

Pharmacy and Drug Development

Research Article

Can Dietary Supplementation of *Clinopodium brownei* oil Influence the Growth Performance, Haematology and Serum Biochemical Indices of Hubbard Broiler Chickens?

Alagbe J.O^{1*}

¹Adjunct Lecturer, Department of Biochemistry, Gandhi College of Agriculture, Rajasthan, India

***Corresponding Author:** Alagbe J.O, Adjunct Lecturer, Department of Biochemistry, Gandhi College of Agriculture, Rajasthan, India.

Received Date: 14 January 2026; **Accepted Date:** 02 February 2026; **Published Date:** 12 February 2026

Copyright: © 2026 Alagbe J.O, this is an open-access article distributed under the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

Abstract

This experiment was undertaken to examine the influence of dietary supplementation of *Clinopodium brownei* oil on growth performance and some blood parameters of Hubbard broiler chickens. 400 – 1 day old Hubbard broilers of mixed sex were randomly distributed into four groups (T1, T2, T3 and T4) of 100 birds. Each group was further divided into five replicate consisting of twenty birds. Treatment T1 (Negative group/control): experimental diet without any additive, T2 (Positive control): experimental diet with 2.5 g Adriamycin® /kg diet, T3: experimental diet with 2.0 mL *Clinopodium brownei* oil per kg diet, T4: experimental diet with 4.0 mL *Clinopodium brownei* oil per kg diet. Experimental diet was formulated to meet the nutrient requirements for broilers requirements according to NRC (2012) recommendations. The experiment lasted for 42 days and a completely randomized design was adopted. Feed and fresh water was always made available. Overall result obtained reveals that in T3 and T4, the body weight gain and feed consumption was higher; in T2, it was intermediate; and in T1, it was lower ($p < 0.05$). Dietary supplementation of significantly enhanced ($p < 0.05$) red blood cell, pack cell volume, haemoglobin and white blood cell count. *Clinopodium brownei* oil supplementation decreased serum cholesterol concentration, mortality, feed conversion ratio and increase ($p < 0.05$) concentrations of total protein, albumin, globulin, alanine amino transferase and aspartate transaminase. In conclusion, *Clinopodium brownei* oil supplementation at 2.0 mL or 4.0 mL/kg diet improved body weight gain, feed consumption, feed conversion ratio and some blood constituents without compromising the health status of birds.

Keywords: *Clinopodium brownei* oil, Growth, Performance, Blood, Nutrients.

Introduction

As the demand for antibiotic free feed is increasing globally due to the rising cases of antimicrobial resistance which threatens both human and animals [1]. Incorporation of antibiotics in feed even at a lower concentration can foster resistant genes in bacteria over time and thus need to be prevented [2]. After the ban by the European Union in 2006, the use of medicinal plants have been suggested as one of the potential alternatives to antibiotics [3]. Herbs offer a promising tool to reduce antibiotic use because they contain bioactive compounds, eco-friendly, non-toxic and are gener-

ally regarded as safe [4].

Clinopodium brownei is a plant that carries a unique spectrum of bioactive compounds found in other trees. It is an aromatic, herbaceous, perennial plant which belongs to the family Lamiaceae and native to Tropical and sub-tropical America [5,6]. Every part of the plant holds a therapeutic value. The leaves heals fever, cough, arthritis, diarrhea, nausea, sore throat and vomiting [7,8]. Stem bark addresses skin infection, sexually transmitted disease, pile and eye problems [9,10]. The fruit decoction helps in strengthening

circulation of blood, digestion and also serves as tonic for the liver, heart, lungs and kidney [11]. Methanolic extract from *Clinopodium brownei* have been found to exhibit cytotoxic activity [12,13]. *Clinopodium brownei* leaves have potential deposit of phyto-compounds which includes, flavonoids, tannins, alkaloids, saponins and phenolic compounds which exhibits potent anti-inflammatory, anti-tumor, anti-arthritis, anti-convulsant, anti-rheumatoid, anti-dysentery, antiviral, gastro-protective, cardio-protective, immune-stimulatory, diuretic, anti-helminthic, anti-paralysis, antimicrobial, antioxidant, antifungal and wound healing properties [14,15]. Previous studies by [16] revealed that the supplementation of ginger oil in the diet of birds can accelerate growth, improved feed efficiency, neutralize reactive oxygen species, stabilizes cell membrane, modulate immune activity and coordinate defense against oxidative and inflammatory damage. [17] also reported that feeding broiler chickens with neem oil at 0.30 mL/kg diet resulted in gut protection by inhibiting pathogenic bacteria and fungi, relieved chronic inflammation, regulate blood glucose level and cholesterol balance. Essential oils from rosemary, oregano and garlic have been well documented to promote detoxification, protects liver against oxidative stress, improve cardiovascular health, boost the immune system and improve the overall vitality of birds [18,19,1]. However, there is little or no information on the dietary supplementation of *Clinopodium brownei* oil. This research will help to establish an optimum level of *Clinopodium brownei* oil in broiler feed, promote livestock production, sustainability and food safety. It will also help to promote the use of *Clinopodium brownei* oil as natural alternative to antibiotics.

