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Effects of Dietary Inclusion of Fresh Pawpaw Leaf (*Carica papaya L.*) on Growth Performance and Haematological Indices of Grower Rabbits

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***Abstract*— The effects of dietary inclusion of fresh pawpaw leaf (carica papaya L.) on growth performance and Haematological indices of grower rabbits were evaluated in an eight (8) weeks feeding trials .Atotal of twenty four (24)grower rabbits were assigned to four dietary treatments of six (6) rabbits each, replicated three times with two (2) rabbits per replicate in a completely randomized design (CRD). The experimental diets were formulated and fresh pawpaw leaf included in the diets across at the levels of 0%, 0.5% 1% and 1.5% in T1,T2,T3 and T4 respectively.The results of the study showed; Final Weight (FW), Average Daily Feed Intake (ADFI) and Average Daily Weight Gain (ADWG) were significantly different at (P<0.05). The values obtained were 1130.00,1189.17, 1049.00 and 1292.67 respectively for T1,T2,T3 and T4, the highest value was recorded in T4 with value of 1292.67 that contained 1.5% of Fresh Pawpaw Leaf (FPL). Best performance for Feed Conversion Ratio (FCR) was recorded in T4 with 2.74 with Fresh Pawpaw Leaf (FPL) and the poorest Feed Conversion Ratio was recorded in T3 with 3.31 FPL respectively. Hematological indices were carried out and White blood cell(WBC), Red blood cell(RBC),Hemoglobin (Hb), Mean Corpuscular Volume(MCV),Mean Corpuscular Hemoglobin Concentration (MCHC) were not significantly different among treatment groups(P>0.05). It was concluded from the results obtained that Fresh Pawpaw Leaf (FPL) can be included in diets of grower rabbits at level of 1.5% with improved growth performance and no adverse effect on hematological indices.**

***Index Terms*— Rabbits,Fresh Pawpaw Leaf (FPL), Growth Performanceand Hematology.**

I. INTRODUCTION

Great majority of Nigerians suffer serious health challenges such as diabetics and high blood pressure. Rabbit meat is lean compared to beef, pork mutton andchevon, because of its leannature; it is good for diabetic and hypertensive people. Rabbit meat is an example of white meat, fine grained and low in fat and cholesterol, it is rich in vitamin and minerals. It contains 28g of proteins, 204mg phosphorus, 292mg of potassium and 147 calories. It has no religious taboo and it is socially acceptable, the meat is tender with a mild flavour, hence it is recommended for all age groups as healthy meat(Adewumi*et. al*., 2004).

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In today's world, the importance of animal protein to humankind cannot be overemphasized. Dietary animal protein is necessary for maintaining tissues and for sustaining growth, because of its high biological value (Egbewande, 2010). According to Staal*et. al*., (1997), animal protein is one of the most expensive food components and many consumers are financially handicapped to afford it, thereby resorting to the consumption of cheaper but less digestible plant protein sources. Adewumi*et. al*., (2004) reported that the level of animal protein intake is of greatest concern in developing countries such as Nigeria, where there is a supply deficit in meat and other animal products. Nigeria is richly blessed with a variety of animal protein sources; but the problem is that the animal protein is not sufficiently produced to meet the requirements of Nigerians (Ibe, 2000), judging from the fact that most Nigerians consume less of animal protein daily (FAO, 1985). Furthermore, FAO (2006) gave daily protein requirement of an average adult as65g/caput/day and of this amount, 35g is expected to be of animal origin. Egbewande (2010) reported that in Nigeria, the available protein is given at 45g/caput/day with animal protein accounting for 8g/caput/day, representing a shortfall of about 77% in animal protein recommended by FAO (2006). The short fall in animal protein intake can be bridged via intensive rabbit production and other micro livestock species.

However, intensive rabbit production in Nigeria has been hampered by the perennial problem of feed availability. The high cost of conventional protein and energy ingredients have grossly undermine the potentials of rabbit production. This has made feed alone to account for about 70% of the total cost of rabbit production (Akinmutimi and Ezea, 2006).Hence, the need to explore locally available, non-conventional, low cost but nutritionally adequate feedstuffs for rabbits (Akinmutimi and Obioha, 2010).

