

CHRYSOPHYLLUM ALBIDUM STEM BARK POWDER: EFFECTS ON GROWTH PERFORMANCE AND CARCASS CHARACTERISTICS OF JAPANESE QUAILS (*COTURNIX JAPONICA*)

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Abstract: This experiment was carried out to determine the effect of *Chrysophyllum albidum* stem bark powder (CASB) on the growth performance and carcass characteristics of Japanese quails. A total of 300 - 2 weeks old male Japanese quails were randomly divided into 5 groups each with 60 birds. Each group was further sub-divided into six groups each with 10 quails of comparable group weight. Regular diet was formulated to meet all the nutrient requirements for birds according to NRC (1994). Quails in group A (Ta) received regular diet without CASB while those in Tb, Tc, Td and Te were fed same diet supplemented with CASB at 100 g, 200 g, 300 g and 400 g per kg respectively. A completely randomized design was adopted and birds had unrestricted access to fresh clean water and feed throughout the 30 days experimental period. Qualitative assessment of CASB reveals the presence of tannins, phenols, saponins, alkaloids, flavonoids, tannins and terpenoids was observed in CASB. Average daily weight gain, average daily feed intake, feed conversion ratio and mortality were significantly ($P < 0.05$) influenced by the treatment. Quails fed diet supplemented with CASB recorded a higher ($P < 0.05$) average body weight and average daily feed intake relative to Ta (control), increasing the levels of CASB significantly reduced ($P < 0.05$) feed conversion ratio and mortality. Carcass weight, dressing percentage and weights of breast, thigh, drumstick, wing and back were higher in Tc, Td and Te, intermediate in Tb and lower in Ta ($P < 0.05$) while weight of head, neck and shank were not affected by the treatment ($P > 0.05$). CASB can be supplemented up to 400g/kg in the diet of quails without affecting the performance of birds.

Keywords: *Chrysophyllum albidum*; Growth; Performance; Phytochemicals; Quails

1 INTRODUCTION

Quail is a small bird belonging to the order Galliformes and family Phasianidae, along with domestic chickens, pheasants and partridges [1,2]. The bird was originally a wild game species just as any other domesticated animal. Japanese quails are small avian species belonging to the same family (Pheasant family) as the chicken [2]. The birds are smaller than the pigeon and much smaller than the chicken [3]. Quails are reared mainly for their meat and eggs. Quail farming is said to be a short generation industry with a potential of meeting the economic and nutritional needs of developing countries [4]. Quail meat and eggs are also rich in nutritional value and have been reported to have proven efficacy in the treatment of a number of diseases, including diabetes [5,6]. There are numerous advantages in quail farming which make it worthwhile promoting. Quail farming is less expensive and offers quick returns to farmers and consumers [4]. According to Alagbe [7], the livestock sector has continuously recorded a significant growth, however, there are still some problems confronting the industry such as disease, finance and most recently the rising cases in antimicrobial resistance due to the indiscriminate use of antibiotics has called for a natural and sustainable alternative to promote their performance. Among the potential alternative is the use of *Chrysophyllum albidum* stem bark.

African star apple (*Chrysophyllum albidum*) is a tropical edible fruit tree that belongs to the family of Sapotaceae [8]. The plant has over 800 species widely distributed globally which makes up almost half of the order [9]. It is found in most parts of Africa; Nigeria, Uganda, Niger Republic, Cameroon, Zimbabwe, Zambia, Benin republic, mali, Cote d'Ivoire and some parts of Asia including India [8,10]. Phytochemical evaluation of African star apple's leaves, seeds and roots showed that contains numerous biologically active substances or phyto-constituents which includes; alkaloids, tannin, saponin, phenol and flavonoid [11]. Its fruits contains crude protein content of 8.75%, carbohydrate content of 29.6% and moisture content of 42.1% as reported by Amusa et al., [12]. African star apple have also been reported to contain vitamins (vitamin A, B-complex and C), and iron [13].

Traditionally, the extracts from leaves, root and stem bark of *C. albidum* is used in the treatment of yellow fever, malaria, diarrhea, vaginal, skin eruption, stomach ache, skin infections [14]. *Chrysophyllum albidum* crude extract has been reported to possess a range of biological activities, including antimicrobial activity [15,16]. Moronkola et al. [17], demonstrated the

antimicrobial activity of an oil extract from *Chrysophyllum albidum* against *Escherichia coli*, *Pseudomonas aeruginosa*, *Salmonella aureus* amongst others.