Materials and Methods

Study/Experimental Area

The experiment was carried out at the Poultry Unit of the Teaching and Research Farm, Gandhi College of Agriculture, Rajasthan, India between the months of June to August, 2025. The research ethics and guidelines of the Animal Production and Health Department of the institution approved the conduct of the experiment (GN/067H/2025C).

Collection and Preparation of *Clinopodium Brownei* Extracts

Freshly collected leaves of *Clinopodium brownei* from Gandhi College premises was sent to the Taxonomy department of the institution for proper identification and authentication by a certified taxonomist before it was assigned a voucher specimen number GNT/08/005. Collected leaves were sorted, washed with running tap water and dried under shade for 12 days, then grounded into powdered with an electric blender and kept in an airtight containers under room temperature. 500 g of grounded *Clinopodium brownei* was steam-distilled using H-shaped Clavenger apparatus for 2 hours to obtain

the essential oil. The essential oil was then dried by anhydrous sodium sulfate and stored in sample bottles and kept in the refrigerator at 4°C for further analysis.

Chemical analysis of bioactive compounds were carried out using Aludra Quadrupole GC/MS (Model T8050NX). Gas chromatograph was kept at a specification of temperature (15 to 35°C), humidity (25 – 80 %), column head pressure setting of 0 ~ 100 psi, cooling speed of 50 °C and maintained at a pressure range of 0 – 999 Kpa once 0.5 mL of *Clinopodium brownei* oil was injected into the machine while the mass spectrometry unit was maintained at mass stability 0.1 amu, maximum scan rate of 10,000 amu, emission current 10 – 350 µA and ionization energy (150 – 320 °C) before the outcome or results were processed via MS 3200RT software to calculate the percentage concentration and retention time of each compounds as presented in Table 1.

Management of birds

400 – 1 day old Hubbard broiler of mixed sex was purchased from a commercial hatchery in Rajasthan, India. Birds were cared for according to management recommendation approved by Indian Society of Animal Production. Before arrival of the birds, battery cages, pens, feeding and watering troughs were properly washed and disinfected with Supermax Morigad® with Aquaclean® in the ratio of 1:1. Upon arrival chicks were unboxed and their average initial body weight was measured using a digital sensitive scale before they were randomly distributed into four groups (T1, T2, T3 and T4) of 100 birds, each group was further divided into five replicate consisting of twenty birds. Anti-stress (Glucose + Multivitamins) for 3 days and the experiment lasted for 42 days. Brooding temperature was maintained at 35 °C for the first week and it was reduced each week by 2 °C until a temperature of 27°C was achieved. Experimental diet was formulated to meet the nutrient requirements for broilers requirements according to [20] recommendations as presented in Table 2. Birds had free access to fresh water, feed and were vaccinated according to the vaccination schedule developed by Gandhi College of Agriculture, Rajasthan based on disease prevalence in the area. Strict biosecurity and other management measures were observed throughout the period of the experiment. During data collection periods, feed consumption was estimated as the difference between feed offered and refusals from the previous day feeding. Body weight gain (g) was calculated as the difference between final body weight and initial body weight. Feed conversion ratio was determined by dividing total feed consumption by body weight gain. Mortality was recorded as it occurs during the experimental period. Proximate composition of experimental diets were analyzed according to [21] official methods.

Set of the Experiment

Birds were randomly allocated into four groups, each group has five replicate consisting of twenty birds each in a com-

pletely randomized design as follows:

Treatment 1 (Negative group/control): Experimental diet without any additive

Treatment 2 (Positive control): Experimental diet with 2.5 g *Adriamycin® /kg diet (*according to the instructions on the package insert)

Treatment 3: Experimental diet with 2.0 mL Clinopodium brownei oil per kg diet

Treatment 4: Experimental diet with 4.0 mL Clinopodium brownei oil per kg diet

Sampling and analysis of blood constituents

On the last day of the experimental period, 6 mL of blood was collected from the wing vein of ten randomly selected birds per treatment. 3 ml of blood each for haematological evaluation and serum biochemical analysis. Before collection, ice pack was made available to maintain the samples and prevent deterioration. Blood for haematology was collected into bottles containing EDTA (anticoagulant) while those for serum biochemistry was collected into plain sample bottles. MT-Musson Automated –Haemo Analyzer (GH-3300, China) was used to determine: red blood cell count, haematocrit value, haemoglobin and white blood cell count. Kit was maintained at a temperature of 15 to 30 °C and humidity (70 – 85 %) after samples were arranged in the metallic collection chamber. Serum samples were analyzed with HBI – Auto chemistry analyzer (Model VB3000C, Taiwan) and maintained at a sample volume of 245 µL, temperature (10 to 35 °C) and humidity (5 to 85 %).

