Nig. J. Anim. Prod. 2020, 47(5): 41 - 47
©Nigerian Society for Animal Production
Nigerian Journal of Animal Production

Evaluation of rectal temperature and some haematological indices of grower rabbits fed dietary ginger (*Zingiber officinale*) root meal

Ochefu, J., Ahemen, T., Oloche, I. J. and Atser, T.
Federal University of Agriculture, Makurdi
Corresponding author: jochefu@gmail.com; 234-8065551465

Abstract

This experiment was set to evaluate rectal temperature and haematological indices of grower rabbits fed graded levels of dried ginger root meal (DGRM). Twenty-four rabbits (12 does and 12 bucks) weighing 557.09g on the average were used for the study which lasted for eight weeks. The experimental diet was compounded with the inclusion of DGRM at 15% (T_2), 25% (T_3) and 35% (T_4) while treatment (T_1) was the control (without DGRM). The experimental animals were randomized by weight into the four treatments with six replicates each. Rectal temperature was measured weekly in the course of the study. At the end of the feeding trial, the rabbits were sacrificed. Blood samples were collected for haematological analysis and serum biochemical analysis. Parameters measured were Red blood cell (RBC), White blood cell (WBC), Packed cell volume (PCV), Haemoglobin (Hb), Mean corpuscular volume (MCV), Mean corpuscular haemoglobin (MCH), Mean corpuscular haemoglobin count (MCHC) and leucocytes differential count. Also measured were serum sodium, calcium, potassium, chloride and phosphorus concentration. The mean values obtained for rectal temperature were not significantly ($p>0.05$) difference across treatments. T_3 presented higher mean haemoglobin (Hb) concentration (15.31±0.52 g/dl) while White Blood Cell values (7.36±0.68 $10^9/mm^3$) in T_2 differed significantly ($p<0.05$) from other treatment means. Significant ($p<0.05$) variation was also observed in the concentration of serum sodium with T_3 showing higher mean value (110.71±3.05 mEq/L). It can be concluded from this study that haemoglobin and serum sodium concentration were elevated by dietary treatment.

Keywords: Rabbits, ginger, rectal, temperature, haematology

Une Évaluation de la température rectale et de certains indices hématologiques de lapins en etatde croissance, nourris avec de la farine de racine de gingembre (Zingiber officinale)

Ochefu, J., Ahemen, T., Oloche, I. J. et Atser, T.
Federal University of Agriculture, Makurdi
Corresponding author: jochefu@gmail.com; 234-8065551465

Résumé

Cette expérience visait à évaluer la température rectale et les indices hématologiques de lapins en etat de croissance nourris à des niveaux échelonnés de farine de racine de gingembre séchée (DGRM). Vingt-quatre lapins (12 lapins et 12 mâles) pesant en moyenne 557,09 g ont été utilisés pour l'étude qui a duré huit semaines. Le régime expérimental a été composé avec l'inclusion de DGRM à 15% (T2), 25% (T3) et 35% (T4) tandis que le traitement (T1) était le témoin (sans DGRM). Les animaux de laboratoire ont été randomisés en poids dans les quatre traitements avec six répliques chacun. La température rectale a été mesurée chaque semaine au cours de l'étude. À la fin de l'essai d'alimentation, les lapins ont été sacrifiés. Des échantillons de sang ont été prélevés pour l'analyse hématologique et l'analyse biochimique du sérum. Les paramètres mesurés étaient les globules rouges (le 'RBC'), les globules blancs (le 'WBC'), le volume de cellules emballées (le 'PCV'), l'hémoglobine (Hb), le volume corpusculaire moyen (le 'MCV'), l'hémoglobine

corpusculaire moyenne (le 'MCH'), le taux d'hémoglobine corpusculaire moyen (le 'MCHC') et numération différentielle des leucocytes. Les concentrations sériques de sodium, de calcium, de potassium, de chlorure et de phosphore ont également été mesurées. Les valeurs moyennes obtenues pour la température rectale n'étaient pas significativement (p> 0,05) de différence entre les traitements. T3 présentait une concentration moyenne d'hémoglobine (Hb) plus élevée (15,31 ± 0,52 g / dl) tandis que les valeurs de globules blancs (7,36 ± 0,68 109 / mm3) en T2 différaient significativement (p <0,05) des autres moyens de traitement. Une variation significative (p <0,05) a également été observée dans la concentration de sodium sérique, la T3 montrant une valeur moyenne plus élevée (110,71 ± 3,05 mEq / L). On peut conclure de cette étude que l'hémoglobine et la concentration sérique de sodium étaient élevées par un traitement diététique.