Previous studies have shown that dietary supplementation *Chrysophyllum albidum* leaf meal at 2.0 g/kg diet had a positive influence on the final body weight, blood parameters and weight of organs in broiler chickens [18,19]. Similarly, [33]Musa et al. also recorded a significant decrease in population of pathogenic organisms in the ceacum of birds fed with aqueous extract from *Balanites aegyptiaca* and *Alchornea cordifolia* stem bark mixture. However, there is a paucity of knowledge on the potentials of *Chrysophyllum albidum* stem bark powder. This research is timely as it will help to promote sustainability and possibly provide alternatives to antibiotics.

Therefore this research was designed to ascertain the effects of *Chrysophyllum albidum* stem bark powder on the growth performance and carcass characteristics of Japanese quails.

2 MATERIALS AND METHODS

2.1 Experimental Location and Ethical Guidelines

The experiment was carried out at the Poultry Section, Sumitra Research Institute, Gujarat, India. The institute is situated between 23° 13' N and 72° 41' E North India and the research was carried out between the months of July to September, 2022 after it gained the approval of the ethics committee of the department of Animal Production, Sumitra Research Institute, Gujarat, India (SS/HP2022/15C). All management guidelines were in line with the animal protocol guidelines approved by the institute.

2.2 Collection and Preparation of *Chrysophyllum albidum* Stem Bark Powder

Fresh stem bark from *Chrysophyllum albidum* was harvested from Orathur village in Kancheepuram district, India. The collected stem bark were sent to the department of taxonomy for proper identification at Sumitra Research Institute, Gujarat before it was assigned a reference number (HP/011C/2022). It was air dried for 11 days until a constant weight was attained.

Thereafter, it was grounded into powder with electric blender before it was packed into an airtight labelled zip lock and sent to the laboratory for further examination.

3 CARE OF EXPERIMENTAL ANIMALS AND DESIGN

A total of 300 - 2 weeks old male Japanese quails were sourced from Amit commercial breeding farms, located in Gujarat, India. The birds were transported early in the morning to the Poultry unit of Sumitra Research Institute, Gujarat and individually weighed and randomly divided into 5 groups each with 60 birds. Each group was further sub-divided into six groups each with 10 quails of comparable group weight. Before the arrival of birds, battery cages and experimental pen was thoroughly cleaned, disinfected with Morigad® plus, well ventilated and provided with electric bulbs (200 watts) to supply heat and illumination for feeding birds. Each group was housed in with dimension of 300 cm by 150 cm, which was designed to accommodate 10 quails equipped with manual feeders and nipple drinkers. Regular diet which is adequate in all nutrient was formulated according to Nutritional Research Council's guidelines for birds was supplied to birds throughout the one week adjustment period[20]. A completely randomized experimental design was adopted with quails in treatment A (Ta) fed regular diet without *Chrysophyllum albidum* stem bark powder while those in Tb, Tc, Td and Te received same diet supplemented with *Chrysophyllum albidum* stem bark powder at 100 g, 200 g, 300 g and 400 g/kg diet. Birds had unlimited access to clean water and feed. Weight gain and feed intake were given consideration throughout the experiment which lasted for 30 days. Mortality recorded as encountered during the experimental period and its percentage was calculated as number of dead birds divide by number of total birds multiplied by 100.

4 PHYTOCHEMICAL SCREENING OF CHRYSOPHYLLUM ALBIDUM STEM BARK POWDER

Phytochemical evaluation of crude extracts was performed as according to the methods described by Harborne [21].

Test for Tannins

1 g of *Chrysophyllum albidum* stem bark powder was added to 2 ml of Iron (III) chloride and thoroughly mixed together in a test tube. A formation of blue-green colour indicated the presence of tannins.

Test for Saponins

1 g of *Chrysophyllum albidum* stem bark powder was added to 2 ml of distilled water and mixed thoroughly for 60 seconds. The formation of foam indicated the presence of Saponins.

Test for Steroids

1 g of *Chrysophyllum albidum* stem bark powder was added to 2 ml of chloroform and mixed thoroughly in a test tube followed by the adding of 2 drops of Concentrated Tetraoxosulphate (VI) acid and kept for 60 seconds. A development of a red colouration indicated the presence of steroids.