Statistical Analysis Adopted

Data collected were subjected to the analysis of variance (ANOVA) using the General Linear Model Procedure of Statistical Analysis System [22]. Duncan multiple range test of the same package was used for the post hoc analysis where significant difference occurred at $P < 0.05$.

Results and Discussion

Bioactive compounds in Clinopodium brownei oil is presented in Table 1. The essential oil has a unique chemistry and its most prominent compound includes, α -Humulene (27.42 %), Camphor (17.92 %), Hexadecanoic acid (15.23 %), α -Terpineol (14.21 %), γ -Terpinene (12.99 %), p-Cymene (12.56 %), Oleic acid (11.24 %), α -Pinene (10.05 %), β -Caryophyllene (8.17 %) and Cis-linalool oxide (5.93 %) which have been previously associated with anti-inflammatory, antioxidant, gastro-protective, anti-tumor and dermato-protective properties [23]. β -Caryophyllene have been reported to reduce oxidative stress inside the liver, stabilizes cell membrane and boost glutathione [24,25]. α -Terpineol and γ -Terpinene have shown to inhibit the activities of some pathogenic bacteria and fungi in the gastro-intestinal tract of birds [26]. These compounds have also been utilized traditionally in the treatment of chronic inflammations, skin infections, urinary tract

infections, pyrexia, sexually transmitted diseases, snake bite, tooth ache amongst others [3].

Bioactive compounds	% Area	Retention time (min)
γ -Terpinene	10.94	12.99
α -Terpineol	6.03	14.21
β -Caryophyllene	15.05	8.17
α -Humulene	7.75	27.42
α -Pinene	12.37	10.05
p-Cymene	10.04	12.56
Cis-linalool oxide	8.74	5.93
Camphor	7.93	17.95
Hexadecanoic acid	11.46	15.23
Oleic acid	9.22	11.24

Table 1: Prominent Bioactive compounds in Clinopodium brownei oil by GC-MS analysis

Ingredients	Starter (%)	Finisher (%)
Maize	50.18	55.02
Wheat bran	4.01	5.63
Soymeal	35.06	30.0
Fish meal	5.00	2.00
Mono Calcium Phosphate (MCP)	3.00	4.00
Calcium bicarbonate	1.50	2.00
Lysine	0.20	0.25
Methionine	0.25	0.25
Premix (Vitamin and Mineral)	0.25	0.25
Salt	0.30	0.35
Toxin binder	0.25	0.25
Total	100	100
Analyzed Nutrients (Percentage)		
Crude protein	23.44	21.09
Ether extract	4.02	3.94
Crude fibre	3.47	3.83
Calcium	1.18	1.21
Phosphorus	0.58	0.61
ME (kcal/kg)	3015.3	3218.2

Each 2.5 kg consists of: Vit A 12000, 000 IU; Vit D3, 2000, 000 IU; Vit. E. 10g; Vit k3 2 g; Vit B1, 1000 mg ; Vit B2, 49g ; Vit B6, 105 g; Vit B12, 10 mg; Pantothenic acid, 10 g; Niacin, 20 g , Folic acid , 1000 mg ; Biotin, 50 g; Choline Chloride, 500 mg, Fe, 30 g; Mn, 40 g; Cu, 3 g; Co, 200 mg; Si, 100 mg and Zn , 45 g

Table 2: Percentage composition of experimental diet for starter phase (0-21d) and finisher phase (22-42d)

Growth performance of Hubbard broilers fed diet supplemented with *Clinopodium brownei* oil is presented in Table 3. In the starter, finisher and overall result obtained showed that birds fed diet supplemented with *Clinopodium brownei* oil in treatment 3 and treatment 4 had the highest ($p < 0.05$) body weight gain and feed consumption followed by the antibiotics group (treatment 2) with the non-supplemented group showing the least figures. Body weight result suggests that the presence of bioactive compounds in *Clinopodium brownei* oil especially α -Humulene can protect the stomach lining from pathogenic organisms to allow smooth digestion and absorption of nutrients which translates to a better weight gain [27]. These compounds also have no withdrawal period and are generally regarded as safe [28]. Previous studies have also shown that α -Humulene can shut down inflammatory messenger and protects tissues from oxidative stress [29]. Though birds fed with antibiotics also show an appreciable body weight gain because synthetic antibiotics also interfere with the activities of some pathogens in the gut, however, its continuous use can cause the deposit of toxic residues in animal products, environment as well as antimicrobial resistance [30]. The result obtained in this study aligns with the report of [31] who supplemented sunflower essential oil in the diet of broiler chickens. [32], also recorded a body weight gain of 2205 – 2607.1 g/b in birds fed diet