Mots clés : lapins, gingembre, rectal, température, hématologie

Introduction

The physiology of livestock is influenced by available dietary nutrients (Ajao *et al.,* 2013). Feed is an important aspect of livestock production. Etim and Oguike (2010) stated that increase in meat production can be achieved through proper nutrition. But the food/feed competition between man and animals has made animal husbandry exorbitant. Therefore, researches are being focus on non-conventional feedstuffs. One prominent herbal products used in animal diet in Nigeria today is ginger (Esonu *et al.*, 2001). Though, basically used as phyto-additives, Omage *et al*. (2007) had used it as substitute for a conventional dietary ingredient. Ginger is an underground rhizome of which chemical composition is: starch 40-60%, proteins 10%, fats 10%, fibres 5%, inorganic material 6%, residual moisture 10%, and essential oil 1 – 4% (Omole, 1982). It is important therefore, to determine the effect of this non-conventional feedstuff on the physiology of the animal. More so that Ochefu *et al*. (2020) reported elevation of visceral organ weights of rabbits fed ginger in diets. A relatively noninvasive method of assessing this effect is by body temperature variation and haematological studies. The blood and its components are important in assessing the nutritive status of animal, feed toxicity and animal health (Aya *et al.,* 2013; Isaac *et al.,* 2013). Apart from blood, core temperature variation could be used to monitor on a regular basis, the physiological status of the animal. The tiniest change in body physiology of an animal can be determined by rectal temperature measurement (Sellier *et al*., 2014). It is against these backgrounds that this study was conducted to assess the haematological response and rectal temperature of growing rabbits fed diets with graded levels of ginger rhizome meal.

Materials and methods

The experiment was carried out at the Rabbitry Unit of the Teaching and Research Farm, College of Animal Sciences, Federal University of Agriculture, Makurdi, located on latitude 7° 48'33.6″N and longitude 8° 37'12.7″ E (https://www.google.com/maps).Twenty four, apparently healthy, rabbits were used for the experiment. The rabbits were obtained from the research farm of the University and were acclimatized for one week. Ivermectin® subcutaneous injection was administered (at 0.2mls per rabbit) against endo and ecto-parasites. Dried ginger root tuber was purchased from a local market and milled to consumable particle. Four diets were compounded with ginger meal at 0%, 15%, 25% and 35%; labelled T_1, T_2, T_3, and T_4 respectively. The

experimental diet is presented in Table 1. The rabbits were randomized by weight into experimental diets. There were six replicates per dietary treatment, with equal number of bucks and does. Feed and clean drinking water were served *ad-libitum*. The feeding trial lasted for eight weeks. At the end of the trial, the animals were starved for 12 hours and thereafter were stunned and sacrificed by severing the jugular vein as demonstrated by Njidda *et al.* (2006). Blood samples were collected from the severed jugular vein of the rabbit. 5mls of blood was collected into the sterile EDTA (ethylene diamine tetraacetic acid) tube for haematological analysis. Another 5mls was collected into EDTA free sample bottles for serum mineral analysis. Parameters measured were, packed cell volume (PCV) Red blood cell (RBC) (Erythrocyte) counts were White blood cell (WBC) (Leucocytes) count using automatic haematology analyzer. Blood constants [mean corpuscular haemoglobin concentration (MCHC), mean corpuscular haemoglobin (MCH) and mean corpuscular volume (MCV)] were calculated using the appropriate formulae by Jain (1986). Also measured were serum sodium, potassium calcium and phosphorus. The experiment was set in a completely randomized design (CRD). The data obtained were subjected to analysis of variance (ANOVA) using SPSS® Version 21, statistical package. Means were separated using LSD (Least Significant Differences).

