decrease in TLC, neutrophil and eosinophil levels on the 20th and 30th days of the experiment. The results indicated possession of good anthelmintic activity by both extracts with better results from the alcoholic extract of *Carica papaya* seeds. These herbal extracts can be a safe and therapeutically efficacious alternative to standard chemical drugs.

Key words: Albendazole, Anthelmintic, *Carica papaya*, Goat, Phytochemical.

INTRODUCTION

Since the Indus valley civilization, small ruminant husbandry has been a numerically and economically remarkable contributor to livestock as a source of nutritious food, regular income, warm clothing, food security in remote areas, food security and fixed deposit for nomadic, transportation of ration, source of income for women and many uses for poor and landless farmers of the Indian subcontinent who keep these animals on almost zero input system with pasture grazing supplemented with tree loppings. The grazing behaviour of these animals and no parasitic control program exposes them to heavy gastrointestinal parasitism leading to unthriftiness and poor production leading to economic loss with occasional animal loss and setbacks to the poor rural household. Several reports have suggested that gastrointestinal parasitic infection imposes severe economic losses on the livestock industry and adversely affects the health, weight gain, feed conversion efficiency, milk production and reproduction of animals (Fthenakis and Papadopoulos, 2018).

Anti-parasitic drugs are frequently used to control the internal parasites in grazing herds. But these drugs are not able to give a long-term solution. Indiscriminate use of commonly used anti-parasitic drugs like benzimidazole, levamisole and ivermectin has developed resistance. Toxicity due to inappropriate dose administration, long withdrawal period, risk of drug residues in animal products and cost of the treatment are other big problems associated with the use of synthetic drugs (Gill, 1996; Kaplan, 2004). Ethno-medicine plays a very significant role in human health care since time immemorial and a large number of people in India directly or indirectly depend on medicinal plants derived drugs for their health care needs (Sharma *et al*., 2021). Medicinal plants are used worldwide to treat various ailments in humans and livestock. A number of medicinal plants have been used to treat intestinal parasites in men and animals (Githiori *et al*., 2005; Liu, 2020). The herbal treatments are feasible, locally available to farmers and are environmentally innocuous control methods. Hence, it is the need of the day to develop anthelmintic drugs of herbal origin to manage the threatening anthelmintic resistance developed by the endoparasites against the available chemical anthelmintic.

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Carica papaya belongs to the family Caricaceae and is available throughout the world including in tropical and subtropical regions. India is the largest producer of papaya. *Carica papaya* is well known for its nutritional and medicinal importance and extracts of different parts of the plant have shown protective effects against many diseases. It is also a good source of vitamins A and C (Goku *et al*., 2020; Suryawanshi *et al*., 2022). *Carica papaya* has been reported for diversified effects like antiparasitic, antiseptic, antimicrobial, anti-inflammatory, antihypertensive, antidiabetic antioxidant, immunomodulatory, hypoglycemic and hypolipidemic (Elgadir *et al*., 2014; Jaiswal *et al*., 2010). Various in vitro studies have reported the anthelmintic effect of *Carica papaya* (Goku *et al*., 2020; Islam *et al*., 2019; Odhong *et al*., 2014). However, studies on the in vivo anthelmintic action of *Carica papaya* are meager. The present study is, therefore, undertaken to evaluate the *in vivo* anthelmintic activity of the *Carica papaya* seeds on the gastrointestinal nematodes of goats.

MATERIALS AND METHODS

Animals

Twenty-four adult goats of either sex, naturally infested with helminth parasites were selected from an unorganized goat farm in Bikaner. Initially, all the goats at the farm were screened for helminth infestation by examination of faecal samples. The goats with eggs per gram of faeces (EPG) more than 700, as determined by McMaster method (Soulsby, 1982) following concentration with salt floatation technique were chosen for the experiment. These goats were randomly divided into four groups *viz.* T_1 (negative control), T_2 (positive control; treated with a single dose of albendazole @ 7.5 mg/kg body weight on day zero), T_3 (treated with aqueous extract of seeds of *Carica papaya* @ 100 mg/kg body weight orally daily for 30 days) and T_4 (treated with alcoholic extract of seeds of *Carica papaya* @ 100 mg/kg body weight orally daily for 30 days), each having six goats. Animals were maintained at their respective place of rearing to avoid any undue stress due to changes in management conditions. Ethical standards and guidelines as recommended by the Committee for the Purpose of Control and Supervision of Experiments on Animals (CPCSEA), Govt. of India, were followed during the entire study. The study was conducted at the College of Veterinary and Animal Science, Rajasthan University of Veterinary and Animal Sciences, Bikaner from the month July 2019 to December 2019, after the onset of the rainy season and up to early winters when goats are maintained on green pasture.

