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Leptadenia Hastate and Cedrus Brevifolia Oil: Effect on Growth Performance, Caecal Microbial Population, Fermentation and Haematological Indices of Weaner Rabbits

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A B S T R A C T

This experiment was carried out to examine the effect of Leptadenia hastate and Cedrus brevifolia oil dietary supplementation on the growth performance, caecal microbial population, fermentation and some haematological indices of weaner rabbits. Eighty buck growing rabbits of mixed sex with an initial body weight of 618.7 ± 1.8 g and 4– months of age were randomly assigned into four treatments (n=20 each) were used for the 60 days feeding trial. Basal diet was formulated to meet the nutritional standard of growing rabbits according to NRC (2007). The treatments include; A (control): basal diet without oil, B: basal diet supplemented with 200 mg Leptadenia hastate oil per kg DM daily, C: basal diet with 200 mg Cedrus brevifolia oil per kg DM daily and D: basal diet supplemented with 100 mg each of Leptadenia hastate and Cedrus brevifolia oil per Kg DM daily. Leptadenia hastate and Cedrus brevifolia oil supplementation enhanced ($p<0.05$) average daily weight gain, average daily feed intake while the high crude coriander oil supplementation level decreased feed to gain ratio. Leptadenia hastate and Cedrus brevifolia oil supplementation decreased Staphylococcus aureus, Escherichia coli, Pseudomonas spp, Streptococcus spp count, ammonia nitrogen and increased the populations ($p<0.05$) of Lactobacillus spp and total volatile fatty acid. Leptadenia hastate and Cedrus brevifolia oil supplementation increased ($p<0.05$) the concentration of pack cell volume, haemoglobin, red blood cell and white blood cell but did not influence pH across the treatments ($p>0.05$). In conclusion, Leptadenia hastate and Cedrus brevifolia oil supplementation at 200 mg/kg DM feed increased growth performance, inhibits the activities of caecal pathogenic organisms, improved ceacal fermentation and haematological parameters without causing any deleterious effect

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INTRODUCTION

The growing concern regarding the use and subsequent prohibition of antibiotic growth promoters and other substances on animal production opened the search for alternatives which could have a similar positive impact in livestock production without the undesirable effects which ultimately led to the banning of Antibiotic growth promoters (Harnandez and Alagbe, 2025; Shittu et al., 2024). The use of herbal plants and their extracts (essential oils) have been identified as natural alternative to antibiotics because they possess several medicinal properties (Matlop et al., 2017; Daniel et al., 2023).

Leptadenia hastate is one of the medicinal plant with abundant therapeutic properties, it is widely distributed in Europe, Australia and some parts of Asia including India (Nikiéma et al., 2001). The leaves, stem and root of the plant have been reported to contain alkaloids, saponins, phenolic glycosides, tannins, flavonoids, proanthocyanidins and triterpene which have generally been considered as non-toxic, effective and eco-friendly (Bayala et al., 2011). These compounds have also been found to possess antimicrobial, antioxidant (Agubosi et al., 2022b), anti-tumor, anti-inflammatory, immune-stimulatory, gastro and cardio- protective effect (Agubosi et al., 2022a; Alagbe et al., 2022). Its leaves, flowers, and shoots have been found to be loaded with significant quantity of protein, fiber, fat, and energy (Hassan et al., 2023). Extracts from the leaves of Leptadenia hastate have been used in traditional medicine in the treatment of skin infections, gastro-intestinal infections, pyrexia, snake bite and cararrh (Abubakar et al., 2015). Reports have also shown that extracts from Leptadenia hastate can inhibit the growth of Bacillus metagarium, Staphylococcus aureus, Escherichia coli, Salmonella paratyphi, Pseudomonas aeruginosa, Aspergillus niger and Fusarium oxysporum (Nikiéma, 2001; Bayala et al., 2011).