Table 1: Ingredients and nutrients composition of experimental diets calculated analysis

	Dietary treatments			
Ingredients	T_1	T_2	T_3	T_4
Maize	39.70	24.86	15.90	7.80
Maize offal	14.40	14.95	13.00	10.00
Soybean meal	19.70	21.30	22.60	24.00
Ginger	0.00	15.00	25.00	35.00
Rice bran	0.80	0.75	1.00	1.40
Rice offal	22.40	20.14	19.50	18.80
Bone Ash	2.50	2.50	2.50	2.50
Salt	0.25	0.25	0.25	0.25
Premix	0.25	0.25	0.25	0.25
Total	100.00	100.00	100.00	100.00
Calculated nutrients				
CP	15.05	15.01	15.00	15.01
CF	12.03	11.87	11.91	11.87
Fats	3.84	3.99	4.15	4.32
Calcium	1.23	1.68	1.98	2.28
Phosphorus	0.97	1.28	1.48	1.68
Energy	2501.58	2505.00	2500.91	2503.01

T= Treatment, %= Percentage, CP = Crude protein, CF = crude fibre.
2.5kg of Mineral Vitamin premix contain: Vit. A, 10,000,000 i.u; Vit. D_3, 2,000,000 i.u; Vit.E, 20,000mg; Vit.K_3,2000mg; B_1,3000mg; B_2,5000mg; niacin, 45,000mg; calcium pantothenate, 10,000mg; Vit.B_6,4000MG; B_{12}, 20MG; Choline chloride 300,000mg; folic acid, 1,000mg; biotin,50mg; manganese, 300,000mg; ir on, 120,000mg; zinc, 80,000mg; copper, 8,500mg; iodine, 1,500mg; cobalt, 300mg; selenium, 120mg; antioxidants, 120,000mg

Results and discussion

Results of rectal temperature observed in this study are presented in Table 2. It is shown that significant variations ($p>0.05$) were not observed in rectal temperature across treatment means. Rabbit body temperature range has been documented by various authors: 38.0 – 39.6℃ (Du *et al*., 2010); 38.5 – 40.0℃ (Harcourt-Brown, 2002) and 37.0 – 39.5℃ (Fielding, 1991). The results obtained in this study were within the range documented by Fielding

(1991). This implies that the core temperature of the rabbits was not affected by dietary treatment, which also suggests that the rabbits were not under stress. The haematological values obtained from this work were summarized in Table 3. The packed cell volume values obtained were within the reference range for rabbit (33.0-48.0%) (Harcourt-Brown 2002). There was no significant difference ($p>0.05$) among treatment means. The red blood cells were within the normal reference range (4.0 - 8.0 x 10^{12}/l) (Henry *et al*., 2017). The means of red blood cell count obtained in this experiment were not significantly different ($p>0.05$) among the treatments. The means were in the range of 5.94±0.61 to 7.79±0.61 (10^{12}/mm^3). This suggests that the diets were nutritionally beneficial to the rabbits (Oyawoye and Ogunkunle, 1998). The haemoglobin (Hb) concentration differed significantly ($p<0.05$) across the different diets. T_3 had the highest mean (15.31±0.52) haemoglobin value while T_4 had the least mean haemoglobin value (12.72±0.47). These values were however, within the reference range (9.4-17.5g/dl) (IACUC, 1998). MCV values obtained were within the reference range (50-90fl) (RAR, 2009). The values obtained for MCH and MCHC were within the range of 17.95±5.07 - 25.77±5.07pg and 33.30±0.04 - 33.38±0.04g/dl respectively. These values were within the reference range (18 – 24pg and 27 – 34g/dl) respectively for rabbit (Oyawoye and Ogunkunle, 1998). White blood cell count showed a significant difference ($p<0.05$) among the different treatment means. The mean WBC counts values were in the range of 4.37±0.62 to 7.36±0.68 (x10^9/mm^3). The highest white blood cell counts value was recorded in T_2 while the least was in T_1. The mean white blood cells count in all treatments were within the reference range (5 – 12 x 10^9/l) for rabbit (Harcourt-Brown, 2002). Increase in the total WBC counts of rabbits on ginger diets was reported by (Ugwuja *et al*., 2008; Onu and Aja, 2011), who inferred that this indicated the effect of immune stimulating properties of ginger. Lymphocyte, Neutrophil, Eosinophil and Monocyte were not significant ($p>0.05$) across treatment means and were within the reference range (RAR, 2009).