One of such locally available feedstuffs is pawpaw leaf and it parts. Pawpaw on the other hand, also has both nutritional and medicinal values to man and animals. Some studies conducted on pawpaw leaf reveals, that the freshpawpaw leaf is effective as anti-oxidant (it can flush out free radicals in the body system, thereby reducing abnormal growth or tumour),anti – microbial (it can fight secondary bacterial infection thereby enhancing feed efficiency and promote growth), diuretics (medications that are given to help the kidney get rid of excess water and salt from the body through urination) and as dysturia (it can cure painful urination) (Adewumi*et. al*., 2004). Preliminary report by Bitto*et. al*., (2006) affirmed the inclusion of 30% pawpaw peel in rabbit

diets with no adverse effects on growth performance of female rabbits. Pawpaw (*Caricapapaya*) Leaf is said to be a tropical herbaceous plant that grows between latitudes 32^{o} North and South.It contains appreciable amount of macro and micro-nutrients required for rabbit growth and development such as protein, carbohydrate, minerals, vitamins and fat content in little amount. (FAO, 2001)

Studies showed that pawpaw leaf proximate composition and functional properties suggest that Fresh PawpawLeaf (FPL) could be profitably utilize in rabbits feed but it is quite unfortunate that its usage as feed ingredient in developing countries has not been realized.

Pawpaw (*Carica papaya*), is a tropical herbaceous plant.It bears fruits that may vary from yellowish green, yellow or orange in color when ripe. (FAO 1995).

Pawpaw(*Carica papaya*) leaf was analyzed for proximate composition functional properties, the meal was high in protein(32.4%) but moderate in available carbohydrates and some anti-nutritional component such as tannin and saponin which gives the unripe pawpaw a bitter taste and it causes reflex of the upper digestive tract which can lead to excessive heartbeat (Morton, 1977). Moreso, the fresh latex is acrid (having sharp or biting and pungent smell) which causes irritation to the eyes and nose and can provoke eye inflammation and blisters when in contact with the skin (Morton 1977).

II. Materials and Methods

Experimental Site

The study was conducted at the Teaching and Research unit, Department of Animal Science, Taraba State University, Jalingo. It is located within the Guinea Savannah Zone; it lies between latitude 8^{0}50'North of the equator. The state is characterized by tropical climate marked by dry and rainy seasons. The rainy season usually commences in the month of March and ends in October. The dry season starts in late October and ends in March. The annual rainfall is between 1000 – 1500mm with an average temperature of 38^{0}c depending on the season (Taraba Diary 2008).

Source and Processing of Test Ingredients

The Fresh Pawpaw Leaf (FPL)was obtained from Jalingo metropolis and its environs in Taraba State, North Eastern Nigeria. The leaves were cuts fresh>, thoroughly cleaned and chopped into smaller pieces, weighed and then fed to the experimental rabbits according to levels of inclusion.

Experimental Design and Animals Management.

Twenty - four (24) un-sex grower rabbits of mixed breeds obtained from rabbit farmers in Jalingometropolis were used for the study. On arrival the rabbits were placed on vitamin supplement to enhance feeding and boast their immunity. The rabbits were weighed and assigned to four dietary treatments of six (6) rabbits per treatment replicated three (3) times with two (2)rabbits per replicate in a completely randomized design (CRD).The rabbits were housed individually in cages and feeds was provided twice daily between 7-9 am in the morning and 3-5 pm in the afternoon and water was supplied adlibitum. Standard medications and management practices were strictly adhered to as to ensure good health of the rabbits to achieve effective results. The rabbits were allowed seven days acclimatization period before the feeding trial which lasted for 56 days..