supplemented with phytochemicals. Increase in feed consumption especially among birds in Treatment 3 and 4 indicates that *Clinopodium brownei* oil improved the aroma and taste of feed compared to the other treatments. These result is in agreement with the report of [33] who reported a higher feed intake in broilers fed diet supplemented with *Polyalthia longifolia* leaf. Overall total feed consumption value which varied from 4743.2 – 5203.9 g/b was higher than 4800.2 – 5106.7 g/b reported by [29] when *Sphenocentrum jollyanum* oil was fed to broiler chickens. Variation in result could be attributed to the differences in the chemical compounds of essential oils, breed, geographical location as well as concentration or dosage administered [34]. Highest mortality was recorded in the non-supplemented treatment followed by the antibiotic group while none was reported in treatment 3 and 4. The presence of γ -Terpinene, Camphor and Hexadecanoic acid ignites an antimicrobial impact in the tightening, protection of the gut lining and inhibits the activities of bacteria and fungi [35]. The overall mortality rate (1.00 %) recorded in antibiotic growth suggests that possibility of resistance by some of the pathogens in the gut causing gastro-intestinal disturbance and also possibly interfering with the absorption of nutrients [23]. The best feed conversion was recorded among birds in treatment 3 and 4 compared to the other group. This result is in consonance with the report of [26,33].

Parameters	T1	T2	T3	T4	SEM
Starter phase (0 to 21 d)					
Initial body weight (g/b)	53.11	52.96	53.11	53.12	0.31
Final body weight (g/b)	663.7c	702.8b	755.4a	760.9a	33.17
Body weight gain (g/b)	610.59c	649.84b	702.29a	707.78a	21.06
Total feed consumption (g/b)	1442.6c	1511.7b	1600.7a	1605.2a	67.92
Feed conversion ratio	2.36a	2.32b	2.27c	2.26c	0.21
Mortality (%)	1.00	1.00	-	-	0.03
Finisher phase (22 to 42 d)					
Body weight gain (g/b)	1509.5c	1771.8b	1866.1a	1868.9a	73.61
Total feed consumption (g/b)	3300.6c	3508.6b	3591.2a	3598.7a	102.8
Feed conversion ratio	2.19a	2.00b	1.92c	1.92c	0.03
Mortality (%)	1.50	-	-	-	0.02
Overall (1 to 42 days)					
Body weight gain (g/b)	2173.2c	2474.6b	2621.5a	2629.8a	88.76
Average daily weight gain (g/b)	51.74c	58.92b	62.42a	62.61a	0.57
Total feed consumption (g/b)	4743.2c	5020.3b	5191.9a	5203.9a	151.2
Average daily feed consumption (g/b)	112.9c	119.5b	123.6a	123.9a	2.86
Feed conversion ratio	2.18a	2.03b	2.00c	2.00c	0.03
Mortality (%)	2.50a	1.00b	-	-	0.01

Means within a row with different letters and significantly different ($p < 0.05$); SEM Standard error; Means within a row with different letters and significantly different ($p < 0.05$); SEM Standard error; T1: Experimental diet without oil (control); T2: experimental diet + 2.5 g Adria-

mycin® /kg diet; T3: experimental diet + 2.0 mL Clinopodium brownei oil/kg diet; T4: experimental diet + 2.0 mL Clinopodium brownei oil/kg diet

Table 3: Growth performance of Hubbard broilers fed diet supplemented with Clinopodium brownei oil

Haematological parameters of Hubbard broilers fed diet supplemented with Clinopodium brownei oil is presented in Table 4. Pack cell volume, red blood cell and white blood cell values were higher ($p < 0.05$) in treatment 2, 3 and 4 compared to treatment 1. Hemoglobin value was higher in treatment 3 and 4, intermediate in treatment 2 and lowest in treatment 1 ($p < 0.05$). The pack cell volume recorded in this study was within 25.09 – 36.00 % range cited by [3]. Haemoglobin value was within 7.50 – 20.00 g/dL referenced by [19]. These values point to the presence of iron sufficiency in the blood [36]. Red blood cell values were within the values 1.90

– 3.08 (1012/L) recorded by [3,37] who supplemented turmeric oil in the diet of broiler chickens. However, values were lower than 2.02 – 3.50 (1012/L) reported by [36]. This result suggests sufficient oxygen in the tissue to drive absorbed nutrient round the body of birds to ensure proper functioning of the system [38]. The values of white blood cell in this experiment were within the normal range 9.66 – 26.00 (109/L) reported by [27] who fed broilers with *Sida acuta* leaf extract. [30] reported that high concentration of white blood cell in the serum triggers the production of antibodies to prevent the entry and proliferation of infection in the body.