Cedrus brevifolia is an important medicinal plant widely distributed in Africa and Asia (Jasińska et al., 2013; Kadis et al., 2010). It has a drought resistant capacity that is well-differentiated from other species of the genus based on morphological and Eco physiological traits (Sharma and Singh, 2023). The plant is rich inmonoterpenes and sesquiterpenes with major compounds including □-pinene, -□ -pinene, limonene, cedrol and himachalene derivatives (Koutsaviti et al., 2022; Ladjal et al., 2007). These compounds are known for their antimicrobial, antioxidant and anti-inflammatory properties (Kadis et al., 2010).

Given the nutrient density and therapeutic qualities of L. hastate and the antioxidant, anti-inflammatory, and antimicrobial capacities of C. brevifolia oil, their combined dietary supplementation could synergistically improve growth performance, stabilize caecal fermentation processes, and positively modulate the microbial flora of weaned rabbits. Individually, these phytogenic resources have shown promising bioactivities, but little is known about their combined effects on animal performance and gut health (Hassan et al., 2023). Exploring their potential use in rabbit diets could offer a sustainable means of improving growth performance and gut ecology while reducing reliance on synthetic additives.

By investigating the combined supplementation of L. hastate and C. brevifolia oil, this research could provide evidence for a novel feed strategy that enhances growth performance, improves caecal fermentation, and promotes a healthier microbial balance in weaned rabbits. Such outcomes would contribute to improved rabbit productivity, reduced reliance on synthetic additives, and increased profitability for farmers, especially in resource-limited settings. Furthermore, the use of natural feed supplements aligns with global trends toward sustainable and antibiotic-free livestock production.

LITERATURE REVIEW

Research Station

The study was carried out at Gandhi College of Agriculture Rabbit section located at Rajasthan which is located in Northwatern India bounded on the West and Northwest by Pakistan.

Plant Collection and Identification

Fresh leaves of Leptadenia hastate and Cedrus brevifolia were collected in Rajasthan, India and taken to the Department of Crop Taxonomy, Gandhi College of Agriculture for proper identification and authentication by a certified taxonomist (Dr. Amit Patra) before it was assigned a voucher number AG/08A/2024C and AG/08B/2024D respectively.

Essential Oil Extraction Technique

The fresh leaves of Leptadenia hastate and Cedrus brevifolia were air-dried for eight and 10 days respectively. Thereafter, dried leaves were separately pulverized using mechanical grinder prior to extraction. The essential oil from each sample was extracted by steam distillation technique according to the method recently described by Alagbe (2024). Briefly, 500 g of the pulverized leaves were placed in a Clavenger apparatus, steam produced passes through the condenser and is collected into a glass collector. The oil obtained was dried over anhydrous sodium sulphate and stored in a refrigerator prior to analysis of their bioactive components. The process is repeated for each of the pulverized leaf samples adopting the same technique.

GC-MS Analysis of Bioactive Compounds in Leptadenia Hastate and Cedrus Brevifolia Essential Oil

Analysis of each essential oil was carried out using a TSQ 9000 Triple Quadrupole GC-MS instrument (Trace 1300 Series, USA). After 5mL injection of sample into the GC collection chamber, the initial temperature of the kit is set at a temperature of 40 °C for 15 min, followed by an increase to 200 °C at a rate of 5 °C/minutes, pressure of 1.4902 psi and average velocity of 44.22 cm/seconds were also maintained. The mass spectrometer was set at an electron ionization mode of 70eV, ion source temperature of 220 °C, quadrupole temperature of 120 °C and transfer line temperature of 250 °C. Acquisition of ion was through Scan mode (scanning from m/z 40 to 500 amu at 2.5s/scan rate). All other processes were done by strictly adhering to the manufacturer's instructional manual.

Relative percentage amounts of bioactive components were evaluated from the total peak area by apparatus software. Identification of components in the volatile oil was based on the comparison of their mass spectra and retention

time with literature data and by computer matching with NIST (2001) library as well as by comparison of the fragmentation pattern of the mass spectral data with those reported in the literature. Composition of their bioactive compound is presented in Table 1 and 2.