Experimental diets;

Four experimental diets were formulated using various feed ingredients such as maize, full fat soya beans, maize brans fish meal and fresh papaya leaf(FPL). The fresh papaya leaf was included in the formulated as;T1(0% FPL), T2(0.5% FPL), T3 1% (FPL) and T4(1.5% FPL) respectively. The ingredients was thoroughly mixed to avoid dustiness and for proper acceptance by the rabbi

Table 1: Composition of Grower Rabbits Diets

Ingredients	**T1**	**T2**	**T3**	**T4**
Maize	51.00	51.00	51.00	51.00
Full Fat Soybean Meal	23.00	22.50	22.00	21.50
Maize Bran	14.00	14.00	14.00	14.00
Fresh Pawpaw Leaf	0.00	0.50	1.00	1.50
Fish Meal	5.50	5.50	5.50	5.50
Bone Meal	3.00	3.00	3.00	3.00
Limestone	2.75	2.75	2.75	2.75
Premix	0.25	0.25	0.25	0.25
Salt	0.30	0.30	0.30	0.30
Lysine	0.10	0.10	0.10	0.10
Methionine	0.10	0.10	0.10	0.10
Total	**100.00**	**100.00**	**100.00**	**100.00**
Calculated Analysis				
Crude protein %	18.24	18.22	18.19	18.17
MetabolizableEnergy (ME(Kcal/kg)	2,829	2,823	2,817	2,811
Crude fibre (CF)	4.39	4.43	4.40	4.42
Ether extract(EE)	6.72	6.63	4.95	6.64

Calcium	2.40	2.573	2.91	2.39
Phosphorus	0.78	0.77	0.77	0.83
Lysine	1.02	1.01	0.90	1.01
Methionine	0.47	0.47	0.47	0.47
Ash	**2.77**	2.79	1.80	2.82

Data Collection

Feed intake was recorded daily while live weight was measured on weekly basis. The results for daily feed intake and weekly live weight was used to determine the Average daily feed intake (ADFI), Average Daily Weight Gain (ADWG), Final Weight (FW) and Feed Conversion Ratio (FCR).

Hematology

Blood samples about 2mls was collected from the ear-vain of each rabbit for hematological evaluation in each treatment (one from each replicate at in an aseptic condition and used for analysis, the samples was placed in sterilizes glass bottles containing ethylene diamine acetic acid (EDTA) to avoid clotting.

Hematological Studies

The following hematological parameters was analyzed, Packed Cell Volume (PCV) Red Blood Cell (RBC), White Blood Cell (WBC), Hemoglobin (Hb), while Mean Cell Hemoglobin Concentration(MCHC) was computed using appropriate formula as described by (Jain,1986).

Chemical Analysis

The proximate analysis of the diet was conducted to ascertain dry matter (DM), Crude protein (CP), Ether Extract (EE), Crude Fiber (CF) Nitrogen Free Extract (NFE) and Total Ash as recommended by AOAC (2002).

Statistical Analysis

The experimental results were subjected to Analysis of Variance (ANOVA) while mean was separated using Duncan Multiple Range Test (DMRT), (Steel and Torrie 1980).

III. Results and Discussion

Proximate Composition of the Experimental Test Diet, Pawpaw Leaf Meal (PLM)

The result of the proximate composition of Fresh Pawpaw Leaf (FPL) is presented in Table 2. The result showed that it contained Dry Matter (DM) 88.5%, Crude Protein (CP) 23.3%, Ash 3.0%, Crude Fibre(CF) 11.0%, Nitrogen Free Extract (NFE) 43.7% and Ether Extract (EE) 7.5% respectively.

The Crude Protein (CP) value 23.3% fallsslightly below the value of 26.14% CP reported by Oloruntola and Ayodele, (2017), but above the value reported by Nodu*et. al.*, (2014) of 8.85% (CP). Crude Fibre(CF) value 11.0% is also slightly different from the value reported by Oloruntola and Ayodele (2017) 16.05% Crude Fibre butabove the report of study conducted by Nodu*et. al.*, (2014) who reported 1.85% Crude Fibre. The Nitrogen Free Extract of 43.7 is lower than values of 58.3% reported by Ronke*et. al.*, (2014). The Ether Extract content of 7.5% was slightly higher than the value of 6.24% as reported by Nodu*et. al.*, (2014) and the values obtained in the studies conducted by Oloruntola and Ayodele, (2014) of 5.40% Ether Extract. The Dry Matter (DM) contains value of 88.5% which is higher than the values obtained in the study conducted by Nodu*et. al.*, (2014) of 22.10% (DM) and the 32.61% (DM) obtained by Ronke*et. al.*, (2014). The Ash value of 3.0% was lower than the value of 6.38% reported by Nodu*et. al.*, (2014) and the values reported by Oloruntola and Ayodele, (2017) of 16.44% Ash.

