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Evaluation of growth performance, carcass quality and organoleptic indices of weaner rabbits fed two dietary protein levels with or without alligator pepper (Aframomum melegueta)

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Target Audience*:* Producers, Fast food outlets, Scientists, Feed additive suppliers

Abstract

Aframomum melegueta, a phyto-additive has been reported to have anti-oxidizing, anti-microbial, and flavor enhancing properties. The aim of this trial was to assess the efficacy of Aframomum melegueta in terms of growth performance, carcass quality and organoleptic indices of weaner rabbits (mixed breed and unsexed) fed two dietary protein levels with or without Aframomum melegueta seed meal (APSM). Six experimental diets were formulated such that diets A, B and C contained 18%CP and 0%, 0.1%, 0.2% APSM, respectively while diets D, E and F contained 16%CP with 0%, 0.1% and 0.2% APSM, respectively. Thirty-six weaner rabbits were allotted into the 6 dietary groups of 3 replicates each and two rabbits/replicate in a study lasting 8 weeks. Daily Weight Gain (DWG), Daily Feed Intake (DFI), Feed Conversion Ratio (FCR), carcass characteristics and sensory qualities were monitored. Data collected were analysed using a 2x3 factorial arrangement in a completely randomized design. Proximate composition of APSM on dry matter basis showed crude protein 6.39%, crude fat 7.10%, crude fibre 14.53%, ash 3.05% and nitrogen free extract 59.76%. The phytochemical constituents present are saponin 7.5%, tannin 0.021%, flavonoid 10.10% and alkaloids 1.70%. Findings showed that the main effects of protein levels and APSM did not elicit any significant differences (P>0.05) on DFI, DWG FCR and meat sensory attributes. Inclusion of APSM in rabbit diets caused a reduction in abdominal fat contents. Interaction between protein and inclusion levels of APSM did not reveal any significant variations except on apparent adhesion. In conclusion, the use of alligator pepper had no adverse effect on growth performance and carcass traits while 16% dietary protein level appeared better utilized compared to 18% in weaner rabbit diets.

Keywords*:* Alligator Pepper Seed Meal, Growth, Rabbit, Sensory Attributes.

Description of Problem

Rabbit production is very essential in improving animal protein intake in the developing countries like Nigeria. Rabbits are prolific animals that do not compete directly with man for both cereal and legume grains. They are also favored because of their high fecundity, low cost of investment, short gestation interval, as well as ability to utilize diverse forages (1). Herbs and spice mixtures are now added to monogastric animal diets to improve their nutritive value, boost animal growth rate, enhance feed conversion efficiency and maintain health (2) due particularly to the worldwide ban on the use of antibiotics in livestock production.

Aframomum melegueta K. Schum, a spice, belongs to the ginger family (Zingiberaceae), and is also known as grains of paradise or alligator pepper (3). Locally, it is known as ataare in Yoruba, ose oji in Igbo, and cittáá in Hausa of Nigeria (4). The seed of Alligator pepper is used in different African cultures as a spice or medicine. In traditional medicine, the seeds are employed as a local remedy for gastrointestinal disorders, snake-bite, diarrhea, cardiovascular diseases and, diabetes among others (5). Investigations on Alligator pepper seeds or its extracts showed that it possess antioxidant and antibacterial effects (6, 7, 8); antidiarrheal action (9); anti-inflammatory properties [10); modulation of blood profile and antihypercholesterolemic effect (11) and can manage erectile dysfunction [12). In addition to these attractive properties, spices have been shown to increase feed palatability and thus feed intake (13). Afolabi and Eko (14) reported that inclusion of Alligator pepper seed meal in pullet chicks diet had no detrimental effect on their performance. Because of the antimicrobial, antioxidant and flavor enhancing properties of alligator pepper, it was hypothesized that it may promote growth and feed utilization and possibly have a protein sparing effect in rabbit diets. This study therefore was designed to evaluate the effects of alligator pepper seeds on the growth; carcass characteristics and organoleptic indices of weaner rabbits fed two dietary protein levels.

