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Effects of Feeding Graded Levels of Discarded Dried Cabbage Leaves (DDCL) on Haematology and Serum Biochemical Indices on the Performance of Growing Rabbits in the Semi-Arid Region of Maiduguri, Borno State

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Abstract: *This study was conducted to determine the effects of feeding graded levels of dried discarded cabbage leaves (DDCL) on haematological and serum biochemical parameters of growing rabbits. A total of seventy-Five (75) growing rabbits of between seven to eight weeks of age were randomly assigned to five treatment groups in a completely randomized design. Each group was replicated three times with five rabbits per replicate. Five experimental diets were formulated such that T1, T2, T3, T4 and T5 were supplemented with DDCL at 0, 5, 10, 15 and 20% respectively. Feed and water were provided ad libitum and the experiment lasted for 10 weeks. The haematological parameters determined included pack cell volume (PCV), haemoglobin (Hb), red blood cells (RBC), mean corpuscular volume (MCV), mean corpuscular haemoglobin (MCH), mean corpuscular haemoglobin concentration (MCHC), white blood cell (WBC) while serum biochemical indices are: total protein, globulin, albumin, cholesterol, serum glutamic pyruvate transaminase (SGPT), serum glutamic oxaloacetate transaminase (SGOT). Results on haematology revealed that there were no significant differences (P>0.05) in the values of PCV, RBC, MCV, WBC. HB, MCH and MCHC values significantly differed (P<0.05) among the treatments. All the serum biochemical constituents were within the normal range and the values were comparable (p>0.05) among the treatments with the exception of creatinine among rabbits of treatment I was significantly (p<0.05) higher compared to rabbits of other treatments. It was concluded that dietary supplementation of DDCL up to 20% had no deleterious effect on the haematology and serum biochemical parameters of rabbits.*

Keywords: *Haematology, Growing Rabbit, Discarded Dried Cabbage, Leaves, Serum and Performance*

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DESCRIPTION OF PROBLEM

The world population, estimated to rise to 16 billion in the year 2030, is expected to increase to more than 17.5 billion by 2040. This increase in human population requires a large quantity of animal protein to meet the protein requirements of the growing population; this is going to be a

serious problem for developing countries like Nigeria. Ahamefule *et al*. (2006) and Igwebuike *et al.,* (2016) reported that there is inadequate protein supply in the diet of most people living in developing countries including Nigeria. The protein consumption of people in these countries is below the Food and Agriculture Organization's (FAO) recommendation of 35g of animal protein/person/day requirement. In order to overcome the problem of protein shortages, attention is now focused on the production of animals that are prolific and capable of using different sources of feeds that are less costly or which are underutilized (Omoikhoje *et al.*, 2005 and Igwebuike *et al.*, 2016).

Ahamefule *et al*., (2006) reported that rabbit production is a realistic approach to counter the animal protein deficit in the diet of Nigerians. This is because of its high fecundity, high genetic potential, rapid growth rate and relatively low cost of production. Rabbit (*Oryctolagus cuniculus*) has short generation interval, high prolificacy, good mothering ability and easy management, with ability to utilize waste and other non-conventional feed sources. Although, they are described as pseudo-ruminants, rabbits can feed on a wide variety of feeds from grasses, herbs, leafy weeds, vegetables, household wastes and garbage. Besides, they are known to yield high quality protein meat with low fat (Ahamefule *et al*., 2006).

Rabbits are also considered effective for the meat production and they can use up to 30% against 10% crude fibre in the diets of most poultry species. Compared to meat from other species, rabbit meat is high in protein and vitamins, and rich in minerals. It contains little fat and high proportion of essential poly-unsaturated fatty acids such as linoleic and linolenic acids (Aduku and Olukosi, 1990). Despite the nutritional benefits offered by rabbit meat and easy climate adaptation of species, rabbit breeding is less developed in Nigeria. The major reason for this fact is the lack of awareness and high cost of feed which are factors affecting animal production in the country. Feed accounts for about 70 % of the total cost of production in livestock and is a major threat to the expansion of the sector in Nigeria (Ojebiyi and Saliu, 2014). Research findings have shown that rabbits can do well on non-conventional or alternative feed ingredients. The use of available and cheap ingredients to feed rabbit is therefore highly recommended.