Table 2: Rectal temperature (˚C) of rabbits fed graded level of ginger root meal (Mean±SEM)

	Treatments			
Week (s)	**T_1**	**T_2**	**T_3**	**T_4**
1	37.67±0.22	37.40±0.24	37.57±0.27	37.59±0.22
2	37.76±0.72	36.23±0.78	37.58±0.85	37.76±0.72
3	37.66±0.33	37.80±0.36	38.07±0.39	37.78±0.33
4	38.19±0.98	35.12±1.06	38.32±1.16	38.49±0.98
5	38.34±0.19	38.45±0.19	37.99±0.22	38.34±0.19
6	38.66±0.24	38.60±0.26	39.12±0.28	38.97±0.24
7	38.26±0.16	38.75±0.17	38.71±0.19	38.91±0.16

T=Treatment, SEM=Standard Error of Mean, ℃=Degree centigrade

Table 3: Blood parameters of grower rabbits fed graded levels of ginger root meal (Mean±SEM)

	Treatment			
Parameter	**T_1**	**T_2**	**T_3**	**T_4**
PCV (%)	40.67±1.54	42.56±1.69	45.44±1.69	38.67±1.54
RBC (10^{12}/mm^3)	7.80±0.55	7.79±0.61	5.94±0.61	7.38±0.55
Hb (g/dl)	13.53±0.47^b	14.21±0.52^{ab}	15.31±0.52^a	12.72±0.47^b
MCV(fl)	53.88±5.16	61.18±5.67	71.60±5.67	52.90±5.16
MCH (pg)	25.77±5.07	19.35±5.57	23.44±5.57	17.95±5.07
MCHC (g/dl)	33.30±0.04	33.34±0.04	33.38±0.04	33.32±0.04
WBC (10^9/mm^3)	4.37±0.62^b	7.36±0.68^a	5.44±0.68^b	5.42±0.62^b
Lymphocyte (%)	66.67±1.42	61.25±1.57	64.95±1.57	63.33±1.42
Neurophil (%)	31.00±1.55	33.72±1.70	31.48±1.70	32.50±1.55
Eosinophil (%)	1.83±0.76	1.96±0.83	1.24±0.83	2.33±0.76
Basophil (%)	0.00±0.14	0.39±0.16	0.01±0.16	0.17±0.14
Monocyte (%)	1.50±0.74	3.04±0.81	3.36±0.81	1.67±0.74

a,b =Means in the same row with different superscripts are significantly ($p< 0.05$) different
Key - PCV = parked cell volume, RBC = Red blood cell, WBC=white blood cell, Hb = haemoglobin, MCV= Mean corpuscular haemoglobin, MCHC = Mean corpuscular haemoglobin concentration, T = Treatment, SEM = Standard Error of Mean.

The result of serum minerals of rabbit fed graded levels of dried ginger meal are presented in Table 4. The result obtained showed that mean serum Sodium (Na) concentration was significantly ($p< 0.05$) different among treatments. T_1 had least value 96.55±2.77 mEq/L and T_3 having the highest value of 110.71 ± 3.05 mEq/L. The mean concentration observed in this study were lower than the range (132-155 mEq/L) documented (Putwain, 2008). IACUC (1998) reported serum sodium level as 141±0.93mmol/L while Kraus *et al*. (1984) reported a range of 138 – 155meg/L in the New Zealand White rabbit. This observation is an instance of hyponatraemia which may occur due to chronic renal failure. According to Lee *et al*. (2014) it is a case of severe hyponatremia; serum sodium being below 120MEql/L. This condition is also occasioned bytoo much water intake dietary and inadequacy of dietary sodium. Emmanuel and Ochefu (2018) noted that the water intake of these rabbits on dietary ginger was between 156.25±28.37 - 398.87±32.55 mililitres against the reference range (50 -100 mililitres) reported by Harcourt-Brown (2002). With this result, there is an indication that dried ginger meal may induce hyponatremia in rabbits. Which in this case may be as a result of excess water intake and subsequent wastage of serum sodium via frequent micturition. However, the subject of inadequate dietary sodium chloride may be considered, sincethe dietary sodium chloride inclusion is 0.25% instead of 0.5 – 0.7% suggested (Fielding, 1991). Serum potassium (K), Calcium (Ca), Chloride (Cl) and Phosphorus (P) were not significantly ($P< 0.05$) different among treatment mean. The values obtained in this study for these parameters were within the reference range (Bradley, 2001). This implies that DGRM had no deleterious effect on the concentration of these serum mineral.