Animal Management and Dietary Treatment

Eighty buck growing rabbits of mixed sex with an initial body weight of 618.7 ± 1.8 g and 4– months of age were randomly assigned into four treatments (n=20 each) were used for the 60 days feeding trial. Rabbits were cared for according to procedures outlined by Indian Society of Animal Production and housed individually in an already disinfected galvanized battery cage measuring (40 x 30 x 30 cm) equipped with feeder and automatic nipple drinkers was kept in semi-housed pens. Basal diet was formulated to meet the nutritional standard of growing rabbits according to NRC (2007). The treatments include; A (control): basal diet without oil, B: basal diet supplemented with 200 mg Leptadenia hastate oil per kg DM daily, C: basal diet with 200 mg Cedrus brevifolia oil per kg DM daily and D: basal diet supplemented with 100 mg each of Leptadenia hastate and Cedrus brevifolia oil per Kg DM daily. To ensure that animals take a full dose of the oil supplement, it was mixed in 100 g total diet DM to each rabbits before the first feeding in the morning. Rabbits were fed twice daily at 8:00 and 14:00 H, fresh water was supplied unrestricted throughout the experimental period and a completely randomized design was adopted. Feed intake was calculated as the difference between the feed offered and leftover from the previous day feeding. Average body weight gain was estimated as the difference between the average initial body weight and the average final body weight. Average daily weight gain and average daily feed intake was calculated as body weight gain and total feed intake divided by the experimental period respectively. Feed conversion ratio was calculated by dividing average daily feed intake by average daily weight gain. Composition of experimental diet is presented in Table 3 and its proximate analysis was done using AOAC (2015) procedures.

Collection and Analysis of Blood Parameters

At the end of the study, 5 mL of blood was collected fromfive randomly selected rabbits per treatment for haematological studies. Samples were collected in the morning into labeled sample bottles containing anticoagulant before it was sent to the laboratory for further examination. Analysis of red blood cell, pack cell volume, haemoglobin and white blood cells were carried out using Sysmex Automatic Haemo- Analyzer (Model XC-0944M, Netherlands). Kit was operated according to the manufacturers instruction to obtain precision in results.

Analysis of Caecal Microbes and Fermentation

On the last day of the experiment, 20g caecal content was taken from five randomly selected rabbits (same used for haematological evaluation) into a sterile sample bottle. Samples were spitted into 2 portions each for microbial population estimation and the other for the determination of caecal fermentation. For microbial analysis, a drop of 10 % peptone reagent was added to each sample before it was transferred to the laboratory. Caecal analysis of microbial population was done using Frosh Microbial Analyzer (Model XC-900H, China). Each microbewas individually identified on the counting chamber and their

population was estimated with the Kits' software before results were displayed on the monitor.

For caecal fermentation analysis, concentration of ammonia nitrogen and total volatile fatty acid were determined according to the method outlined by Annison (1954). pH of the sample was taken using pHep® Packet Sized pH meter with the following technical specifications; range (0.0 to 14.0), resolution (0.1 pH), accuracy (+0.1 pH) and environment (0 to 50 ℃).

METHODOLOGY

Statistical Analysis

Data obtained was subjected to one-way analysis of variance (ANOVA) using General Linear Model of SAS (2001)and the significant means separated by Duncan's multiple range test at $p<0.05$ level of significance.

Table 1. GC-MS Profiling of Leptadenia Hastate Essential Oil

S/N	Compounds	Reaction time (min)	Percentage Area
1	2,3,6,7-Tetramethyloctane	633	0.47
2	Trimethylbenzene	699	0.12
3	1,2,3-Benzenetriol	711	19.61
4	3-Hexenylhexanoate	774	0.06
5	Diisooctyl phthalate	809	30.44
6	Geranyl acetone	856	0.25
7	Cyclohexylhexanoate	881	0.18
8	Phthalic acid	906	12.45
9	γ-Cadinene	931	0.03
10	2,6,10-Trimethyltetradecane	1002	0.19
11	Epiglobulol	1055	0.07
12	2-Heptanol	1092	9.43
13	β-Sesquiphellandrene	1141	0.01
14	Geranyl acetone	1160	0.16
15	2,2-Methylene bis [6-(1,1-dimethylethyl)4- ethyl]Phenol	1188	0.80
16	Ethyl-9,12- Octadecadienoate	1211	0.02
17	Squalene	1246	0.19
18	Isopropyltetradecanoate	1270	0.55
19	9-Hexadecenoic acid	1308	0.49
20	Cis,cis-9,12-Octadecadienoic	1354	0.15
21	4,6-Dimethyldodecane	1398	0.06
21	4,5-Dimethylnonane	1420	0.11
22	β-Cymene	1503	0.16
23	Cis-α-Bisabolene	1584	0.04
	Total		76.04