Adeyemi *et al.,* (2011) emphasized the use of vegetable leaves in animal feeding as a valuable way to reduce the cost of animal feed. Studies have indicated that the leaves of vegetable plants had high protein content (26 to 35%) and good mineral contents (Acho *et al*., 2014). Discarded cabbage (*Brassica oleracea* var. capitata) is a vegetable by-product that is available in many parts of Nigeria. It could be considered a potential non-conventional feed resource for rabbits. Mekasha *et al*., (2002) have confirmed that cabbage contains 86 - 140 g dry matter (DM)/kg, 137 - 280 g crude protein (CP)/kg DM, 9 - 17 g ether extract (EE)/kg DM and 186 g crude fibre (CF)/kg DM. In addition, 2436.27 Kcal metabolizable energy (ME)/kg DM; an 80.4% dry matter digestibility (IVDMD) and 84% total digestible nutrients (TDN) were reported for cabbage (NRC, 2007), making it a good source of nutrients for livestock. However, despite the nutritive value of this vegetable, it is reported to contain S-methyl-L-cysteine sulphoxide and glucosinolates that depress intake and lead to production of gas (bloat) by rabbit. Previous work has shown cabbage to be superior to other vegetables when fed to fish, but less work has been done to determine the optimal dietary supplementation of cabbage in rabbit diets. Although few studies were conducted on cabbage, most of them were conducted outside the country so the general objective of this study

is to assess the effect of feeding graded levels of DDCL on the haematological and serum biochemical indices of growing rabbit and evaluate the optimal level of inclusion of dry discarded cabbages on the performance of growing rabbits.

MATERIALS AND METHODS

Experimental Site

The study will be conducted at the Livestock Unit of the Teaching and Research Farm, Department of Animal Production Technology, Ramat Polytechnic, Maiduguri. Maiduguri is located between latitude 11°5' and 12^0 North, longitude 13°09' and 14^0 East and at an altitude of 354 m above sea level (DNMA, 2013). The area has a semi-arid tropical climate with a wide seasonal diurnal range of temperature. The hottest months are April and May with a temperature range between 39.4 and 40.1 ^{0}C under shade (Afolayan *et al.,* 2013).

Experimental Animals and their Managements

Seventy five (75) rabbits (New Zealand white) between 6 and 7 weeks of age will be used for the feeding trial which will last for 12 weeks. Before the commencement of the experiment, a one-week adjustment period will be observed. The rabbits will be individually weighed and divided into 5 groups. Each group will be replicated thrice with 75 rabbits per replicate in such way to ensure uniformity of average weight of each group. The groups will be randomly assigned to five dietary treatments. Each rabbit will be individually housed in a wire cage measuring 33.0 x 38.0 x 45.0 cm (WxLxH). The cages, in rows, will be raised 45 cm above the ground to facilitate cleaning. Each cage cell will be equipped with plastic drinkers and metal feeding troughs. The experimental diets (in mash form) and clean drinking water will be provided *ad-libitum* throughout the experimental period.

Collection and Processing of Discarded Cabbage Leaves (DCL)

Discarded cabbage leave will be obtained from a local fresh vegetable market (Kasuwanmoromoro) Gamboru, Maiduguri, BornoState and chopped to a smaller piece in order to facilitate easy drying using local knife. Chopped discarded cabbage leaves will be allowed to dried in a room temperature under a shedfor a period of 7-10 days until when it is fully dried. The discarded cabbage leave (DCL) will be grounded through a 2-mm screen using a hammer mill or grinding machine and chemically analyzed for proximate composition.

Experimental Diets

The ingredient composition and the calculated analysis of the experimental diets are shown in Table 1. The discarded cabbage leaves will be incorporated at levels of 0, 10, 20, 30 and 40% in diets 1 (control), 2, 3, 4 and 5, respectively. The diets will be formulated to supply 18% crude protein (CP) on dry matter basis.

