

Feed Additive Potentials of Kola Nut, Bitter Kola, and Wonderful Kola: A Review

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Abstract

The chemical constituents of different types of kolas are beginning to gain attention as a natural feed additive because of safety risks, residues, and consumer dissatisfaction associated with the use of synthetic products. This review explores a diverse array of literature on the use of kola nut, bitter kola, and wonderful kola as feed additives from different sources such as Springer, PubMed, Scopus, Crossref, Google Scholar, Research Gate, and Index Copernicus Journals. The chemical composition of kola nut, bitter kola, and wonderful kola showed that they contained carbohydrate, ash, crude fiber, ether extract, crude protein, tannin, saponin, phytic acid, phenol, trypsin inhibitor, sterol, steroids, flavonoid, alkaloid, oxalate, caffeine, hydrogen cyanide, and vitamins in different proportions. These bioactive compounds gave the kolas phytochemical potentials as feed additives. The use of these kolas influenced growth response, especially weight gain and feed conversion ratio, nutrient digestibility, hematological parameters, serum biochemistry, antioxidant capacity, carcass weight, egg production, and spermatogenesis in broilers, layers, rabbits, and pigs differently. There is a dearth of information on the use of kola nut seed or pod in layers and pigs; bitter kola seed in pigs and wonderful kola seed in poultry and rabbits. More effort is still needed to determine the appropriate inclusion levels and fully elucidate their mode of action.

Keywords: Bitter kola, broiler, kola nut, pig, rabbit, wonderful kola

INTRODUCTION

Feed additives are micro-quantity ingredient(s) added to basic feed to fulfill a specific role.^[1] They may improve or preserve the feed. They may be vitamins, minerals, amino acids, immunomodulators, oils, acidifiers, drugs, hormones, enzymes, antibiotics, antioxidants, probiotics, prebiotics, binders, colorants, and symbiotics.^[2] They are added to feed to improve health, promote growth, and productivity, enhance metabolic activities, affect gut microbial flora, upscale feed utilization, feed efficiency, animal performance, and profitability.^[3,4] However, synthetic additives have some safety risks, residues, and consumer dissatisfaction.^[5] These concerns led to the ban of some of the synthetic products in the European Union in 2006,^[6] especially in-feed antibiotics.^[7]

Consumers are beginning to appreciate and pay a premium for safe and natural food of animal origin.^[8] These kinds of foods can only be achieved with the use

of phytochemical feeds. Phytochemical feeds are also known as plant feed additives. They are natural. Plants possess biologically active compounds, metabolites, and oils.^[9] The plant parts could be leaves, roots, bark, flowers, or fruit. Others are herbs and spices. They have been tested on poultry, pigs, cattle, sheep, goats, rabbits, and so on. Their biological active constituents include saponin, tannin, flavonoid, pectin, glycoside, alkaloid, and organic acid.^[10]

Many medicinal plants such as kola (*Cola nitida*), bitter kola (*Garcinia kola*), wonderful kola (*Buchholzia coriacea*), and other forms of kola are mostly consumed

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by humans most especially aged people in producing areas of Africa. The seed, nut, and bark have been reported to treat various ailments. They have been reported to boost immunity, fight infections, relieve cough or throat troubles, remedy dysentery, reduce inflammation, protect against glaucoma, hypoglycemia, and diabetes, and an antidote against poisoning.^[11]

This study focuses on the review concerning the efficiency of kolas as a feed additive for livestock.

CHEMICAL COMPOSITION OF KOLA NUT

The chemical composition of kola nut shows that it contained 25.56%–69.00% carbohydrate, 33.60% dry matter, 1.50%–3.10% ash, 7.13%–11.40% crude fiber, 5.17%–18.00% ether extract, and 2.63%–8.90% crude protein.^[12-14] It has been reported to contain steroids, flavonoids, and vitamins.^[15] Others include theobromine, theophylline, methylxanthine, polyphenol, catechins, and phlobaphens.^[16]

CHEMICAL COMPOSITION OF BITTER KOLA

The potential of bitter kola stems from its minerals, vitamins, and nutritional facts.^[11] reported that it contained 70.31% carbohydrate, 90.82% dry matter, 4.17% ash, 3.94% crude fiber, 1.03% ether extract, 11.27% crude protein, 0.35% tannin, 0.68% saponin, 0.55% phytic acid, 0.16% phenol, 2.74 μ /g trypsin inhibitor, 0.09% sterol, 2.13% steol, 2.13% flavonoid, 0.43% alkaloid,

0.43% oxalate, 0.61% caffeine, and 1.35 mg/kg hydrogen cyanide.