Materials and Method

Experimental site: The experiment was carried out at the Rabbitary Unit of Teaching and Research Farm, Ladoke Akintola University of Technology (LAUTECH), Ogbomoso, Oyo state, Nigeria. Ogbomoso is located on Longitude $4^{o}15'$ East of the Greenwich meridian and latitude $8^{o}15'$ North of the equator in the derived savanna zone of Nigeria. The latitude is between 300 and 600 meters above sea level. The mean annual temperature is about 27^{0}C while that of average rainfall is 1247mm (15). The vegetation of the study area is in the derived savannah zone.

Processing of test ingredient

Alligator pepper seeds were obtained from Waso market in Sabo-Ogbomoso. The seeds were removed from the epicarp and milled into a fine powder using a Gasa blender with model number QBL-20140 until they could pass through a 0.5 mm screen and stored in airtight bottles till required for analysis.

Experimental rabbits, diets and management

Thirty-six (36) weaned rabbits of mixed sex and mixed breeds of Chinchilla, New Zealand White and California White with average weight of 500-700g were used for the experiment. The rabbits were purchased from a reputable farm in Ibadan, Nigeria. They were divided into six groups and 3 replicates with 2 rabbits per replicate. The rabbits were housed in hutches having separate feeders and drinkers. Six diets were formulated (Table 1) such that diets A, B and C contained 18%CP supplemented with 0%, 0.1% and 0.2% alligator pepper, respectively. Diets D, E and F contained 16%CP supplemented with 0%, 0.1% and 0.2% alligator pepper, respectively. Initial body weights of the rabbits were taken on replicate basis at the start of the study and thereafter on two weeks' basis. Weekly feed intake was also recorded. The average daily weight gain (DWG), daily feed intake (DFI) and feed conversion ratio (FCR) were calculated from the data obtained during the experimental period. At the end of the 8^{th} week feeding trial, 2 rabbits were selected randomly per group. The mean body weights were representative of the range of the body weight within each group. The rabbits were starved overnight to clear the gut but drinking water

was provided. The rabbits were slaughtered, drained of blood and eviscerated (16). The hot dressed carcass was weighed and compared with the live weight to obtain the carcass yield (dressing percentage). The carcasses were cut into prime parts and weighed. The internal organs and gut contents were also excised, weighed and expressed as a percentage of live weight. For the sensory attributes, 10 semi-trained panelists were used to evaluate colour, flavor, juiciness, ease of fragmentation, apparent adhesion, residue after chewing and acceptability.

Chemical and Statistical Analysis

Samples of the milled alligator pepper (APSM) and experimental diets were analyzed on dry matter basis for proximate composition using (17) while phytochemical screening was carried out using the methods described by (18). All data collected were analyzed as appropriate for a 2x3 factorial arrangement in a Completely Randomized Design (CRD) using procedure of (19). Significant means was separated by Duncan's multiple range test of the same statistical package.

Table 1: Composition of experimental diets (%)

			18%CP		16%CP	
Ingredients	**A**	**B**	**C**	**D**	**E**	**F**
Maize	40	40	40	40	40	40
Soybean meal	15	15	15	10	10	10
Wheat offal	25	25	25	30	30	30
Palm kernel cake	14.25	14.25	14.25	15.25	15.25	15.25
Alligator pepper	-	0.1	0.2	-	0.1	0.2
Fish meal	2	2	2	1	1	1
Limestone	3	3	3	3	3	3
Premix[a]	0.25	0.25	0.25	0.25	0.25	0.25
Salt	0.25	0.25	0.25	0.25	0.25	0.25
Methionine	0.25	0.25	0.25	0.25	0.25	0.25
Total	100	100	100	100	100	100
Analyzed composition (%)						
Dry Matter	89.52	90.03	89.36	89.24	89.13	89.45
Crude protein	18.12	17.95	18.11	16.13	16.11	16.08
Crude fibre	11.32	11.26	11.41	12.34	12.19	12.31
Ether extract	2.14	2.11	2.31	2.56	2.42	2.32
Ash	2.06	2.21	2.28	2.45	2.34	2.43
ME[b] (kcal/kg)	2791.5	2791.5	2791.5	2803.3	2803.3	2803.3