Parameters	T1	T2	T3	T4	SEM
Pack cell volume (%)	28.16b	30.96a	32.18a	33.04a	0.37
Hemoglobin (g/dL)	8.42c	10.07b	13.59a	14.02a	0.06
Red blood cell (1012/L)	2.15b	2.28a	2.53a	2.55a	0.02
White blood cell (109/L)	10.03c	13.72b	16.32a	16.84a	0.03

Means within a row with different letters and significantly different ($p < 0.05$); SEM Standard error; Means within a row with different letters and significantly different ($p < 0.05$); SEM Standard error; T1: Experimental diet without oil (control); T2: experimental diet + 2.5 g Adria-mycin® /kg diet; T3: experimental diet + 2.0 mL Clinopodium brownei oil/kg diet; T4: experimental diet + 2.0 mL Clinopodium brownei oil/kg diet

Table 4: Haematological parameters of Hubbard broilers fed diet supplemented with Clinopodium brownei oil

Serum biochemical indices of Hubbard broilers fed diet supplemented with Clinopodium brownei oil is presented in Table 5. Total protein concentration in treatment 1 (4.40 g/dL) were lower ($p < 0.05$) than treatment 2 (4.85 g/dL), treatment 3 (5.40 g/dL) and treatment 4 (5.46 g/dL). Albumin and globulin values which varied from 2.09 – 2.61 g/dL and 2.31 – 2.81 g/dL were influenced ($p < 0.05$) by the treatment. Total protein values reported in this study were within the normal range 4.00 – 7.51 g/dL reported by [39] when phytogenics was supplemented in the diet of broiler chickens. However, values were lower than 5.00 – 7.08 g/dL recorded by [16]. Result obtained suggests that the birds were well nourished [40]. Albumin and globulin values were within the values 2.00 – 4.00 g/dL and 2.00 – 5.00 g/dL reported by [4] when papaya essential oil was supplemented in the diet of broiler chicks. Serum globulin plays a significant role in the fight against infections

[3]. Cholesterol values was within the normal range 98.11 – 220 mg/dL reported by AMTL (2001). Cholesterol serum concentration significantly decreased ($p < 0.05$) as the level of Clinopodium brownei oil increased across the treatments. This outcome indicates that Clinopodium brownei oil possess hypolipidemic properties and can prevent exposure to cardio-vascular disease [41]. Alanine amino transferase was higher in T1 (30.21 IU/L) than in T2 (26.92 IU/L), T3 (25.06 IU/L) and T4 (24.81 IU/L) ($p < 0.05$) while aspartate transaminase was lower ($p < 0.05$) in T2 (45.75 IU/L), T3 (45.02 IU/L) and T4 (45.10 IU/L) than in T1 (57.83 IU/L). Alanine amino transferase and aspartate transaminase recorded in this study was within the normal range 20.08 – 47.00 IU/L and 36.00 – 71.00 IU/L reported by [42] when grounded ginger and garlic were fed to broiler chickens.

Parameters	T1	T2	T3	T4	SEM
Total protein (g/dL)	4.40c	4.85b	5.40a	5.46a	0.03
Albumin (g/dL)	2.09c	2.31b	2.57a	2.61a	0.02
Globulin (g/dL)	2.31a	2.54a	2.83a	2.85a	0.01
Cholesterol (mg/dL)	102.4a	100.5a	87.76b	85.01b	0.19
Alanine amino transferase (IU/L)	30.21a	26.92b	25.06b	24.81b	0.58

Aspartate transaminase (IU/L)	57.83a	45.75b	45.02b	45.10b	0.44
-------------------------------	--------	--------	--------	--------	------

Means within a row with different letters and significantly different ($p < 0.05$); SEM Standard error; T1: Experimental diet without oil (control); T2: experimental diet + 2.5 g Adriamycin® /kg diet; T3: experimental diet + 2.0 mL Clinopodium brownei oil/kg diet; T4: experimental diet + 2.0 mL Clinopodium brownei oil/kg diet

Table 5: Serum biochemical indices of Hubbard broilers fed diet supplemented with Clinopodium brownei oil

Conclusion

It was concluded that Clinopodium brownei oil has measurable pharmacological properties. Its bioactive compounds forms an integrated biochemical system that regulates inflammation, protects tissues and promotes organ function. Dietary supplementation of Clinopodium brownei oil up to 4 mL/kg diet improved the growth performance, feed efficiency and blood constituents without compromising the health status of birds.