CHEMICAL COMPOSITION OF WONDERFUL KOLA

The chemical composition of kola nut shows that it contained 66.79%–67.19% carbohydrate, 89.98%–93.11% dry matter, 1.66%–2.51% ash, 2.51%–3.45% crude fiber, 4.03%–4.78% ether extract, and 12.92%–15.41% crude protein.^[17-23] The presence of 0.11% tannin, 4.03% saponin, 1.83% phenol, 0.14%–0.16% steroid, 26.87% flavonoid, and 38.69% alkaloid and vitamins had been reported [Table 1].^[24-26]

EFFECTS OF KOLA NUT SEED OR POD MEAL, BITTER KOLA, AND WONDERFUL KOLA ON THE PERFORMANCE OF LIVESTOCK

Effects of kola nut seed or pod meal on poultry, rabbit, and pigs

The inclusion of kola nut pod meal at 10%–30% on broilers resulted in depressed weight gain (WG), feed conversion, and carcass weight (with increasing inclusion levels).^[27,28] On the other hand, 4%–8% kola nut pod meal recorded improved feed conversion ratio (FCR), nonsignificant carcass characteristics and internal organ weight, reduced total serum protein, creatinine, alanine aminotransferase, aspartate transferase, and cholesterol levels, increased antioxidant enzyme concentration, and no effect on serum biochemical

Table 1: Chemical composition of kola nut, bitter kola, and wonderful kola

Composition	Kola nut	Bitter cola	Wonderful kola
Carbohydrate	28.56–69.00	70.31	66.79–67.19
Dry matter	33.60	90.82	89.98–93.11
Ash	1.50–3.10	4.17	1.66–2.51
Crude fiber	7.13–11.40	3.94	2.51–3.45
Ether extract	5.17–18.00	1.03	4.03–4.78
Crude protein	2.63–8.90	11.27	12.92–15.41
Tannin	0.12	0.35	0.11
Saponin	1.10	0.68	4.03
Phytic acid		0.55	3.18
Phenol	0.23	0.16	1.83
Trypsin inhibitor		2.74 μ /g	0.53
Sterol and steroid	+	0.09	0.14–0.16
Steol		2.13	
Flavonoid	+	2.13%	0.79–26.87
Alkaloid		0.43	3.16–38.69
Oxalate		0.43	1.06
Caffeine		0.61	
Hydrogen cyanide		1.35 mg/kg	
Vitamins	+	+	+
Others			
Theobromine, theophylline, methylxanthine, polyphenol, catechins, and phlobaphens	[16]		
	[12-15]	[11]	[17-26]

indices concentration was also reported.^[29] The use of kola nut seed meal at 500–2000 ppm on broilers caused reduced hemoglobin (Hb), packed cell volume (PCV), albumin, and depressed weight (live, dressed; with increasing inclusion level).^[30] Better FCR, WG, and digestibility at up to 20% resulted in higher globulin and lower cholesterol in the diet of rabbits.^[31] There is a dearth of information on the use of kola nut seed or pod on layers and pigs.

Effects of bitter kola seed or pod meal on poultry, rabbit, and pigs

Aliyu and Mundi^[32] observed that the use of 5–10 g/kg bitter kola meal in the diet of broilers resulted in improved final weight (FW), WG, and average daily weight gain (ADWG) at 5 g/kg. Improved FW, WG, ADWG, dressed weight, liver, heart, gizzard, spleen, and heart at 15 g/kg and improved Hb, packed cell volume (PCV), and white blood cells (WBC) were observed.^[33] Oguntoye and Mafindi,^[34] reported improved growth at 20 g/kg. The use of 2.5%–10% bitter kola meal in the diet of broilers caused improved Hb, PCV, and WBC at 0.25%.^[35] Improved body weight (BW) was

also recorded. The use of bitter kola meal improved spermatogenesis in cocks.^[35]

Esiegwu *et al.*^[36] showed that the use of bitter kola meal at 2.5%–7.5% depressed hen day production in layers but enhanced egg weight. However, enhanced albumin and reduced yolk at 2.5% were observed. The use of bitter kola at 1.5%–4.5% caused increased body weight and improved FCR at 1.5%.^[37] Increased Hb, red blood cell (RBC), and total plasma (TP), whereas bilirubin, sodium (Na), potassium (K), urea, and cholesterol are reduced at higher levels. There is a dearth of information on the use of bitter kola seed meal on pigs.