Blood Sample Collection

At the end of the experiment three (3) rabbits were randomly selected per treatment fasted overnight and used for blood analysis. Blood samples were collected via the vein into a labeled Ethylene diamine tetra acetic acid (EDTA) treated tubes for hematological analysis and into tubes without se for serum biochemical evaluation. The hematological indices determined include the

pack cell volume (PCV), red blood cell (RBC), white blood cell (WBC), hemoglobin (Hb), mean corpuscular volume (MCV), mean corpuscular hemoglobin concentration (MCHC), mean corpuscular hemoglobin (MCH) and white differential counts which include lymphocytes, monocytes, eosinophils and neutrophils. MCV, MCH and MCHC were calculated according to Jain (1986), PCV was determined by micro hematocrit method, while WBC, RBC and Hb were determined by the improved Neubauer haematocytometer and cyanomethemoglobin respectively. Blood samples that were meant for serum chemistry were collected into bottles free of any anticoagulant. Albumin, globulin and serum total protein were determined by Biuret reactions (Bush, 1991) and cholesterol (Roschian *et al.*, 1974). Activities of serum glutamic pyruvate transaminase (SGPT), serum glutamic pyruvate transaminase (SGOT) were computed according to Reitman and Frankel (1957).

Laboratory Analysis

The proximate composition of experimental diets and DDCL and the formulated diets were analysed according to AOAC (2000), while mineral analysis were carried out using Atomic Absorption Spectrophotometer (AAS). Vitamin content of DDCL was analysed using method reported by Onwuka (2005).

Statistical Analysis

The Data collected will be subjected to analysis of variance (ANOVA) using General Linear Models Procedure of SAS (version 9.0) to compute means (±standard errors). The means where significant will be separated using the Duncan's multiple range tests.

RESULTS AND DISCUSSION

Chemical Composition of DDCL and Experimental Diets

The proximate composition of DDCL and experimental diet are presented in Table 2. The results revealed that the dry matter content, crude protein, crude fibre, ether extract, ash nitrogen detergent fibre and acid detergent fibre in the DDCL were 11.0, 8.75, 11.9, 16.7, 1.89, 25.6 and 23.1 respectively, while for experimental diets ranges from 90.71 - 91.00, 19.08 - 19.77, 13.21 - 17.57, 3.80 - 4.20, 3.23 - 4.61, 27.54 – 29.48 and 17.09 - 19.22%, respectively. The crude protein in this current experiment decreased as the inclusion of DDCL increased from treatments 1 to 5. The result suggests that DDCL can be able to supply adequate amounts of dietary proteins. However, proximate composition in the experimental diets was within the range recommended for growing rabbits by NRC (1977) and Ibrahim *et al.,* (2018). The result is in agreement with the findings of Tarigan *et al.,* (2018) and Abdullah *et al.,* (2018). The mineral and vitamins composition of DDCL are presented in Table 3. The DDCL contains higher concentrations of minerals such as calcium, potassium, sodium, magnesium, phosphorus, iron, manganese and zinc respectively. The mineral composition of DDCL agrees with the report of Soetan *et al.,* (2016). Life is dependent upon the body's ability to maintain balance between minerals and they play a vital role in metabolic processes (Ozcan, 2003). Calcium, magnesium and potassium play an important role in red blood cell formation and body mechanism (WHO, 1996). Potassium is required in maintaining body fluid volume and osmotic pressure. DDCL contains 53.16 mg of vitamin A and 11.43 mg of

vitamin C. Both vitamins perform the role of antioxidant and can aid to boost the immune system (Wright, 2002).