Preparation of extract

The dried mature seeds of *Carica papaya* were procured from the local market and coarse ground for the preparation of extracts. The extracts were prepared by hot continuous extraction by using soxhlet's assembly. The aqueous (pressure 72 mbar; temp 40°C) and alcoholic (pressure 145 mbar; temp 40°C) extracts were concentrated in a rotary evaporator (Hei-VAP, Heidolph Instruments, GmbH and Co.KG, Germany) and the residues obtained were stored at -20°C. The extractability or yield (%) of aqueous and ethanolic extract was 2.44 % and 5.34 %, respectively.

Faecal sample examination

Faecal samples from each animal were collected directly from the rectum in the morning, starting from day zero (pre-treatment) and at days 10, 20 and 30 post-treatment and further processed and examined for the presence of eggs of gastrointestinal parasites. Eggs were recovered by salt floatation technique and counted by the McMaster method (Solsby, 1982). Egg per gram (EPG) was calculated as follows:

Table 1: Qualitative phytochemical analysis of aqueous and alcoholic extracts of *Carica papaya* seeds.

Active principle	Test applied	Aqueous extracts of *Carica papaya* seeds	Alcoholic extracts of *Carica papaya* seeds
Alkaloids	Dragendroff's reagent	+	+
	Wagner's reagent	+	+
Reducing sugars	Benedict's reagent	-	+
	Fehling's reagent	-	+
Glycosides	Benedict's reagent	-	+
	Fehling's reagent	-	+
Sterols	Salkowski reaction	-	-
	Lieberman buchard reaction	-	-
Proteins	Xanthoprotein test	-	-
	Biuret test	-	-
Tannins	Lead acetate test	+	+
	Ferric chloride test	+	+
Flavonoids	Alkaline reagent test	+	+
	Lead acetate test	+	+
Saponins	Foam test	+	+
Anthraquinones	Bontrager's test	-	-

Eggs per gram (EPG) =
Total number of eggs in the two chambers × 100

Anthelmintic efficacy was calculated by the faecal egg count reduction (FECR) test (Wood *et al*., 1995) according to the following formula:

$$\text{FECR} = \frac{\text{Pre - treatment EPG - Post - treatment EPG}}{\text{Pre - treatment EPG}} \times 100$$

Haematological estimations

The blood samples (3 ml) were collected in EDTA on day zero (pre-treatment) and on days 10th, 20th and 30th post-treatment for haematological estimations. Blood smears for differential leukocyte count (DLC) were prepared from fresh blood. The estimation of haematological parameters *viz.* haemoglobin (Hb), packed cell volume (PCV), total erythrocyte count (TEC) and total leukocyte count (TLC) was carried out using a fully automatic analyzer (Mindray BC-2800 Vet). Differential leukocyte count (DLC) was carried out manually.

Biochemical estimations

The blood samples (5 ml) were collected in plain tubes for serum biochemical estimation. Then serum was harvested by centrifugation at 3000 rpm for 10 minutes. The separated serum was stored at -20°C until analysis. Biochemical parameters *viz.* serum creatinine, serum albumin, alkaline phosphatase (ALP), serum alanine aminotransferase (ALT), serum aspartate aminotransferase (AST), serum cholesterol, Gamma-glutamyl transpeptidase (GGT), serum glucose, triglycerides (TGL), urea, total protein (TP) and total serum bilirubin were estimated using a fully automatic biochemistry analyzer 'Turbo Chem 100, Awareness Technologies, USA', employing the dedicated iChem 100 reagent kits.