Test for Flavonoids

1 g of *Chrysophyllum albidum* stem bark powder was added to 2 ml of diluted ammonia and mixed after which 1 ml of concentrated Tetraoxosulphate (VI) acid was subsequently added. The development of a yellow colouration indicated the presence of flavonoids.

Test for Alkaloids

1 g of *Chrysophyllum albidum* stem bark powder was added to 1 ml of 10 % potassium iodide before it was mixed. Subsequently, 2 drops of sodium hydroxide solution were added to each and mixed for 1 min. A red or brown colouration indicated the presence of alkaloids.

Test for Terpenoids

1 g of *Chrysophyllum albidum* stem bark powder was added to 2 ml of Tetraoxosulphate (VI) acid. The mixture was then heated to 70° C for 2 min. The development of a grey colouration indicated the presence of Terpenoids.

Test for Cardiac glycosides

1 g of *Chrysophyllum albidum* stem bark powder was added to 2 ml of chloroform and 3 ml of glacial acetic acid followed by the addition of Iron (III) chloride and mixed together and kept for 60 seconds. Subsequently, 1 ml of Tetraoxosulphate (VI) acid was added. The development of a brown colouration indicated the presence of cardiac glycosides.

5 PROXIMATE COMPOSITION OF EXPERIMENTAL DIET

Proximate composition of experimental diet was carried out according to the methods described by Association of Analytical Chemist [22].

6 STATISTICAL ANALYSIS

All data on growth performance and carcass characteristics were subjected to one-way analysis of variance (ANOVA) using SPSS version 21. The differences among the treatment means were determined ($P < 0.05$) by Duncan multiple range test of the same software.

Table 1 Ingredient and Nutrient Composition of Experimental Diet for Japanese Quails

Ingredients	Quantity
Maize	51.86
Whear bran	3.00
Soya bean meal	35.0
Fish meal	3.00
Limestone	2.00
Bone meal	4.00
Lysine	0.20
Methionine	0.20
Premix	0.25
Salt	0.30
Toxin binder	0.20
Total	100.01
Calculated analysis	
Crude protein	22.80
Crude fibre	3.71
Ether extract	3.92
Calcium	1.68
Phosphorus	0.64
Metabolizable energy (kcal/kg)	2778.6
Determined analysis	
Crude protein	23.40
Crude fibre	3.35

Ether extract	4.00
Calcium	1.82
Phosphorus	0.77
Metabolizable energy (kcal/kg)	2881.6

Table 2 Phytochemical Screening of *Chrysophyllum albidum* Stem Bark Powder

Chemical compounds	Outcome
Tannins	+
Alkaloids	+
Flavonoids	+++
Terpenoids	+++
Saponins	++
Phenols	+++
Glycosides	+

+ Present; ++moderately present; +++ highly present

The presence of selected phytochemicals with biological effects in plants were determined qualitatively. The results presented in Table 2. The presence of tannins, phenols, saponins, alkaloids, flavonoids, tannins and terpenoids was observed in *Chrysophyllum albidum* stem bark powder. Phenolic compound, flavonoid and terpenoids are the most prominent compounds in the sample. These phytochemicals play a significant defensive role against herbivory and pathogen attack, inter-plant competition, and abiotic stresses in plants [23] can be utilized for therapeutic or medicinal purposes [24]. Phenolic compounds of *Chrysophyllum albidum* stem bark powder possess a wide array of pharmacological properties, including, antioxidant [25], antiulcer, cytoprotective, chemopreventive [39], anti-inflammatory, antidiabetogenic [26,27], antimicrobial [28,29] and hepatoprotective [30,31] activities. Tannins have been reported to possess antimicrobial properties against pathogens such as, *M. Staphylococcus aureus*, *Streptococcus epidermidis*, *Pseudomonas aeruginosa*, *Candida albicans*, *Brevibacillus agri*, *Propionibacterium acnes*, *Trichophyton mentagrophytes*, amongst others [32,33]. Flavonoids and terpenoids have been suggested to scavenge the activities of free radicals and also possess cardi-protective effects [34,35], antimicrobial [36], immune-stimulatory [37,38] and hepato-protective properties [39,40]. Pharmacologically, alkaloids have been shown to exhibit analgesics and anti-inflammatory activities [41,42]. Results obtained in this study is in agreement with the findings of Moronkola et al. [17]; Oriajogun et al. [11]; Kalemba and Kunicka [23].