The haematological response of rabbits fed diets containing graded levels of dried discarded cabbage leaves (DDCL) is presented in Table 4. The PVC, Hb, RBC, MCV, MCH and MCHC values ranges between 42.00 to 44.08 %, 10.61 to 12.10 g/dl, 7.02 to 7.52 ×106 /L, 30.66 to 31.92 fl, 17.68 to 19.90 pg and 64.56 to 66.58 % respectively, while those of WBC, lymphocytes, monocytes, neutrophils, basophil and eosinophils values ranges between 10.82 to 12.36 ×106 /L, 51.28 to 52.51 %, 1.20 to 1.44 %, 33.21 to 33.96 %, 0.58 to 0.84% and 4.11 to 5.07 % respectively. The values for all the parameters measured were not significantly (P>0.05) influenced by the dietary inclusion of DDCL with exception of RBC and Hb. However, all values fall within the reference range reported by Ozkan *et al.,* (2012) for rabbits. The result also showed that the animals were not anaemic because they have a PCV above 30% (Jenkins, 2008), there is also enough oxygen in the blood because the RBC values slightly increased from diet 1 to 5 at a significant level. According to Chineke *et al.,* (2006), Hb, MCH and MCHC values can be used to determine the efficiency of the bone marrow to produce red blood cell. WBC and its differentials were not significantly (P>0.05) affected by the inclusion of DDCL in the diets. This result is in agreement with the reports of Ahemen *et al.,* (2013) but contrary to the findings Jiwuba *et al.,* (2016).

Serum Biochemical Parameters

The various serum biochemical parameters estimated from blood sample collected from rabbits reared under different treatments on the last day of the feeding trial are presented in Table 5. All the blood biochemical constituents were within the normal range as described by Alessandro (2007), and the values were comparable (p>0.05) among the treatments with the exception of creatinine. Among the parameters estimated the mean creatinine content among rabbits of treatment I was significantly (p<0.05) higher compared to rabbits of other treatments. However, the values of creatinine in all treatments were within the normal range. Higher creatinine level in treatment I may be due to higher level of protein intake through groundnut cake as dietary protein consumption increases serum creatinine level through protein catabolism rather than decreased clearance (Juraschek *et al.,* 2013). The results of the present study indicated that inclusion of dried discarded cabbage leaves had no deleterious effect on serum biochemical constituents.

Table 1: Ingredients Composition of the Experimental Diets

	Level of DDCL in the diets (%)				
Ingredients (%)	0	5	10	15	20
Maize	40.98	40.98	40.98	40.98	40.98
Wheat offal	17.00	17.00	17.00	17.00	17.00
DCL	0.00	05.00	10.00	15.00	20.00
Groundnut cake	23.37	18.37	13.37	08.37	03.37
Fish meal	3.00	3.00	3.00	2.11	3.00
Groundnut haulms	13.00	13.00	13.00	13.00	13.00
Bone meal	2.00	2.00	2.00	2.00	2.00
Common Salt (NaCl)	0.50	0.50	0.50	0.50	0.50
Premix*	0.15	0.15	0.15	0.15	0.15
Total	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**
Calculated Analysis					
Crude protein (%)	18.61	18.31	18.27	18.11	18.06
Crude fibre (%)	13.21	14.67	15.79	16.88	17.57
Ash (%)	3.23	3.39	4.52	4.42	4.61
Metabolizable Energy (Kcal/Kg)	2567.67	2566.26	2469.73	2454.76	2443.12

** Premix (grow fast) manufactured by Animal Care Service Consult (Nig) Ltd. Lagos, Supplied the following per kg of premix: Vitamin A, 5000,00 IU; Vitamin D_3 800,000 IU; Vitamin E, 12,000 mg; Vitamin K, 1,5000 mg; Vitamin B_1, 1,000 mg; Vitamin B_2, 2,000 mg, Vitamin B_6, 1,500 mg; Niacin, 12,000 mg; pantothenic acid, 20.00 mg; Biotin,10.00 mg; Vitamin B_{12}, 300.00 mg; folic acid, 150,000 mg; choline, 60,000 mg; manganese, 10,000 mg; iron;15,000 mg, zinc 800.00 mg; Copper 400.00 mg; Iodine 80.00 mg; cobalt 40 mg; selenium 8,00 mg.*
DDCL= Dried Discarded Cabbage Leaves