Phytochemical analysis

The phytochemical analysis was undertaken to determine the presence of various active constituents *viz.* alkaloids, reducing sugars, glycosides, tannins, flavonoids, saponins, phytosterols, anthraquinones and proteins of aqueous and alcoholic extracts of *Carica papaya* seeds by conducting the various tests described by Raaman, 2006.

Statistical analysis

The data obtained from various parameters were analyzed by as per the SPSS (Version 20) and new duncan multiple range test (New Duncan MRT). The data was considered statistically significant when p<0.05.

RESULTS AND DISCUSSION

The phytochemical analysis showed the presence of alkaloids, tannins, flavonoids and saponins in both the extracts of *Carica papaya* seeds (Table 1). Glycosides and reducing sugars were present only in the alcoholic extract of seeds. This observation was found to be consistent with the observations of previous studies which reported the presence of saponins, glycosides, tannins flavonoids and alkaloids in the aqueous extract of seeds (Naggayi *et al*.,

Table 2: Effect on eggs per gram (EPG) and per cent faecal egg count reduction (FECR) following oral administration of aqueous and alcoholic extracts of *Carica papaya* seeds in goats.

Group	Treatment	Eggs per gram (EPG) level (Mean ± SE) and FECR%						
		Day 0	Day 10th		Day 20th		Day 30th	
		EPG level	EPG level	FECR%	EPG level	FECR%	EPG level	FECR%
1	Control (Untreated)	1016.67 ± 60.00^{aA}	1033.33 ± 84.33^{bA}	-	1066.67 ± 55.78^{cA}	-	1183.33 ± 65.41^{cA}	-
2	Albendazole @ 7.5 mg/kg body weight orally	966.67 ± 66.67^{aA}	483.33 ± 30.73^{aB}	50.00	283.33 ± 30.73^{aC}	70.69	150.00 ± 34.16^{aD}	84.48
3	Aqueous extract of seeds of *Carica papaya* @ 100 mg/kg body weight orally	1050.00 ± 76.38^{aA}	916.67 ± 65.41^{bA}	12.69	650.00 ± 42.82^{bB}	38.09	316.67 ± 47.73^{abC}	69.84
4	Alcoholic extract of seeds of *Carica papaya* @ 100 mg/kg body weight orally	1100.00 ± 85.64^{aA}	900.00 ± 57.74^{bB}	18.18	616.67 ± 40.14^{bC}	43.93	250.00 ± 34.16^{abD}	77.27

Different superscripts with denotations a, b and c indicate significant (p<0.05) differences within the groups (values in the same column); superscripts with denotations A, B, C and D indicate significant (p<0.05) differences within the days (values in the same row).

2015). Some of the observations made were also not consistent with previously reported data, for example, the presence of anthraquinones in the aqueous extract (Adeneye and Olagunju, 2009) and the absence of tannins in ethanolic extract (Goku *et al*., 2020) of *Carica papaya* seeds. The total action of the extracts is a sum of the activities of their constituents (Rates 2001). The anthelmintic effect of papaya seeds has been variously attributed to carpaine (an alkaloid) and carpasemine (later identified as benzyl thiourea by Panse and Paranjpe, 1943) and benzyl isothiocyanate (Kermanshai *et al*., 2001; Krishnakumari and Majumder, 1960; Tang, 1971).

Initially, all the goats were heavily infected with mixed species of gastrointestinal helminths. There was a significant reduction ($p<0.05$) in egg counts in groups T_3 and T_4 compared with the negative control group (Table 2). The present data clearly shows that *Carica papaya* is effective against gastrointestinal helminths as is evident from FECR. The faecal egg count reduction was higher with alcoholic extract as compared to aqueous extract but the difference was not significant.

According to International anthelmintic efficacy guidelines, for an effective anthelmintic, there should be

Table 3: Haematology of control (untreated, Group I), albendazole-treated (Group II), aqueous extract of *Carica papaya* seeds treated (Group III) and alcoholic extract of *Carica papaya* seeds treated (Group IV).