Table 2. GC-MS Profiling of Cedrus Brevifolia Essential Oil

S/N	Compounds	Reaction time (min)	Percentage Area
1	Hexahydrofarnesyl acetone	761	1.90
2	Tetratetracontane	788	1.36
3	α-pinene	809	49.38
4	1,3,5,8-Undecatetraene	856	0.07
5	1,8-Cineole	880	0.18
6	α-Terpinolene	902	9.97
7	α-Himachalene	964	0.20
8	β-Caryophyllene	1021	10.59
9	Isoaromadendrene Epoxide	1045	0.90
10	Isopropyl-12-methyltridecanoate	1092	8.37
11	Benzene isothiocyanate	1140	0.11
12	α-Zingiberene	1169	0.35
13	α-Cadinol	1230	0.47
14	17-Octadecynoic acid	1255	0.26
15	hexadecanoic acid	1303	0.94
16	Methylcyclohexane	1317	0.12
17	Cis-Carvotanacetol	1405	0.55
18	Ethylbenzene	1439	0.71
19	β-bisabolol	1490	0.38
	Total		86.81

Table 3. Ingredient and Chemical Composition of Basal Diet (% DM)

Components	Quantity (% DM)
Maize (8.9 % CP)	29.75
Wheat barn (11 % CP)	20.00
Palm kernel meal	20.00
Groundnut cake (41 % CP)	15.50
Soya bean meal (45 % CP)	10.00
Mineral/Vitamin Premix	0.25
Bone meal	3.00
Limestone	1.50
Salt	0.50
Total	100.0
Chemical composition (% DM)	
Dry matter	89.69
Crude protein	14.04
Crude fibre	13.55
Ether extract	2.61
Ash	7.04
Energy (Kcal/kg)	2600.4

2.5 kg Growers premix contained: Thiamine, 1000 mg, riboflavin, 6000 mg, pyridoxine, 5000 mg, cyanocobalamine, 25 mg, niacin, 60,000 mg., D-panthotenate, 20,000 mg, folic acid, 200 mg, D-biotin, 8 mg, Retinyl acetate, 40 mg, cholecalciferol, 500mg, tocopherol acetate, 40,000 mg., menadione, 800 mg, ascorbic acid, 60,000 mg, manganese, 500 mg, iron, 80,000 mg, zinc, nill, copper, nill, cobalt, 80 mg, iodine, 400 mg, selenium, 40 mg, choline chloride, 80,000 mg.

RESULTS AND DISCUSSION

GC-MS profiling of Leptadenia hastate and Cedrus brevifolia essential oil is presented in Table 1 and 2 respectively. Analysis of Leptadenia hastate by GC-MS reveals the presence of 23 bioactive compounds representing 76.04 % while Cedrus brevifolia contained 19 compounds representing 86.81 %. The major compound in Leptadenia hastate essential oil were; Diisooctyl phthalate (30.44 %), 1,2,3-Benzenetriol (19.61 %), Phthalic acid (12.45 %) and 2-Heptanol (9.43 %) while Cedrus brevifolia essential oil is dominated by □-pinene (49.38 %), β-Caryophyllene (10.59 %), α-Terpinolene (9.97 %) and Isopropyl-12-methyltridecanoate (8.37 %). The presence of these compounds suggests that both oils have numerous medicinal properties such as, anti-inflammatory, antifungal, antioxidant (Oluwafemi et al., 2021), antitumor, anticancer (Singh et al., 2021), antimicrobial, cardio-protective (Devendran and Balasubramanian, 2011; Mamza et al., 2012), immune-stimulatory (Bazie et al., 2014), hepato-protective (Olajuyige et al., 2011), anti-helminthic, antidiarrheal, antidiabetic, cytotoxic (Odozi et al., 2014), neuroactive, cryoprotectant (Arawande et al., 2013), antimetabolite, hypocholesterolemic (Lima et al., 2010), amongst others. The result on the GC-MS profiling of Leptadenia hastateand Cedrus brevifolia essential oilis in consonance with the results of Sotirios et al. (2020) and Ifeoma et al. (2022).