References

- John, Alagbe Olujimi. "Novel phytochemicals' impact on weaned pigs' growth performance, hematology and serum biochemical indicators." *Black Sea Journal of Agriculture* 7, no. 2 (2024): 82-89.
- Alagbe, J. O. "Use of medicinal plants as a panacea to poultry production and food security: A review." *Gospodarka I Innowacje* 22, no. 2022 (2022): 1-12.
- Bashir, Musa, John O. Alagbe, Adegbite Motunrade Betty, and E. A. Omokore. "Growth Performance, caeca microbial population and immune response of starter broiler chicks fed aqueous extract of Balanites aegyptiaca and Alchornea cordifolia stem bark mixture." *United Journal for Research and Technology* 2, no. 2 (2020): 13-21.
- Anorue, Daniel Nnadozie, Friday Ubong, and Alagbe Olujimi John. "Investigating the effects of pawpaw (*Carica papaya*) essential oil dietary supplementation on the growth performance and carcass characteristics of broilers." *Research in Agricultural and Veterinary Sciences* 7, no. 3 (2023): 164-174.
- Noriega, Paco, Lissette Calderón, Andrea Ojeda, and Erika Paredes. "Chemical composition, antimicrobial and antioxidant bioautography activity of essential oil from leaves of Amazon plant Clinopodium brownei (Sw.)." *Molecules* 28, no. 4 (2023): 1741.
- Aguilar, I.E.; Galviz, R.A. Determinación de la Composición Química y Actividad Antibacteriana del Aceite Esencial extraído de la planta Satureja brownei (Briq.) cultivada en el Jardín de plantas Medicinales "Dr. Luis Ruiz Terán" de la Facultad de Farmacia y Bioanálisis, Universidad de los Andes. Bachelor's Thesis, Universidad de los Andes, Mérida, Venezuela, 2015.
- Vandebroek, Ina, and David Picking. "Clinopodium brownei (Sw.) Kuntze (Lamiaceae)." In *Popular Medicinal Plants in Portland and Kingston, Jamaica*, pp. 89-94. Cham: Springer International Publishing, 2020.
- Noriega, Paco, Alessandra Guerrini, Gianni Sacchetti, Alessandro Grandini, Edwin Ankuash, and Stefano Manfredini. "Chemical composition and biological activity of five essential oils from the Ecuadorian Amazon rain forest." *Molecules* 24, no. 8 (2019): 1637.
- Ballesteros, José L., Massimo Tacchini, Antonella Spagnoletti, Alessandro Grandini, Guglielmo Paganetto, Luca Maria Neri, Arianna Marengo, Letizia Angiolella, Alessandra Guerrini, and Gianni Sacchetti. "Rediscovering medicinal Amazonian aromatic plants: Piper carpunya (Piperaceae) essential oil as paradigmatic study." *Evidence-Based Complementary and Alternative Medicine* 2019, no. 1 (2019): 6194640.
- Zhiñin Quezada, Hector Rolando, Bladimir Valentin Poma Mendoza, Leonardo Paúl González Niveló, and Gonzalo Bladimir Quito Ulloa. "Etnobotánica y derechos de la naturaleza en el aja shuar: caso de estudio parroquia Nankais, cantón Nangaritza, provincia Zamora Chinchipe, Ecuador." *Siembra* 8, no. 2 (2021).
- Cuesta, Francisco, Manuel Peralvo, Andrés Merino-Víteri, Macarena Bustamante, Francis Baquero, Juan F. Freile, Priscilla Muriel, and Omar Torres-Carvajal. "Priority areas for biodiversity conservation in mainland Ecuador." *Neotropical Biodiversity* 3, no. 1 (2017): 93-106.
- Mestanza-Ramón, Carlos, Suján M. Henkanathhegedara, Paola Vásquez Duchicela, Yadira Vargas Tierras, Maritza Sánchez Capa, Diana Constante Mejía, Mirian Jimenez Gutierrez, Manuel Charco Guamán, and Paúl Mestanza Ramón. "In-situ and ex-situ biodiversity conservation in Ecuador: A review of policies, actions and challenges." *Diversity* 12, no. 8 (2020): 315.
- Aziz, Zarith AA, Akil Ahmad, Siti Hamidah Mohd Setapar, Alptug Karakucuk, Muhammad M. Azim, David Lokhat, Mohd Rafatullah, Magdah Ganash, Mohammad A. Kamal, and Ghulam Md Ashraf. "Essential oils: extraction techniques, pharmaceutical and therapeutic potential-a review." *Current drug metabolism* 19, no. 13 (2018): 1100-1110.
- Diniz do Nascimento, Lidiane, Angelo Antônio Barbosa de Moraes, Kauê Santana da Costa, João Marcos Pereira Galúcio, Paulo Sérgio Taube, Cristiane Maria Leal Costa, Jorddy Neves Cruz, Eloisa Helena de Aguiar Andrade, and Lênio José Guerreiro de Faria. "Bioactive natural compounds and antioxidant activity of essential oils from spice plants: New findings and potential applications." *Biomolecules* 10, no. 7 (2020): 988.