Parameters	Days	Groups			
		I	II	III	IV
Hb (g/dl)	0	7.95±0.16^{aA}	7.62±0.14^{aA}	7.73±0.16^{aA}	7.68±0.11^{aA}
	10	7.88±0.07^{aA}	8.05±0.14^{abA}	8.12±0.12^{abA}	8.27±0.10^{abB}
	20	7.73±0.12^{aA}	8.58±0.16^{bB}	8.62±0.13^{bB}	8.70±0.06^{bC}
	30	7.63±0.16^{aA}	9.42±0.13^{bC}	9.23±0.12^{bC}	9.33±0.05^{bD}
PCV (%)	0	24.47±0.29^{aA}	23.87±0.47^{aA}	23.48±0.41^{aA}	23.83±0.28^{aA}
	10	24.55±0.31^{aA}	24.55±0.32^{aA}	24.58±0.40^{aA}	24.97±0.32^{aB}
	20	24.02±0.11^{aA}	25.97±0.40^{bB}	26.20±0.45^{bB}	26.17±0.28^{bC}
	30	23.68±0.27^{aA}	28.52±0.42^{bcC}	27.92±0.36^{bC}	28.32±0.14^{bD}
TEC (%)	0	8.73±0.19^{bA}	7.90±0.14^{aA}	7.87±0.24^{aA}	8.6±0.22^{bA}
	10	8.25±0.17^{aA}	9.04±0.29^{bB}	8.57±0.27^{abB}	9.15±0.01^{bAB}
	20	7.89±0.14^{aA}	9.70±0.35^{bC}	9.17±0.27^{bBC}	9.69±0.06^{bBC}
	30	7.65±0.13^{aA}	11.14±0.26^{cD}	9.65±0.29^{bC}	10.27±0.05^{bC}
TLC (%)	0	10.08±0.23^{abA}	10.02±0.28^{aA}	11.17±0.29^{cA}	10.75±0.18^{bcA}
	10	10.42±0.19^{bA}	9.37±0.22^{aB}	10.68±0.31^{bA}	10.40±0.15^{bA}
	20	10.68±0.18^{cA}	8.67±0.21^{aC}	10.12±0.27^{bcBC}	9.80±0.19^{bB}
	30	11.07±0.30^{cA}	7.57±0.15^{aD}	9.70±0.21^{bC}	9.18±0.13^{bB}
N (%)	0	40.67±0.67^{aA}	43.17±0.70^{abA}	46.17±1.66^{bA}	44.17±1.30^{abA}
	10	42.17±0.95^{bA}	36.83±0.65^{aB}	42.83±1.74^{bAB}	40.67±1.02^{abAB}
	20	44.33±0.62^{bAB}	32.83±0.95^{aC}	40.67±2.01^{bB}	36.83±1.52^{aB}
	30	47.00±0.93^{cB}	28.83±1.08^{aD}	33.17±2.06^{bC}	28.67±1.15^{aC}
L (%)	0	50.00±0.82^{bA}	47.67±0.99^{abA}	45.50±1.50^{aA}	48.00±1.59^{abA}
	10	48.33±0.76^{aA}	55.33±1.15^{cB}	50.00±1.98^{abB}	51.67±1.26^{abA}
	20	45.67±0.62^{aAB}	60.67±2.12^{dC}	53.17±2.20^{bB}	57.83±1.49^{cdB}
	30	43.17±0.98^{aB}	66.17±1.66^{dD}	61.67±2.14^{bcC}	65.83±2.17^{cdC}
M (%)	0	4.17±0.48	3.50±0.56	3.50±0.43	3.33±0.56
	10	4.17±0.48	3.50±0.22	3.33±0.72	3.67±0.42
	20	4.17±0.48	3.67±0.49	3.67±0.67	3.17±0.48
	30	3.83±0.60	3.17±0.31	3.33±0.42	3.67±0.67
E (%)	0	5.17±0.31^{aA}	5.17±0.48^{aA}	4.33±0.67^{aA}	4.33±0.67^{aA}
	10	5.33±0.49^{bA}	4.17±0.60^{abAB}	3.33±0.67^{aAB}	3.67±0.49^{aAB}
	20	5.67±0.33^{bA}	3.33±0.33^{aB}	2.17±0.70^{aBC}	2.33±0.42^{aBC}
	30	5.83±0.40^{bA}	1.67±0.56^{aC}	1.50±0.43^{aC}	1.50±0.56^{aC}
B (%)	0	0.17±0.17	0.50±0.34	0.17±0.17	0.50±0.22
	10	0.00±0.00	0.17±0.17	0.33±0.33	0.67±0.42
	20	0.17±0.17	0.33±0.33	0.00±0.00	0.00±0.00
	30	0.17±0.17	0.17±0.17	0.17±0.17	0.33±0.33