[a]Premix supplied per kg of diet: Vitamins A 800 I.U.; D3 (1,4731.C.U); Riboflavin 4.20mg; Pantothenic acid 5.0mg; Nicotinic acid 20.0mg; Folic acid 0.5mg; Choline 300mg; Vitamin K, 2.0mg; Vitamin B12, 0.01mg; Vitamin E, 2.5I.U; Manganese, 56.0mg; Iodine, 1.0mg; Iron 20.0mg; Copper 10.0mg; Zinc 50.0mg and Cobalt 1.25mg

[b]M.E: Metabolizable energy

Results and Discussion

The result of the proximate composition of APSM on dry matter basis showed crude protein 6.39%, crude fat 7.10%, crude fibre 14.53%, ash 3.05% and nitrogen free extract 59.76%. The result revealed that APSM has a low protein, ash and ether extract, moderate fibre and high carbohydrates. The values are similar to those recorded by (18) where protein was 7.20%, fat 2.6%, ash 2.5% with a lower

crude fibre of 5.54%. The seeds of Alligator pepper have been variously reported to be particularly rich in carbohydrates, crude fibre, and minerals (20, 21), indicating it to be of good nutritional quality, and hence justifying its incorporation into diets. The determined phytochemical constituents present include saponin 7.5%, tannin 0.021%, flavonoid 10.10% and alkaloids 1.70%. Previous authors (18, 20) had also reported the presence of phytochemicals in alligator pepper.

The main effect of protein and APSM levels (Table 2) elicited no significant (P>0.05) variations on the performance of weaner rabbit among the treatment groups. The values obtained for dietary protein levels in terms of DWG are (9.6g and 9.4g), DFI (47.9 and 43.1g) and FCR (5.2 and 4.6) for 18 and 16% CP, respectively. For the APSM levels, values of all parameters measured (DWG, DFI and FCR) ranges from 8.8-10.3g, 38.3-50.3g and 3.6-5.6, respectively. The interaction effect of protein and alligator pepper also revealed no significant changes on the performance parameters (Table 3). Though there were no significant effects in the values obtained, rabbits on 16%CP diet without APSM had the best values for DWG, DFI and FCR while those on 16%CP diet with 0.2%APSM had the least and poorest values for DWG and FCR. Rabbits on 18%CP with 0.1%APSM had the highest DFI and poorest FCR. Feeding of growing rabbits with 16%CP appears adequate, which was earlier recommended by (22). The feed consumption, which was not significantly influenced, affirmed the report of (14) on pullet chicks. Inclusion of Garcinia kola (23) depressed feed intake and growth performance and the effect seem to increase with higher concentration. However, (24) revealed that Garcinia kola seed can be used in the diet of growing rabbits at 2.5 % to enhance feed intake and weight gain, thereby promoting tissue lay down without compromising feed efficiency.

Table 2: Main Effect of Protein and Alligator pepper levels on the performance of weaner rabbit

Parameters	Protein levels		SEM	P. values	Alligator levels		SEM	P. values	
	18%	16%			0%	0.1%	0.2%		
DWG (g/r)	9.6	9.4	0.52	0.76	10.3	9.58	8.8	0.90	0.54
DFI (g/r)	47.9	43.1	3.95	0.41	38.3	50.3	48.0	6.85	0.72
FCR	5.2	4.6	0.57	0.48	3.6	5.5	5.6	0.99	0.61

Table 3: Interaction effects of protein and alligator pepper levels on performance of weaner rabbits.