Growth performance of growing rabbits fed diet supplemented withLeptadenia hastate and Cedrus brevifolia essential oil (Table 4). Average daily body weight gain was lower in treatment D (15.24 g) than in treatment B (19.16 g), C (19.17 g) and D (22.61 g) ($p<0.05$) whereas average daily feed intake was higher in treatment D (103.1 g), C (103.1 g), B (103.0 g) than treatment A (99.10 g) ($p<0.05$). The result suggests that the presence of bioactive compounds inLeptadenia hastate and Cedrus brevifolia essential oil can enhance the activities of digestive enzymes in the gut to allow absorption of nutrients which explains the reason for higher body weight among bucks in treatment B and C compared to the control. Although a superior body weight gain was recorded in treatment D relative to the other groups, this indicates that a synergistic combination of Leptadenia hastate and Cedrus brevifolia essential oil can modulate the activities of beneficial microorganisms and improve gastro intestinal morphology thus promoting rapid absorption capacity of nutrients (John, 2024b). The dietary supplementation of Leptadenia hastate and Cedrus brevifolia essential oil can also improve voluntary intake by having positive impact on palatability of diet through enhanced flavour and aroma (John, 2024c). Result obtained in this study is in conformity with the reports of Hafeez et al. (2016) who reported that encapsulation of essential oils containing thymol,

limonene and carvacrol at 100 mg/kg diet significantly improved body weight gain and feed intake of birds. Similarly, Alagawany et al. (2016) noted that dietary supplementation of garlic and turmeric extract improved performance and apparent ileal digestibility of nutrients compared with control in growing rabbits. Best feed to gain ratio was recorded among rabbits fed diet supplemented with essential oil, this results suggests that the bioactive compounds in the essential oil have therapeutic properties and can also modulate the retention period of feed in the gut translating to better weight among animals. This result is in agreement Abd El – Hack et al. (2016); Ahmed et al. (2013) when essential oil was supplemented in the diet of piglets.

Table 4. Growth Performance of Growing Rabbits Fed Diet Supplemented with Leptadenia Hastate and Cedrus Brevifolia Essential Oil

Parameters	A (control)	B	C	D	SEM
Experimental period	84	84	84	84	-
Number of animals	15	15	15	15	-
Average Initial body weight (g)	620.5	620.1	619.8	618.7	0.01
Average final body weight (g)	1900.4^{c}	2229.7 b	2230.1 b	2517.8 a	56.96
Average body weight gain (g)	1279.9^{c}	1609.6 b	1610.3 b	1899.1 a	31.04
Average daily weight gain (g)	15.24^{c}	19.16b	19.17b	22.61a	4.76
Average total feed intake (g)	8316.7^{c}	8652.8 b	8660.8 b	8663.7 a	161.8
Average daily feed intake (g)	99.01^{c}	103.0a	103.1a	103.1a	0.07
Feed: gain	6.50^{a}	5.38b	5.38b	4.57c	0.02

a,b,c: Means within a row with different superscripts are significantly different ($p<0.05$); TA: basal diet without oil (control); TB: basal diet with supplemented with 200 mgLeptadenia hastate oil/kg DM daily; TC: basal diet with supplemented with 200 mg Cedrus brevifolia oil/kg DM daily; TD: basal diet supplemented with 100 mg Leptadenia hastate and 100 mg Cedrus brevifolia oil mixture/kg DM daily.