Different superscripts with denotations a, b, c and d indicate significant ($p<0.05$) differences within the groups (values in the same column); superscripts with denotations A, B, C and D indicate significant ($p<0.05$) differences within the days (values in the same row).

significant statistical differences between the treated and control groups and the calculated percent effectiveness should be 90% or more. Effectiveness below 90% may be adequate when the claimed parasites do not have any other effective treatment (Vercruysse *et al*., 2001). In our study, aqueous and alcoholic extracts of *Carica papaya* seeds

Table 4: Biochemical analysis of control (untreated, Group I), albendazole-treated (Group II), aqueous extract of *Carica papaya* seeds treated (Group III) and alcoholic extract of *Carica papaya* seeds treated (Group IV).

Parameters	Days	Groups			
		I	II	III	IV
Serumcreatinine (mg/dl)	0	0.91±0.03	0.91±0.07	0.78±0.07	0.80±0.11
	10	0.95±0.05	0.94±0.08	0.92±0.06	0.91±0.06
	20	0.95±0.08	0.91±0.05	0.88±0.04	0.83±0.04
	30	0.97±0.04	0.80±0.04	0.78±0.06	0.83±0.10
Serum albumin (g/dl)	0	2.81±0.11^{cA}	1.96±0.09^{abA}	1.77±0.05^{aA}	2.15±0.13^{abA}
	10	2.76±0.26^{bA}	2.53±0.13^{abB}	2.08±0.07^{aA}	2.56±0.10^{abAB}
	20	2.28±0.20^{aAB}	2.82±0.26^{abBC}	2.59±0.14^{abB}	2.98±0.07^{bB}
	30	2.19±0.18^{aB}	3.18±0.29^{bcC}	3.24±0.21^{bcC}	3.51±0.13^{cC}
Serum alkaline phosphatase (IU/L)	0	141.83±6.49	122.93±3.66	137.42±25.37	126.67±7.84
	10	142.07±3.87	119.62±3.03	125.68±25.79	125.75±9.38
	20	143.72±2.30	117.02±2.96	122.77±21.35	124.67±8.24
	30	144.03±2.65	116.02±3.45	122.70±27.79	123.12±8.03
Serum alanine aminotransferase (IU/L)	0	28.98±2.27	38.08±0.91	39.87±1.89	38.52±2.70
	10	29.48±4.46	37.43±3.46	35.65±5.22	33.13±2.29
	20	34.62±1.33	35.37±5.42	35.53±2.33	31.48±2.65
	30	35.93±1.04	33.73±1.24	34.55±3.34	30.87±6.04
Serum aspartate aminotransferase (IU/L)	0	129.43±11.09	117.47±10.73	132.72±6.19	123.53±6.45
	10	129.78±14.82	112.08±10.83	131.93±6.76	122.17±6.85
	20	131.58±11.51	109.83±10.48	129.03±7.10	121.15±5.71
	30	133.75±15.26	107.18±11.22	126.22±10.37	117.20±7.08
Serum cholesterol (mg/dl)	0	85.52±2.37	83.55±2.63	76.54±3.83	82.67±3.94
	10	86.95±3.52	82.04±2.59	76.10±2.84	81.65±5.11
	20	87.23±2.13	81.47±2.03	75.95±1.89	81.27±3.93
	30	88.14±3.10	81.38±3.20	75.14±2.95	81.04±4.29
Serum gamma-glutamyl transpeptidase (U/L)	0	38.32±2.41	35.55±4.38	30.95±5.14	33.43±1.40
	10	39.57 ± 3.00	34.90±3.29	30.93±5.19	33.63±2.38
	20	40.58±2.89	34.28±2.83	30.73±4.24	33.78±1.68
	30	41.38±3.33	34.07±2.96	30.18±3.57	33.93 ± 2.07
Serum glucose (mg/dl)	0	42.62±1.79^{abA}	39.92±0.91^{aA}	41.54±2.21^{abA}	39.61±1.38^{aA}
	10	40.16±1.41^{aA}	48.10±1.66^{bB}	44.79±1.96^{abA}	43.06±1.04^{aA}
	20	39.99±1.81^{aA}	54.28±0.97^{bC}	50.18±1.30^{bB}	50.02±0.99^{bB}
	30	38.33±1.05^{aA}	61.54±1.01^{bD}	60.72±3.33^{bC}	60.38±1.35^{bC}
Triglyceride (mg/dl)	0	25.24±1.20	26.86±1.98	26.54±1.61	26.85±1.33
	10	26.03±2.22	25.10±1.44	32.99±2.64	32.86±1.75
	20	31.52±2.97	31.27±2.69	31.14±2.55	31.06±2.31
	30	25.03±2.76	24.85±2.64	26.77±4.48	26.86±1.95
Serum total protein (g/dl)	0	5.81±0.13^{aA}	5.82±0.22^{aA}	5.72±0.28^{aA}	6.17±0.43^{aA}
	10	5.65±0.13^{aAB}	6.19±0.23^{aAB}	6.29±0.27^{aAB}	6.28±0.27^{aA}
	20	5.57±0.20^{aAB}	6.74±0.25^{bBC}	6.79±0.19^{bBC}	6.65±0.36^{bA}
	30	5.07±0.09^{aB}	7.35±0.26^{bC}	7.14±0.20^{bC}	7.38±0.23^{bB}
Serum total bilirubin (mg/dl)	0	0.08±0.01	0.09±0.01	0.09±0.01	0.08±0.01
	10	0.08±0.01	0.09±0.01	0.08±0.01	0.08±0.01
	20	0.09±0.01	0.09±0.01	0.08±0.01	0.08±0.01
	30	0.09±0.01	0.09±0.01	0.08±0.01	0.08±0.01