15. Bruni, Renato, Alessandro Medici, Elisa Andreotti, Carlo Fantin, Mariavittoria Muzzoli, Marco Dehesa, Carlo Romagnoli, and Gianni Sacchetti. "Chemical composition and biological activities of Ishpingo essential oil, a traditional Ecuadorian spice from *Ocotea quixos* (Lam.) Kosterm.(Lauraceae) flower calices." *Food chemistry* 85, no. 3 (2004): 415-421.
16. Shittu, M. D., O. J. Alagbe, O. Alaba, E. O. Okanlawon, F. A. Adelakun, P. O. Emmanuel, and D. O. Adejumo. "Effect of ginger, garlic and negro pepper on gut microbes, gut histomorphometry and pathological assessment of selected organs of broiler chickens." *ADAN JOURNAL OF AGRICULTURE* 5, no. 1 (2024).
17. Obikaonu, H. O., I. C. Okoli, M. N. Opara, V. M. O. Okoro, I. P. Ogbuewu, E. B. Etuk, and A. B. I. Udedibie. "Haematological and serum biochemical indices of starter broilers fed leaf meal of neem (*Azadirachta indica*)." (2012): 71-79.
18. Nworgu, F. C., S. A. Ogungbenro, and K. S. Solesi. "Performance and some blood chemistry indices of broiler chicken served fluted pumpkin (*Telfaria occidentalis*) leaves extract supplement." (2007): 90-98.
19. Agubosi, O. C. P., and Alexander James. "Influence of dietary inclusion of Sunflower (*Helianthus annuus*) oil on growth performance and oxidative status of broiler chicks." *Central Asian Journal of Medical and Natural Science* 3, no. 1 (2022): 187-195.
20. National Research Council, Division on Earth, Life Studies, and Committee on Nutrient Requirements of Swine. "*Nutrient requirements of swine*." (2012).
21. AOAC. Official Methods of Analysis of AOAC International, 20th ed.; AOAC International: Gaithersburg, MD, USA, 2016
22. SAS Institute, (2001). SAS users Guide Statistics. SAS Institute Inc., Cary, NC.
23. Hernandez M, Alagbe JO. (2025). Influence of *Abrus procatorious* crude oil supplementation on the growth performance, Nutrient digestibility, Ruminant fermentation and Microbial population of Malabari Bucks. *International Journal of Global Sustainable Res.* 2025a; 3(7): 527-538
24. Sharma, Singh, Alagbe Olujimi John, Liu Xing, Sharma Ram, and Kumar Amita. "Comparative analysis of ethanolic *Juniperus thurifera* leaf, stem bark and root extract using gas chromatography and mass spectroemetry." *International Journal of Agriculture and Animal Production* 2, no. 6 (2022): 18-27.
25. Ojediran, Taiwo Kayode, Olujimi John Alagbe, Durojaye Victor, and Emiola Adewale. "Analysis of *Kigelia africana* (Lam.) Benth. fruit powder's antioxidant and phytochemical properties." *Brazilian Journal of Science* 3, no. 7 (2024): 38-49.
26. Alagbe, J. O. "Dietary supplementation of *Rauvolfia vomitoria* root extract as a phytogenic feed additive in growing rabbit diets: Growth performance and caecal microbial population." Concept in *Dairy and Veterinary Sciences* 4, no. 2 (2021): 2021.
27. Shittu, M. D., and J. O. Alagbe. "Phyto-nutritional profiles of broom weed (*Sida acuta*) leaf extract." *Annals of Clinical Toxicology* 3, no. 2 (2020).
28. Morris, Hernández, and Alagbe John Olujimi. "INFLUENCE OF *Odontonema strictum* OIL ON THE GROWTH PERFORMANCE AND RUMINAL FERMENTATION OF BARBARI BUCKS." Research in: *Agricultural & Veterinary Sciences* 9, no. 2 (2025).
29. Zubairu, H., Mubarak A. Adediran, and J. O. Alagbe. "Effect of Partial Replacement of Soya Meal with *Sphenocentrum jollyanum* Seed Meal on the Growth Performance and Haematological Constituents of Broiler Chicken." *International Journal of Integrative Research* 3, no. 10 (2025): 741-752.
30. Omokore, E. O., and J. O. Alagbe. "Efficacy of dried *Phyllanthus amarus* leaf meal as an herbal feed additive on the growth performance, haematology and serum biochemistry of growing rabbits." *International Journal of Academic Research and Development* 4, no. 3 (2019): 97-104.
31. Agubosi, O.C.P., Soliu, M.B and Alagbe, J.O. (2022). Effect of dietary inclusion levels of *Moringa oleifera* oil on the growth performance and nutrient retention of broiler starter chicks. *Central Asian Journal of Theoretical and Applied Sciences* 3(3): 30-39.
32. Alagbe, John Olujimi. "*Clerodendron splendens* leaf extract supplementation in weaner rabbits: impact on growth performance, haematology and intestinal microbial population." *Cerrado: Agricultural and Biological Research* 1, no. 1 (2024): 21-31.
33. Shittu, M. T., John Olujimi Alagbe, Olusegun Ojeniyi Ojebiyi, Taiwo Kayode Ojediran, and Trimisiyu Adewale Rafiu. "Growth performance and haematological and serum biochemical parameters of broiler chickens given varied concentrations of *Polyalthia longifolia* leaf extract in place of conventional antibiotics." *Animal Science and Genetics* 18, no. 2 (2022).
34. Ojediran, Taiwo Kayode, I. A. Emiola, V. Durojaye, and John Olujimi Alagbe. "Proximate, vitamin and GC-MS profiling of *Kigelia africana* fruit powder." *Cerrado: Agricultural and Biological Research* 1, no. 1 (2024): 13-20.
35. Alagbe JO, Shittu MD, Tanimomo, Babatunde K. Influence of *Anogeissus leio carpus* stem bark on the fatty acid composition in meat of broiler chickens. *European Journal of Life Safety and Stability* 2022; 14(22): 13-22.
36. Alagbe, John Olujimi. "Effect of coconut shell extract on the growth performance and some haemato-biochemical parameters of broiler chicken." *Brazilian Journal of Science* 3, no. 6 (2024): 82-95.
37. Oluwafemi, R. A., Aisha Omolade Lawal, Adelowo Samad Adetope, and J. O. Alagbe. "Effects of dietary inclusion of ginger (*Zingiber officinale*) and garlic (*Allium sativum*) oil (GGO) mixtures on carcass characteristics and sensory evaluation of broiler chickens." *Journal La Medihealthico* 2, no. 6 (2021): 22-31.
38. Alagbe, John Olujimi. "Effect on performance, serum biochemistry and haematological components of feeding "japanese quails" phytogenic feed additions comprising *Megaphrynium macrostachyum* leaves." *Brazilian Journal of Science* 3, no. 5 (2024): 51-64.