Table 3 Effect of Dietary Supplementation of *Chrysophyllum albidum* Stem Bark Powder (Casb) on the Growth Performance of Japanese Quails

Variables	Ta	Tb	Tc	Td	Te	SEM	P-value
Number of birds per group	60.00	60.00	60.00	60.00	60.00	-	-
Duration of experiment	30.00	30.00	30.00	30.00	30.00	-	-
Average initial body weight (g)	81.52	82.03	81.55	82.01	81.96	0.41	0.97
Average final body weight (g)	371.2 ^d	398.2 ^c	411.5 ^b	417.4 ^b	422.1 ^a	1.35	0.86
*Average body weight gain (g)	289.68 ^d	316.17 ^c	329.95 ^b	335.39 ^b	340.14 ^a	1.20	0.92
**Average daily weight gain (g)	9.66 ^d	10.00 ^c	10.10 ^b	11.18 ^a	11.34 ^a	0.03	0.01
***Average total feed intake (g)	1122.6 ^b	1200.6 ^a	1211.5 ^a	1215.8 ^a	1220.1 ^a	9.55	1.49
****Average daily feed intake (g)	37.42 ^b	40.02 ^a	40.38 ^a	40.53 ^a	40.67 ^a	0.05	0.02
*****Feed conversion ratio	3.87 ^a	3.79 ^b	3.67 ^b	3.63 ^b	3.59 ^c	0.01	0.001
Mortality (%)	3.11 ^a	1.00 ^b	0	0	0	0.01	0.001

Means on the same row having different superscripts are significantly different (P<0.05); SEM: standard error of mean; Ta: Regular diet without *Chrysophyllum albidum* stem bark powder (CASB) ; Tb, Tc, Td and Te: Regular diet supplemented with CASB at 100 g, 200 g, 300 g and 400 g per kg diet respectively. ¹Final body weight – initial body weight *Average final body weight minus average initial body weight; **Average daily weight gain /30 days;***Feed served – left over; ****Total feed intake/3days; *****Average daily feed intake/average daily weight gain.

The effect of dietary supplementation of *Chrysophyllum albidum* stem bark powder (CASB) on the growth performance of Japanese quails (Table 3). Increasing the supplementation of CASB in the diet of quails influenced ($P<0.05$) average daily weight gain, average daily feed intake, feed conversion ratio and mortality. Increasing dietary supplementation of CASB in the diet of quails increased average daily weight gain compared to the control group (Ta). Average daily weight gain in Tc (200 g CASB/kg diet) was similar ($P>0.05$) to quails which received Td (300 g CASB/kg diet) but significantly higher ($P<0.05$) than Tb (100 g CASB/kg diet) and Ta (control). The higher weight recorded among birds fed CASB suggests that it was able to influence the stimulation of gastric juices and digestive enzymes (mucosa and pancreas) secretion leading to a better nutrient digestibility [28,43]. The average body weight gain (289.68 - 340.14 g) recorded in this experiment was similar to the results of a study by Alagbe and Omokore who recorded a range of 173 - 335 g for quails fed diet supplemented with thyme essential oil[25]. This result was lower than 199.76 - 216.17 g recorded by lemon grass with pepper mint essential oil. The variation in this result can be attributed to level of phytonutrients supplemented in the diet as well as composition of phyto-constituents in the test ingredients [29,44]. Similarly, average daily feed intake values which ranged from 37.42 to 40.67 g increased in group of quails fed CASB relative to the control (Ta). This result indicates that CASB can enhance organoleptic stimulation when added to feed [45,46]. The result obtained is in agreement with the findings of Elnaggar et al. when black pepper and turmeric were supplemented in the diet of Japanese quails[47]. Mortality was higher in Ta (control) followed by Tb with 1.00 %, none was recorded in Tc, Td and Te. This result shows that CASB possess antimicrobial properties and can be more efficient when supplemented in the diet of quails above 200 g/kg diet. This also means that CASB can manage the intestinal flora by suppressing the proliferation of pathogenic organisms and giving room for beneficial bacteria to thrive and multiply [39,48]. Results obtained is in consonance with the findings of Gumus et al. [49]; Mohammed et al. [50] when phytonutrients were supplemented in the diets of birds. Increasing CASB in the diet of quails significantly decreased ($P<0.05$) feed conversion and mortality rate from 3.87 (Ta; control) to 3.59 in Te (400 g CASB/kg diet) and 1.00 % (Tc) to 2.11 % (Ta) respectively. Results obtained was similar to the outcome of a study by Siddhartha et al. [51]who recorded a feed conversion ratio which varied from 2.83 - 3.47 in Japanese quails fed diet supplemented with lemongrass and peppermint essential oils.