Table 2: Proximate Analysis of DDCL and Experimental Diets

		Compositions				
Parameters	**DDCL**	**T1**	**T2**	**T3**	**T4**	**T5**
Dry matter	89.0	91.33	91.00	90.71	90.82	90.94
Crude protein	18.7	19.77	19.49	19.36	19.19	19.08
Crude fibre	18.1	13.21	14.67	15.79	16.88	17.57
Ether extract	4.97	3.8	3.86	3.93	4.0	4.2
Ash	7.04	3.23	3.39	4.52	4.42	4.61
Nitrogen detergent fibre	22.0	27.54	28.01	28.66	28.99	29.48
Acid detergent fibre	15.4	17.09	17.87	18.43	18.95	19.22

Table 3: Mineral and Vitamin Composition of DDCL

Parameters	Composition (mg/100g)
Calcium	10.81
Sodium	0.96
Magnesium	0.74
Potassium	7.88
Phosphorus	0.52
Iron	0.23
Manganese	0.09
Zinc	0.014
Vitamin A	53.16
Vitamin C	11.43

Table 4: Haematological parameters of growing rabbits fed graded levels of DDCL

Parameters	Treatments					
	T1	T2	T3	T4	T5	SEM
Pack cell volume(%)	42.00	43.90	44.08	43.91	43.22	7.18^{ns}
Haemoglobin(g/dl)	10.61^{c}	10.90^{b}	11.54^{ab}	11.62^{a}	12.10^{a}	1.44^{*}
RBC($\times10^{6}$/L)	7.02^{b}	7.10^{b}	7.33^{ab}	7.28^{ab}	7.52^{a}	0.36^{*}
MCV(fl)	30.66	30.92	30.09	31.85	31.92	6.21^{ns}
MCH(pg)	17.68	17.99	19.53	19.74	19.90	3.02^{ns}
MCHC(%)	64.56	64.91	66.23	66.42	66.58	5.91^{ns}
WBC($\times10^{6}$/L)	10.82	11.64	11.09	11.78	12.36	1.90^{ns}
Lymphocytes(%)	51.28	51.54	51.78	51.99	52.51	7.56^{ns}
Monocytes(%)	1.44	1.32	1.22	1.20	1.30	0.73^{ns}
Neutrophils(%)	33.21	33.42	33.68	33.84	33.96	4.91^{ns}
Basophils(%)	0.58	0.61	0.70	0.77	0.84	0.18^{ns}
Eosinophils(%)	4.11	4.49	4.54	4.96	5.07	1.33^{ns}

a,b,c= means bearing different superscripts within the same row are significantly different (P<0.05). ns= no significant difference WBC= White blood cells; MCV= Mean corpuscular volume; MCH= Mean corpuscular haemoglobin; MCHC= Mean corpuscular haemoglobin concentration; RBC= Red blood cell; WBC; White blood cell

Table 5: Serum biochemical parameters of growing rabbits fed diet containing DDCL

Parameters	Treatments					
	T1	T2	T3	T4	T5	SEM
Total protein(g/dl)	7.55	7.07	7.03	6.04	6.80	1.12^{ns}
Albumin (g/dl)	2.13	2.37	2.10	2.00	2.95	0.16^{ns}
Globulin (g/dl)	21.92	29.70	20.93	22.04	22.05	3.45^{ns}
Creatinine (g/dl)	1.16	0.90	0.88	0.86	0.83	0.081^{*}
Cholesterol (mg/l)	50.98	53.7	53.2	53.81	53.9	6.66^{ns}
SGPT (iu/l)	31.14	29.35	29.23	28.71	28.40	3.32^{ns}
SGOT (iu/l)	20.63	19.82	18.37	16.95	15.19	1.07^{ns}

a,b,c= means bearing different superscripts within the same row are significantly different (P<0.05). ns= no significant difference SEM= Standard error of means; SGPT= Serum glutamic pyruvate transaminase; SGOT= Serum glutamic oxaloacetate transaminase

Conclusion

The blood parameters measured showed significant differences. It could therefore be concluded with the fact that haematology and serum biochemical parameters were within the normal range, DDCL could be efficiently utilized and tolerated by growing Rabbits up to 20% inclusion level without any harmful effect on the health status of the animal.

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