Effects of wonderful kola seed meal on poultry, rabbit, and pigs

The use of wonderful kola meal at 5–20 g/kg in weaner pigs resulted in better final live weight (FLW), WG, feed gain ratio (FGR), dressing percentage (DP), and increased carcass cut-parts proportions. However, reduced cholesterol and increased alanine aminotransferase (ALT).^[38] There is a dearth of information on the use of wonderful kola seed meal on poultry and rabbits [Table 2].

Table 2: Effects of different inclusions of kola nut pod and seed, bitter kola, and wonderful kola in the diets of broilers, rabbits, and pigs

Livestock	Kola type	Inclusion level	Effects	References
Broilers	Kola nut pod	10–30 inclusion	Depressed WG, feed conversion, carcass weight (with increasing inclusion level)	[27,28]
		4%–8%	Improved FCR, nonsignificant carcass, and internal organ weight. Total serum protein, creatinine, alanine aminotransferase, aspartate transferase, and cholesterol levels, increased antioxidant enzyme concentration, no effect on serum biochemical indices concentration	[29]
	Kola nut seed	500–2000 ppm	Reduced Hb and PCV, albumin. Depressed weight (live, dressed; with increasing inclusion level)	[30]
Layers			No information	
Pigs			No information	
Rabbit	Kola nut pod	10%–30%	Better FCR and WG and digestibility at up to 20%. Higher globulin and lower cholesterol in diet with pod meal	[31]
Broiler	Bitter cola	5–10 g/kg	Improved FW, WG, and ADWG at 5 g/kg	[32]
		5–15 g/kg	Improved FW, WG, and ADWG, dressed weight, liver, heart, gizzard, spleen, and heart at 15 g/kg. Improved Hb, PCV, and WBC	[33]
		20 g/kg	Improved growth	[34]
		2.5%–10%	Improved Hb, PCV, and WBC at 0.25%. Improved BW	[35]
Layers		2.5%–7.5%	Depressed hen day production but enhanced egg weight. Enhanced albumin and reduced yolk at 2.5%	[36]
Rabbit	Bitter cola	1.5%–4.5%	Increased body weight and improved FCR at 1.5%. Increased Hb, RBC, and TP, whereas bilirubin, Na, K, urea, and cholesterol reduced at higher levels	[37]
Broilers	Wonderful kola		No information	
Layers	Wonderful kola		No information	
Weaner pig	Wonderful kola	5–20 g/kg	15 g/kg had better FLW, WG, FGR, and increased carcass cut-parts proportions. Reduced cholesterol and increased ALT	[38]
Rabbit	Wonderful kola		No information	

CONCLUSION

It can be concluded that the chemical composition of kola nut, bitter kola, and wonderful kola showed that they contained carbohydrates, ash, crude fiber, ether extract, crude protein, tannin, saponin, phytic acid, phenol, trypsin inhibitor, sterol steroids, flavonoid, alkaloid, oxalate, caffeine, hydrogen cyanide, and vitamins in different proportions. These bioactive compounds gave the kolas phytogetic potentials as feed additives. The use of these kolas in the diet of livestock gave divergent results. However, the use of kola nut pod meal at lower levels of 4%–8% recorded improved FCR, reduced total serum protein, creatinine, ALT, aspartate aminotransferase, and cholesterol levels, and increased antioxidant enzyme concentration but at higher levels (10%–30%) resulted in depressed WG, FCR, and carcass weight in broiler but resulted in better FCR, WG, and digestibility, higher globulin and lower cholesterol in diet of rabbits. The use of kola nut seed meal at 5%–20% improved FW, WG, improved Hb, PCV, WBC, and spermatogenesis, and reduced cholesterol in broilers but not in layers (depressed hen day production in layers but enhanced egg weight at 2.5%–7.5%). The use of wonderful kola meal at 5–20 g/kg resulted in improved live weight, WG, FCR, and increased carcass proportions, with reduced cholesterol and increased ALT in pigs. There is a dearth of information on the use of kola nut seed or pod in layers and pigs; bitter kola seed in pigs and wonderful kola seed in poultry and rabbits. More effort is still needed to determine the appropriate inclusion levels and fully elucidate their mode of action.

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Conflicts of interest

There are no conflicts of interest.

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