Table 4 Effect of Dietary Supplementation of *Chrysophyllum albidum* Stem Bark Powder (Casb) on the Carcass Characteristics of Japanese Quails

Variables	Ta	Tb	Tc	Td	Te	SEM	P-value
Live weight (g)	293.5	321.8	390.8	400.1	400.8	3.44	1.01
Carcass weight (g)	231.5 ^c	287.2 ^b	320.4 ^a	351.4 ^a	356.9 ^a	2.91	0.87
Dressing percentage	78.88 ^c	80.25 ^b	81.99 ^b	87.83 ^a	89.05 ^a	0.31	0.02
Head	5.97	6.06	6.11	6.17	6.21	0.02	0.01
Neck	3.12	3.56	3.77	4.02	4.03	0.01	0.001
Breast	21.59 ^b	30.06 ^a	30.15 ^a	30.80 ^a	30.87 ^a	0.26	0.03
Thigh	9.13 ^b	11.41 ^a	12.55 ^a	12.71 ^a	12.85 ^a	0.11	0.01
Drum stick	5.81 ^b	7.00 ^a	7.03 ^a	7.11 ^a	7.18 ^a	0.01	0.001
Wing	7.08 ^c	9.07 ^b	10.58 ^a	10.77 ^a	10.93 ^a	0.22	0.10
Shank	2.03	3.19	3.38	3.52	3.58	0.02	0.01
Back	16.57 ^c	20.81 ^b	23.11 ^a	24.05 ^a	24.57 ^a	0.62	0.21

Means on the same row having different superscripts are significantly different ($P<0.05$); SEM: standard error of mean; Ta: Regular diet without *Chrysophyllum albidum* stem bark powder (CASB) ; Tb, Tc, Td and Te: Regular diet supplemented with CASB at 100 g, 200 g, 300 g and 400 g per kg diet respectively

The effect of dietary supplementation of *Chrysophyllum albidum* stem bark powder (CASB) on carcass characteristics of Japanese quails (Table 4). Dressing percentage values which ranged from 78.88 to 89.05 % was higher among quails which received Te (400 g CASB/kg diet), intermediate in Tb (100 g CASB/kg diet), Tc (200 g CASB/kg diet), Td (300 g CASB/kg diet) and lowest in Ta (control). This result indicates that CASB contains both nutritional, medicinal properties and is capable of having positive influence on the final body weights of birds. Outcome obtained is in agreement with the reports of Daniel et al. [34]. Similarly, increase in dietary supplementation of CASB were significantly influenced ($P<0.05$) weights of breast (21.59 - 30.87 g), thigh (9.13 to 12.85 g), drum stick (5.81 to 7.18 g), wings (7.08 - 10.93 g) and back (16.57 to 24.57 g). This implies that supplementation up to 400 g CASB per kg diet was not deleterious to the health of birds. Conversely, weight of neck (3.12 - 4.03 g), shank (2.03 - 3.58 g) and head (5.97 to 6.21 g) were not affected ($P>0.05$) by the treatments. According to John [52], presence of anti-nutrients in a sample could affect the weights of organs and also

cause inflammation affecting the overall health of animals. The results obtained in this study is in agreement with the reports of Genedy and Zeweil [53]; Hernandez et al. [54] when plant extracts were supplemented in the diets of broilers.

7 CONCLUSION

It was concluded that CASB are rich in phyto-constituents - tannins, terpenoids, alkaloids, phenols and glycosides which possess medicinal qualities. Quails fed 400 g CASB per kg diet had a higher average daily weight gain, dressing percentage and excellent feed conversion ratio compared to the control. The health status of quails were not also compromised suggesting that it is safe and efficient.

COMPETING INTERESTS

The authors have no relevant financial or non-financial interests to disclose.

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