Protein levels	18%			16%				
Alligator levels	0%	0.1%	0.2%	0%	0.1%	0.2%	SEM	P. values
DWG (g/r)	9.8	9.8	9.3	10.8	9.2	8.3	0.90	0.54
DFI (g/r) 41.3	55.2	47.3	35.3	45.4	48.7	6.85	0.72	
FCR	4.3	5.9	5.3	2.9	5.0	5.9	0.99	0.61

The main effects of protein and APSM levels on carcass retail cuts, organ weights and intestinal measurements expressed as percentages of live weight are summarized in Table 4. All the parameters did not show any significant differences (p>0.05). The dressing percentage was numerically highest for rabbits on APSM compared to those without APSM.

The retails cuts (fore limb, ribs, loin, hind limb) did not show any significant variations based on APSM levels. Organ weights revealed significant (P<0.05) variations for lungs, spleen and kidney while heart and liver were not (P>0.05) affected. Observations of the internal organ indicated that, heaviest weights were recorded for rabbits on diet B [0.1% AP, 18% CP] and diet F [0.2% AP, 16% CP] when compared to rabbits on other diets. The significant difference in the weights of these internal organs [heart, kidney, liver, and lungs] could probably be due to the higher physiological activities by these organs. Rabbits fed 0.2%APSM recorded the heaviest weights for GIT, small and large intestines compared to rabbits on other diets. Alligator pepper did not influence the length of the small and large intestines. Values for abdominal fat was highest for rabbits in diet without APSM, while rabbits fed 0.1% and 0.2% APSM had significantly (P<0.05) reduced abdominal fat contents. Kout Elkloub et al., (25) pointed out that moringa oleifera leaves increased live body weight and lowered abdominal fat content in chinchilla rabbits. The interaction effects of protein x APSM level are shown in Table 5. Most of the organ weights and retail cuts indicated significant interactions except ribs, loin and abdominal fat. The abdominal fat pad was reduced in rabbits fed APSM at inclusion of 0.1%APSM/18%CP and 0.2%/16%CP. The weight of the gastro intestinal tract, large and small intestine of rabbit on diet having 0.2APSM% were higher (p<0.05) than those fed 0.1%APSM and 0%APSM. The retail cuts (thigh, fore limb, racks and ribs loin) were similar (p>0.05) in all diets and did not differ significantly.

Table 4: Main effects of Protein and Alligator pepper levels on carcass characteristics and organ weights of weaner rabbit

	Protein levels		SEM	P	Alligator levels			SEM	P. values
Parameters	18%	16%			0%	0.1%	0.2%		
Live weight, g	1516	1528	28.7	0.54	1726	1371	1471	35.1	0.73
Dressed weight, %	46.1	50.0	0.72	0.35	42.5^{b}	52.1^{a}	49.5^{a}	0.88	0.64
Fore limbs	9.22	8.62	0.28	0.61	9.13	8.77	8.86	0.34	0.58
Rack/ribs	9.38	9.23	0.35	0.42	9.44	8.65	9.84	0.43	0.46
Loin	17.3	16.8	0.33	0.24	17.55	16.92	16.72	0.40	0.65
Hind limbs	14.2	13.8	0.19	0.61	14.07	14.07	13.84	0.20	0.36
Skin (pelt)	8.73	9.51	0.17	0.46	9.50	8.95	8.91	0.20	0.37
Heart	0.24	0.22	0.01	0.36	0.23	0.22	0.25	0.00	0.42
Liver	2.16	2.23	0.05	0.68	2.12	2.22	2.25	0.00	0.41
Lungs	0.55	0.44	0.03	0.45	0.51^{ab}	0.54^{a}	0.41^{b}	0.03	0.41
Spleen	0.04	0.03	0.00	0.57	0.05^{a}	0.04^{b}	0.03^{b}	0.00	0.25
Kidney	0.56	0.66	0.02	0.45	0.51^{b}	0.66^{a}	0.63^{a}	0.02	0.35
GIT	19.0	22.4	0.57	0.66	19.4^{b}	19.8^{b}	22.9^{a}	0.70	0.42
Small intestine	2.83	3.81	0.18	0.56	2.93^{b}	2.74^{b}	4.30^{a}	0.22	0.65
Large intestine	8.53	9.97	0.66	0.61	8.42^{b}	7.51^{b}	11.81^{a}	0.81	0.58
Abdominal fat	2.29	2.03	0.26	0.46	2.84^{b}	1.93^{a}	1.72^{a}	0.32	0.54
Small intestine, cm	256.7	227.2	6.65	0.36	268.4	230.5	226.9	8.14	0.46
Large intestine, cm	137.9	133.7	3.52	0.48	139.2	137.4	130.7	4.31	0.56

SEM= standard error of the means; a, b, c = means in the same row bearing different superscripts differ significantly (p<0.05).