Caecal microbial count of growing rabbits fed diet supplemented with Leptadenia hastate and Cedrus brevifolia essential oil is presented in Table 5. Staphylococcus aureus, Escherichia coli, Pseudomonas spp and Streptococcus spp population varied from 1.86 – 3.44 (×108 Cfu/mL), 2.00 to 4.09 (×106 Cfu/mL), 0.72 to 1.36 (×106 Cfu/mL) and 0.70 – 1.04 (×106 Cfu/mL) respectively. Dietary supplementation of Leptadenia hastate and Cedrus brevifolia essential oil influenced ($p<0.05$) the treatments. Values obtained decreases as the level of oil supplementation increased across the treatments. Conversely, lactobacillus spp population [(4.22 – 6.91 (×108Cfu/mL)] increases as the dietary supplementation of oil increased across the group ($p<0.05$). Results obtained indicates that essential oil from Leptadenia hastate and Cedrus brevifolia has

inhibitory effects against pathogens and promoting the activities of beneficial bacteria in the intestine. This is made possible due to the presence of bioactive compounds in Table 1 and 2. These compounds can effectively penetrate the cell membrane of pathogenic bacteria leading to their death (John, 2024d; Burt, 2004). This result confirms the earlier result of Omokore and Alagbe (2019), when Phyllantusamarus leaf was supplemented in the diet of growing rabbits. Similar observation was made by Enayat et al. (2021) who discovered a decrease in Escherichia coli count of growing rabbits fed with green coffee extract.

Table 5. Caecal Microbial Count of Growing Rabbits Fed Diet Supplemented with Leptadenia Hastate and Cedrus Brevifolia Essential Oil

Microbial count	A (control)	B	C	D	SEM
Staphylococcus aureus (×10^8 Cfu/mL)	3.44a	2.02b	2.00b	1.86c	0.01
Escherichia coli (×10^6 Cfu/mL)	4.09a	3.11b	2.98c	2.00c	0.02
Pseudomonas spp (×10^6 Cfu/mL)	1.36a	0.92b	0.87c	0.72d	0.16
Streptococcus spp (×10^6 Cfu/mL)	1.04a	0.81b	0.73c	0.70c	0.18
Lactobacillus spp (×10^6 Cfu/mL)	4.22c	5.63b	5.89b	6.91a	0.97

a,b,c: Means within a row with different superscripts are significantly different ($p<0.05$); TA: basal diet without oil (control); TB: basal diet with supplemented with 200 mgLeptadenia hastate oil/kg DM daily; TC: basal diet with supplemented with 200 mg Cedrus brevifolia oil/kg DM daily; TD: basal diet supplemented with 100 mg Leptadenia hastate and 100 mg Cedrus brevifolia oil mixture/kg DM daily.

Ceacal fermentation of growing rabbits fed diet supplemented with Leptadenia hastate and Cedrus brevifolia essential oil is presented in Table 6. pH, ammonia nitrogen and total volatile fatty acid values obtained varied from 6.09 – 6.20, 7.00 – 10.85 mmol/L and 95.88 – 102.2 mmol/L respectively. Caecal pH is an important parameter which determines the internal homeostatis of the caecal environment (Hernandez and Alagbe, 2025). The value of the pH was within 5.90 – 6.72 reported by John (2024e). In this study, the dietary supplementation of Leptadenia hastate and Cedrus brevifolia essential oil did not affect the activities of caecal microbes suggesting improved nutrient digestion. Ammonia nitrogen values was within 4.80 – 10.80 mmol/L reported by Enayat et al. (2021) when green coffee extract was fed to growing rabbits. This shows that the oil is capable of suppressing protozoal which live in symbiotic relationship with methanogenic archaea (Kholif et al., 2021). Total volatile fatty acid is the main source of energy for animals, the increased VFA production, in the present study, may likely be a net result of the improved apparent nutrient digestibility with Leptadenia hastate and Cedrus brevifolia essential oil. Total volatile fatty acid recorded in this experiment was within 89.11 – 150.6 mmol/L reported byGuray et al. (2011); John (2024c) when phytogenics was fed to weaned rabbits.