39. Abudabos, Alaeldein M., Abdullah H. Alyemni, Yousif M. Dafalla, and Rifat Ullah Khan. "The effect of phytochemicals on growth traits, blood biochemical and intestinal histology in broiler chickens exposed to *Clostridium perfringens* challenge." *Journal of applied animal research* 46, no. 1 (2018): 691-695.
40. Alagbe, John Olujimi. "Impact of dietary supplementation of *Rhamnus prinoides* leaf extract on the growth performance, nutrient retention and intestinal microbial count of "japanese quails"." *Brazilian Journal of Science* 3, no. 5 (2024): 40-50.
41. Alagbe, J. O. "Gas chromatography and mass spectroscopy of *Juniperus phoenicea* stem bark extract and its influence on the haemato-biochemical values of growing rabbits." *British Scientific Periodical* 1, no. 1 (2022): 18-33.
42. Oleforuh-Okoleh, V. U., G. C. Chukwu, and A. I. Adeolu. "Effect of ground ginger and garlic on the growth performance, carcass quality and economics of production of broiler chickens." *Glob. J. Biosci. Biotechnol* 3, no. 3 (2014): 225-229.
43. Alagbe, Alagbe Olujimi, Zubairu Habiba, Adedeji Olawale Mo-shood, Bamigboye Samson, Dora Agbonika, and Ramalan Sadiq Muhammad. "Influence of *Juniperus thurifera* root extract on the nutrient digestibility and caecal microbial count of growing rabbits." *Scientist: International Journal of Scientific Studies* 1, no. 1 (2022): 1-11.
44. Alagbe JO, Shittu MD, Tanimomo BK. Influence of *Anogeissus* stem bark on the fatty acid composition in meat of broiler chickens. *European Journal of Life Safety and Stability* 2022; 14(22): 13-22.
45. Singh, A. S., J. O. Alagbe, S. Sharma, R. A. Oluwafemi, and O. C. P. Agubosi. "Effect of dietary supplementation of melon (*Citrullus lanatus*) seed oil on the growth performance and antioxidant status of growing rabbits." *Indonesian Journal of Innovation and Applied Sciences (IJIAS)* 1, no. 2 (2021): 134-143.
46. Duncan, David B. "Multiple range and multiple F tests." *biometrics* 11, no. 1 (1955): 1-42.
47. American Metabolic Testing Laboratories, Inc. Chemistry Profile. (2001). www.caprofile.net/t3.html.
48. Thrall, M. A. (2007). *Hematologia e Bioquímica Clínica Veterinária*. Philadelphia: Lippincott Williams & Wilkins, Sao Paulo: Roca, 582 pp.
49. Agubosi, O.C.P., Oluwafemi, R.A., and Alagbe, J.O. (2021). Preliminary study on GC-MS analysis of *Prosopis africana* seed (African mesquite) oil. *Journal of Ethics and Diversity in International Communication* 1(4): 18-20.

Citation: Alagbe J.O. Can Dietary Supplementation of *Clinopodium brownei* oil Influence the Growth Performance, Haematology and Serum Biochemical Indices of Hubbard Broiler Chickens?. *J. Pharm. Drug. Dev.* Vol. 5 Iss. 1. (2026) DOI: 10.58489/2836-2322/043