Table 5: Interaction effects of protein and Alligator pepper levels on carcass characteristics and organ weights of weaner rabbit

Protein levels	18%CP			16%CP				
APSM level	0%	0.1%	0.2%	0%	0.1%	0.2%	SEM	P
Live weight, g	1679^{a}	1353^{c}	1518^{b}	1773^{a}	1389^{bc}	1424^{bc}	49.6	0.67
Dressed weight, %	33.2^{c}	53.6^{a}	51.3^{ab}	51.7^{ab}	50.5^{ab}	47.8^{b}	1.24	0.71
Fore limbs	9.10^{ab}	8.88^{ab}	9.68^{a}	9.16^{ab}	8.66^{ab}	8.05^{b}	0.48	0.43
Rack/ribs	9.62	8.36	10.17	9.25	8.93	9.51	0.61	0.36
Loin	17.7	17.2	17.2	17.4	16.7	16.3	0.58	0.38
Hind limbs	13.9^{ab}	14.2^{ab}	14.5^{a}	14.2^{ab}	13.9^{ab}	13.2^{b}	0.33	0.37
Skin (pelt)	9.00^{c}	8.65^{c}	8.55^{c}	9.99^{a}	9.26^{ab}	9.26^{ab}	0.30	0.45
Heart	0.24^{ab}	0.26^{a}	0.24^{ab}	0.21^{bc}	0.18^{c}	0.26^{ab}	0.01	0.54
Liver	2.14^{ab}	2.25^{ab}	2.10^{b}	2.11^{b}	2.19^{ab}	2.40^{a}	0.08	0.43
Lungs	0.64^{a}	0.66^{a}	0.36^{b}	0.38^{b}	0.43^{b}	0.46^{b}	0.05	0.35
Spleen	0.06^{a}	0.03^{bc}	0.04^{b}	0.04^{ab}	0.04^{b}	0.02^{c}	0.01	0.45
Kidney	0.45^{c}	0.66^{ab}	0.57 ^{b}	0.57^{b}	0.66^{ab}	0.69^{a}	0.03	0.57
GIT	18.2^{c}	17.9 ^{ab}	20.9^{bc}	20.6^{bc}	21.8^{ab}	4.7^{a}	0.99	0.41
Small intestine	3.14^{b}	2.54^{b}	2.83^{b}	2.73^{b}	2.93^{b}	5.78^{a}	0.30	0.55
Large intestine	10.4^{b}	7.18^{bc}	7.96^{bc}	6.39^{c}	7.84^{bc}	15.7^{a}	1.14	0.57
Abdominal fat	2.91	1.98	1.97	2.77	1.87	1.46	0.45	0.48
Small intestine, cm	286.9^{a}	245.4^{b}	237.9^{b}	250.0^{b}	215.5^{b}	216.0^{b}	11.5	0.34
Large intestine, cm	139.9^{b}	132.4^{b}	141.4^{a}	138.5^{b}	142.5^{a}	120.0^{b}	6.10	0.41

SEM= standard error of the means; a, b, c = means in the same row bearing different superscripts differ significantly ($p<0.05$)