Table 2: Proximate Composition of Pawpaw Leaf Meal (PLM)

Components	Composition (%)
Dry Matter (DM)	88.5
Crude Protein (CP)	23.3
Ash	3.0
Crude Fibre (CF)	11.0
Nitrogen Free Extract (NFE)	43.7
Ether Extract (EE)	7.5

Proximate Composition of the Experimental Diets

The analyzed results for the proximate composition of the experimental rabbits are presented in Table 3. The proximate values for Crude Protein (CP) for the experimental rabbits were found to be 24.5, 25.8, 28.5 and 37.7 representing the values for T1, T2, T3, and T4 respectively. The Crude Fibre(CF) showed 8.5%, 12.0%, 9.0% and 13% for T1, T2, T3, and T4respectively. The Ether Extract (EE) values were 10.0%, 11.0%, 11.0% and 6.7% presenting T1, T2, T3, and T4respectively. The Ash content obtained for the grower rabbit diets according to treatments were 8.5%, 9.0%, 8.5% and 15% for T1, T2, T3, and T4respectively, the nutrient value for the Nitrogen Free Extracts (NFE) were 44.5%, 36.2%, 34.6% and 17.1% for T1, T2, T3, and T4respectively. The Metabolizable Energy (ME) obtained for each treatment diet using Pauzengaequation (1985) were 2829kcal/kg, 2823kcal/kg, 2817kcal/kg and 2811kcal/kg for T1, T2, T3, and T4respectively.

The percentage Crude Protein (CP)is above the recommended values as cited by NRC (1977) and Lebas (1980) recommended 12-13% Crude Protein (CP) for maintenance, 15-16% for growth, 15-18% for gestation and 17-18% for lactation. Cheeke*et. al.*, (1982) and Ranjhan (1993) reported Crude Protein (CP)levels of 12, 15, 16 and 17% for maintenance, normal growth and pregnancy, normal growth and fattening and lactation, respectively, in rabbit diets for optimum performance. The ME from T1, T2, T3, and T4decreased fromT3, and T4as the Fresh Pawpaw Leaf inclusion levels increases. The T1had the highest ME (2829kcal/kg). The values are slightlyhigher than the recommended value of ME required by rabbit from growing stage to adult stage of 1500 - 2390 Kcal/Kg or 2600-2700Kcal/Kg Metabolizable Energy respectively, (Fielding 1991). The same author indicated that the physiological state of the animal (maintenance, pregnancy, growth, lactation etc.) determines the energy requirement of the rabbit and this energy can be supplied

mainly from carbohydrate and fat.Aduku and Olukosi (1990) reported that the energy requirement of rabbits ranged from 2390 – 2500Kcal/kg. Anugwa*et. al.*, (1982) stated that, the digestible energy requirement for growth and optimal productivity of rabbits in the temperate climates is 2500kcal/kg, while in the tropical climates, the digestible energy for growth and development is given as 2800 kcal/kg of feed. The Crude Fibre(CF) content of grower rabbit in the experimental diet range from 8.5% - 13.0% which is between the valuesopinedby (Coudert*et. al.*, 1983) for growing rabbits of 13% - 14% Crude Fibre (CF).

Table 3: Proximate Composition of Experimental Diets

Parameters	T1	T2	T3	T4
Dry Matter	96	94	92	90
Crude Protein	24.5	25.8	28.5	37.7
Crude Fibre	8.5	12.0	9.0	13.0
Ether Extract	10.0	11.0	11.0	6.7
Ash	8.5	9.0	8.5	15.5
Nitrogen Free Extract	44.5	36.2	34.6	17.1

Growth Performance

The effect of experimental diets on productive performance of grower rabbits are as shown on Table 4.The result showed that there was significant difference (P>0.05) among the treatments with respect to Average Daily Feed Intake (ADFI), Average Daily Weight Gain(ADWG), Feed Conversion Ratio (FCR)and Final Weight (FW).