Table 6. Ceacal Fermentationof Growing Rabbits Fed Diet Supplemented with Leptadenia Hastate and Cedrus Brevifolia Essential Oil

Parameters	A	B	C	D	SEM
pH	6.09	6.20	6.18	6.11	0.02
Ammonia-N (mmol/L)	10.85a	7.93b	7.08b	7.00b	0.03
Total volatile fatty acids (mmol/L)	95.88c	111.7b	117.1b	120.2a	10.75

a,b,c: Means within a row with different superscripts are significantly different ($p<0.05$); TA: basal diet without oil (control); TB: basal diet with supplemented with 200 mgLeptadenia hastate oil/kg DM daily; TC: basal diet with supplemented with 200 mg Cedrus brevifolia oil/kg DM daily; TD: basal diet supplemented with 100 mg Leptadenia hastate and 100 mg Cedrus brevifolia oil mixture/kg DM daily.

Haematological parameters of growing rabbits fed diet supplemented with Leptadenia hastate and Cedrus brevifolia essential oil is presented in Table 7. Haematological parameters are very useful in the diagnosis of disease, nutritional deficiency and the physiological status of rabbits (Etim et al., 2013; Hernandez and Alagbe, 2025). In this current study, pack cell volume, red blood cell and haemoglobin values varied from 28.55 – 32.09 %, [(7.07 – 10.48 (×1012/L)] and 80.11 – 106.2 g/L respectively. Pack cell volume, haemoglobin and red blood cell obtained was within 28.00 – 36.00 %, 75.0 – 150.5 g/L and 6.00 – 18.00 [(×1012/L)] cited by Ewuola et al. (2010); RAR (2009). Result red blood cell count suggests that the dietary supplementation of with Leptadenia hastate and Cedrus brevifolia essential oil was able to promote an increase in absorbed nutrients, oxygen level carried to the tissues as well as carbon dioxide returned to the lungs (Omokore and Alagbe, 2019; Jain, 1986). Outcome on pack cell volume and haemoglobin count indicates that the rabbits were not anaemic and absence of hepato-cellular damage (Jain, 1993; Alagbe, 2024). White blood cell count ranged from [(12.51 – 15.80 (×109/L)]. White blood cell count was within [(10.00 – 25.00 (×109/L)] referenced by Mitruka and Rawnsley (1977). This result suggests that the oil could promote the production of more antibodies to fight infections in the body of animals (Muritala et al., 2022)

Table 7. Haematological Parameters of Growing Rabbits Fed Diet Supplemented with Leptadenia Hastate and Cedrus Brevifolia Essential Oil

Variables	A (control)	B	C	D	SEM
Pack cell volume (%)	28.55b	31.22a	32.00a	32.09a	0.66
Haemoglobin (g/L)	80.11c	91.71b	102.5a	106.2a	13.92
Red blood cell ($\times10^{12}$/L)	7.07b	10.02a	10.64a	10.48a	0.05
White blood cell ($\times10^{9}$/L)	12.51b	14.60a	15.33a	15.80a	0.08

a,b,c: Means within a row with different superscripts are significantly different ($p<0.05$); TA: basal diet without oil (control); TB: basal diet with supplemented with 200 mgLeptadenia hastate oil/kg DM daily; TC: basal diet with supplemented with 200 mg Cedrus brevifolia oil/kg DM daily; TD: basal

diet supplemented with 100 mg Leptadenia hastate and 100 mg Cedrus brevifolia oil mixture/kg DM daily.

CONCLUSIONS AND RECOMMENDATIONS

It was concluded that Leptadenia hastate and Cedrus brevifolia essential oil contains numerous bioactive compounds with nutritional and pharmacological properties. These essential oils can be used as natural alternative to antibiotics because they are safe, eco-friendly and has no withdrawal period. It was concluded that the dietary supplementation of Leptadenia hastate and Cedrus brevifolia essential oil up to 200 mg/kg DM diet could improve growth performance, caecal fermentation, microbial population and some haematological parameters observed.

FURTHER STUDY

This research still has limitations, so further research is needed related to the topic of Leptadenia Hastate and Cedrus Brevifolia Oil: Effect on Growth Performance, Caecal Microbial Population, Fermentation and Haematological Indices of Weaner Rabbits in order to perfect this research and increase insight for readers.

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