The main effect of protein and APSM on organoleptic attributes of meat from weaner rabbits revealed that all parameters measured were not significantly influenced as shown in Table 6. The values obtained for protein levels are 6.13 and 5.92 (colour), 6.13 and 6.13 (flavor), 6.13 and 5.50 (juiciness), 6.29 and 5.83 (ease of fragmentation), 5.54 and 4.92 (apparent adhesion), 4.29 and 4.46 (residue after chewing), 7.17 and 7.08 (acceptability) for 18%CP and 16%CP respectively, while that of alligator pepper levels ranges from 5.56 to 6.06, 6.0 to 6.19, 5.38 to 6.25, 5.69 to 6.31, 5.06 to 5.50, 4.19 to 4.63 and 7.00 to 7.25 for colour, flavor, juiciness, ease of fragmentation, apparent adhesion, residue after chewing and acceptability, respectively. The taste panel rating showed that the overall acceptability of the rabbit meat was not dependent on protein or APSM levels. The interaction effect of protein and alligator pepper (Table 7) did not reveal any significant variations except for apparent adhesion. Rabbits on 18%CP without APSM had the highest values for juiciness, ease of fragmentation, apparent adhesion and acceptability, while those on 16%CP with 0.2% APSM had the least values for colour, flavor, juiciness and residue after chewing. Carcass meat from rabbits fed 16%CP without APSM recorded the highest values for flavor and residue after chewing but least values for ease of fragmentation and apparent adhesion respectively. Spices were used primarily for their organoleptic and preservative properties; however, research findings on their medicinal and nutritional properties would further justify their usefulness in the fields of nutraceuticals and functional foods.

Table 6: Main effects of Protein and Alligator pepper levels on meat sensory attributes of weaner rabbits

Parameters	Protein levels		SEM	P	Alligator levels			SEM	P.values
	18%	16%			0%	0.1%	0.2%		
Colour	6.13	5.92	0.68	0.35	5.56	6.44	6.06	0.37	0.43
Flavour	6.13	6.13	1.00	0.34	6.19	6.19	6.00	0.94	0.42
Juiciness	6.13	5.50	0.22	0.35	6.25	5.81	5.38	0.37	0.43
Ease of fragmentation	6.29	5.83	0.24	0.27	6.19	5.69	6.31	0.38	0.33
Apparent adhesion	5.54	4.92	0.19	0.33	5.50	5.06	5.13	0.71	0.40
Residue after chewing	4.29	4.46	0.81	0.48	4.63	4.31	4.19	0.87	0.59
Acceptability	7.17	7.08	0.80	0.23	7.25	7.00	7.13	0.82	0.28

SEM= standard error of the means; a,b,c = means in the same row bearing different superscripts differ significantly ($p<0.05$)

Table 7: Interaction effects of protein and Alligator pepper levels on carcass characteristics and organ weights of weaner rabbit

Protein levels	18%CP			16%CP				
APSM level	0%	0.1%	0.2%	0%	0.1%	0.2%	SEM	P
Colour	5.50	6.13	6.75	5.63	6.75	5.38	0.25	0.61
Flavour	6.13	6.13	6.13	6.25	6.25	5.88	0.94	0.59
Juiciness	6.63	6.13	5.63	5.88	5.50	5.13	0.98	0.60
Ease of fragmentation	6.88	5.75	6.25	5.50	5.63	6.38	0.24	0.47
Apparent adhesion	6.50^{a}	4.88^{ab}	5.25^{ab}	4.50^{b}	5.25^{ab}	5.00^{ab}	0.11	0.57
Residue after chewing	4.38	4.13	4.38	4.88	4.50	4.00	0.85	0.84
Acceptability	7.50	6.88	7.13	7.00	7.13	7.13	0.64	0.40

SEM= standard error of the means; a, b, c = means on the same row bearing different superscripts differ significantly ($p<0.05$)

Conclusion and Applications

This study demonstrated that:

1. Aframomum meleguata seed can be used to maintain growth rate in rabbits fed 16%CP thereby sparing the use of 18% crude protein.
2. The inclusion of 0.2% Aframomum meleguata is likely to produce lean meat based on the reduction of abdominal fat content, which will have positive health implications.
3. Carcass characteristics were not adversely affected with the use of Alligator pepper or lower crude protein content.
4. More research on the quality of meat produced by the inclusion of Aframomum meleguata seed meal in the diets of growing rabbits is advocated.

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