Table 4: Some Serum Mineral Profiles of rabbit fed with ginger root meal (Mean ± SEM)

	Treatments			
Parameters	**T_1**	**T_2**	**T_3**	**T_4**
Sodium mEq/L	96.55±2.77^c	106.15±2.77^{ab}	110.71±3.05^a	98.10±2.77^{bc}
Potassium mEq/L	4.85±0.460	5.07±0.460	4.32±0.50	5.60±0.46
Calcium Mg/dl	5.70±0.65	5.18±0.695	6.17±0.72	6.40±0.65
Chloride Mg/dl	93.13±10.82	108.13±10.82	97.95±11.90	91.85±10.82
Phosphorus Mg/dl	8.35±0.50	7.28±0.50	7.93±0.55	7.22±0.50

a,b =Means in the same row with different superscripts are significantly ($p< 0.05$) different

Conclusion

The study showed that DGRM at 15% and 25 % inclusion boosted Hb and WBC which tended to be beneficial to its use as dietary ingredient, more so that core temperature was not affected. The incidence of hyponatremia is cautionary.

References

Ajao, B. H., Ola, S. I., Adameji, O. V. and Kolawole, R. F. 2013. The relationship of ambient temperature and relative humidity of thermo respiratory function of greater grasscutter. Procduction of the 18th Annual Conference of Animal Science Association of Nigeria. 92.

Aya, V. E., Ayanwale, B. A., Ijaiya, A. T. and Aremu, A. 2013. Haematological and serum biochemistry indices of broiler chickens fed rumen filtrate fermented palm kernel meal based diet. Proc. of the 18th Annual Conf. of Anim. Sci. Assoc. of Nig., 329.

Bradley, T. A. 2001. What every veterinarian needs to know about rabbits. *Zoological education*, 3(1): 42-45.

Henry, A. J., Ozung, P. O. and Udoh, P. I. 2017. Haematological profile and serum biochemical indices of weaned rabbits fed pawpaw leaves (*Carica papaya*) as supplements to corn– soybean meal basal diet *Global Journal of Pure and Applied Sciences* 23:21-25

Du, Y., Li, X. and Tan, D. 2010. Comparison of temperature rise interpretations in the rabbit pyrogen test among Chinese, Japanese, European, and United States pharmacopeias and 2 - 2 - 2 theoretical models proposed by S. Hoffmann *Innate Immunity*17(5): 486–495

Ochefu, J., Emmanuel, B. and Onho, S. C. 2020. Gastrointestinal Tract Morphometry And Visceral Organ Weights Of Grower Rabbit Fed Dried Ginger (*Zingiber officinale*) Root Meal In*: Nigerian Society for Animal Production (NSAP) 45th Annual Conference - Bauchi 2020 Book of Proceedings* Ed: Y. P. Mancha, D. J. U. Kalla, K. M. Bello, S. T. Mbap, T. Abdulkarim, T. Igila, and S. Danbirni ISBN: 978-978-981-320-9

Esonu, B. O., Emenalom, O. O., Udedibie, A. B. I., Berbert, U., Ekpor, C. F., Okoli, E. C. and Iheukwumere, F. C. 2001. Performance and chemistry of weaner pigs fed raw mucuna bean (Velvet bean) meal. *Tropical Animal Production Investment*, 4:49-54.