Different superscripts with denotations a, b, c and d indicate significant ($p<0.05$) differences within the groups (values in the same column); superscripts with denotations A, B, C and D indicate significant ($p<0.05$) differences within the days (values in the same row).

showed good anthelmintic activity with 69.84 and 77.27 percent reduction in faecal egg count, respectively. Faecal egg reduction in goats treated with the standard reference drug albendazole is 84.48 per cent, indicating resistance in gastrointestinal nematodes in the animal farm. There is no significant difference was found in the goats treated with extract of *Carica papaya* seeds (T_3 and T_4) and albendazole (T_2) indicating that *Carica papaya* seeds extract may be used as an alternative to chemical drugs. As recorded in the present study, the anthelmintic activity of *Carica papaya* has also been reported earlier against gastrointestinal helminths (Ameen *et al*., 2010; Ameen *et al*., 2012; Effendy *et al*., 2014; Feroza *et al*., 2017; Islam *et al*., 2019; Zingare *et al*., 2018).

Administration of the standard drug and *Carica papaya* seed extracts resulted in a remarkable improvement in the haematological (Table 3) and biochemical (Table 4) parameters of animals in Groups T_2, T_3 and T_4. A significant increase in the mean values of Hb, TEC, PCV, lymphocytes, serum albumin and glucose was recorded. Our findings on haematological parameters are in accordance with Ameen *et al*. (2010). *Carica papaya* seeds have also been reported to contain various vitamins and minerals which are essential for haemopoiesis (Saeed *et al*., 2014).

CONCLUSION

Aqueous and alcoholic extracts of *Carica papaya* seeds have a remarkable anthelmintic effect in goats. Both extracts were found able to improve altered haemato-biochemical parameters in all naturally parasitic infested goats towards the normal level. Goats treated with plant extracts did not show any adverse effects as visualized by clinical inspection and haemato-biochemical estimation.

Conflict of interest: None.

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