Rabbits fed diets supplemented with Fresh Pawpaw Leaf (FPL)at T4 (1.5%) consumed more feed and recorded the highest intake of feed (52.64g) compared to rabbits on other treatment groups. This result is in line with the observation by Adenola*et. al.*,(2008) that pawpaw leaf meal is a potential feed source for rabbits. Rabbits on diet T4 gained more weight than those on T1 and T2 while rabbits on T3 had the lowest weight. The highest final weight was recorded on rabbits fed T4 diet.

The result obtained on final weight support the results by Adenola, *et al.*, (2008). In all the various percentages of Fresh Pawpaw Leaf in the diet there was no mortality recorded. This indicates the suitability of Fresh Pawpaw Leaf as feed ingredients for feeding grower rabbits.

Table 4: Growth Performance of Grower Rabbit Fed Inclusion Level of Fresh Pawpaw Leaf (FPL)

Parameters	T1	T2	T3	T4	SEM	LOS
Initial Weight	217.30	215.47	214.93	215.15	0.62	NS
Final Weight	1130.00^{b}	1189.17^{ab}	1099.00^{b}	1292.67^{a}	47.19	*
Average Daily Weight Gain	113.94^{b}	121.78^{ab}	104.47^{b}	134.55^{a}	0.84	*
Average Daily Feed Intake	49.63^{b}	49.38^{b}	49.28^{b}	52.64^{a}	0.56	*
Feed Conversion Ratio	2.97^{b}	2.86^{ab}	3.31^{a}	2.74^{b}	0.42	*
Mortality (%)	-	-	-	-	-	-

ab c = means within the same row bearing different superscripts differ significantly (P>0.05)
SEM = Standard Error of Means
LOS= Levels of significance

Hematological Indices of Grower Rabbits Fed Inclusion levels Fresh Pawpaw Leaf (FPL)

Results of hematological parameters is shown inTable 5, this showed no significant different (P<0.05) for all the parameters (PCV,Hb, RBC, WBC, MCHC, MCV and MCH) analyzed. The result obtained signifies that inclusion of Fresh Pawpaw Leaf (FPL) in grower rabbits' diet to a level of 1.5% had no adverse effect on the Hematology of the Rabbits.

Table 5: Haematological Parameters

Parameters	T1	T2	T3	T4	SEM	LOS
PCV	33.33	36.00	35.67	31.33	2.65	NS
HB	10.00	10.00	9.67	9.33	0.23	NS
RBC	3.67	4.00	3.67	3.67	0.28	NS
WBC	11.00	7.67	9.67	10.67	2.27	NS
MCHC	30.67	28.00	27.00	27.33	1.15	NS
MCV	91.67	90.00	91.67	90.33	2.09	NS
MCH	27.00	25.33	26.00	27.33	2.97	NS

PCV = Packed Cell Volume
HB = Hemoglobin
RBC = Red Blood Cell
WBC = White Blood Cell
MCHC = Mean Corpuscular Hemoglobin Concentration
MCV = Mean Concentration Volume
MCH = Mean Corpuscular Hemoglobin

IV. Conclusion

From the resultsobtained, it is evident that Fresh Pawpaw Leaf is a good fiber source for formulating diets for production of grower rabbits. It can be included in the diets of rabbit at level of 1.5% with better growth performance and no adverse effect on hematological parameters of grower rabbits.Therefore, aninference can be drawn that Fresh Papaya Leaf (FPL) can be included in the diet of grower rabbits for better growth performance and normal blood parameters.

V. Recommendation

Based on the results obtained from the research work, it is recommended that:

i. Fresh Pawpaw Leaf can be regarded as suitable feed ingredient which can be included without any deleterious effects on Grower Rabbit Diet.

ii. Fresh Pawpaw Leaf can be incorporated in grower rabbits diets at level of 1.5% and will be safe and improve growth performance and hematological indices.

iii. From the results obtained the idea of including Fresh

Pawpaw Leaf in Grower Rabbit Diets can be introduced to small-scale rabbit farmer to improve production.

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