Etim, N. N. and Oguike, M. A. 2010. Egg production of the domestic fowl (*Gallus gallus*): Factors affecting its production Implications for food security. Proc. 35th Conf., Nig. Soc. for Anim. Prod. 14- 17 March, 2010, Univ. of Ibadan, Nigeria. Pp. 659 - 662

Fielding D. 1991, *Rabbits.* (The tropical Agriculturist) Eds: Coste R. and Smith A. J. Malaysia. Macmillan Pub. Ltd. Pp. 77

Harcourt-Brown F. 2002. *Textbook of Rabbit Medicine*. An Elsevier book Pub. Oxford Great Britain. Pp. 52

IACUC 1998. Guidelines for the Care of and Use of Live Vertebrate Animals. UNMC/UNO Institutional animal care and use committee. University of Nebraska Medical Centre, Omaha, USA. Appendix D.

Isaac, L. J., Abah, G., Akpan, B. and Ekaette, I. U. 2013. Haematological properties of different breeds and sexes of rabbits. Proc. of the 18th Annual Conference

of Animal Science Association of Nigeria. Pp. 24-27.

Jain, W.C 1986. *Schalm's Veterinary haematology*. 4th Edition Lea and Febiger. Philadelphia Pp. 149-162

Kraus A. L., Weisbroth S. H; Flatt R. E. and Brewer N. 1984. *Biology and Diseases of Rabbits. In: Laboratory Animal Medicine.*Eds: Fox J. G., Cohen B. J, Loew F. M. London. Academic press Inc. Pp. 207 – 240.

Lee, J. J., Kilonzo, K., Nistilo, A, Yeates, K. 2014. Management of hyponatremia. (MAJ); *Canadian Medical Association Journal.* 186(8): E281-286.

Njidda, A. A., Igwebuike, J. U. and Isidahomen, C. E. 2006. Haematological parameters and carcass characteristics of weaning rabbits fed grade levels of molasses. *Global Journal of Agricultural Science,* 5(7):167-172.

Ochefu, J., Emmanuel, B. and Onho, S. C. 2020. Gastrointestinal Tract Morphometry and Visceral Organ Weights Of Grower Rabbit Fed Dried Ginger (*Zingiber officinale*) Root Meal In*: Nigerian Society for Animal Production (NSAP) 45th Annual Conference - Bauchi 2020 Book of Proceedings* Ed: Y. P. Mancha, D. J. U. Kalla, K. M. Bello, S. T. Mbap, T. Abdulkarim, T. Igila, and S. Danbirni ISBN: 978-978-981-320-9

Omage, J. J., Onimisi, P. A., Adegbite, E. K. and Agunbiade, M. O. 2007. The Effect of Ginger (*Zingiber officinale* Roscoe) Waste Meal on Growth Performance, Carcass Characteristics, Serum Lipid and serum Cholesterol Profiles of Rabbit. *Pakistan Journal of Nutrition,* 6(4): 359-362.

Omole, T. A. 1982. The effect of level dietary protein on growth and reproductive performance in rabbits. *Journal of Applied Rabbits Research*, 5:83-88.

Onu, P. N. and Aja, P. M. 2011. Growth performance and haematological indices of weaned rabbits fed garlic (*Allium sativum*) & ginger (*Zingiber officinale*) supplemented diets. *International Journal of Food, Agriculture and Veterinary Science*. 1: 51-59.

Oyawoye, E. O. and Ogunkunle, M. 1998. Physiological and biochemical effects of raw jack beans on broilers. Proceeding of 23rd Annual Conference of Nigerian Society of Animal Production. Pp. 141-142.

Putwain, S. 2008. Clinical pathology updates. *Haematology and Biochemistry of rabbits*. 6: 75-77.

Research Animal Resource (RAR). 2009. *Reference values for laboratory animals: Normal haematological values*. RAR Websites, RAR, University of Minnesota. Retrieved from http://www.ahc.umn.edu/rar/refvalues.html

Sellier, N., Guettier, E. and Staub, C. 2014. A review of methods to measure animal body temperature in precision farming. *American Journal of Agricultural Science and Technology*, 2(2), pp.74-99.

Ugwuja, E. I., Ngwu, N.C. and Nwibo, A. N. 2008. Dietary supplement containing mixture of raw curry, garlic and ginger. *The internet Journal of Nutrition and Wellness*. 5(2).

Received: 19th August, 2020
Accepted: 21st November, 2020