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308 Lasani Town, Sargodha Road, Faisalabad - Pakistan
Mob: +92 300 3008585, Fax: +92 41 8815544
E-mail: editorpjn@gmail.com

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The Influence of High Dietary Energy Sources on Haematological Status and Niacin Treatment of the Rabbits

M.O. Ironkwe[1] and B.M. Oruwari[2]
[1]Department of Animal Science and Fisheries, Faculty of Agriculture,
University of Port Harcourt, Choba, P.M.B. 5323, Port Harcourt, Rivers State, Nigeria
[2]Department of Animal Science and Fisheries, Faculty of Agriculture,
University of Science and Technology, P.M.B. 5080, Port Harcourt, Rivers State, Nigeria

Abstract: Four isonitrogenous diets A-control B-12% palm oil, C-12% groundnut oil and D-33% corn meal were fed to 40 weanling rabbits. The experiment was a Completely Randomized Design (CRD). At the end of the 15th week, blood was collected from 24 of the rabbits through cervical cutting while 16 were treated with niacin for another 8 weeks. The blood was collected to ascertain whether the high dietary energy diets was stressogenic on the rabbits through their blood parameters. The result showed significant ($p<0.05$) reduction in all the blood parameters except the white blood cells. This tended to indicate that the high dietary treatments (B and D) did impose stress on the rabbits, hence, these blood constituents were altered compared to the control and groundnut oil (A and C) diets. The observed significant ($p<0.05$) reduction in haemoglobin, packed cell volume and neutrophil production indicate that the oxygen supply to tissues and organs of the rabbits were different and not normal. The significant ($p<0.05$) pattern was quite the same when the effect of niacin treatment was considered in another analysis. The drug reduced the fat deposits in the coronary arteries and this was reflected in the photomicrograph of the arteries.

Key words: Isonitrogenous, weanling rabbits, blood parameters, high dietary energy sources, niacin

INTRODUCTION

The blood constituents reflect the physiological responsiveness of the animal to internal and external environment which includes the type of feed, temperature, age and sex (Pederson *et al*., 2003). Blood chemistry studies are usually undertaken to establish the diagnostic base line of blood characteristics for routine management practice of farm animals (Trambuwa *et al*., 2002) marked after feeding a particular feed material is a good indicator of the health status of that animal.

In the developed countries, there has been a rather cautions approach in the use of feed additives and other performance enhancers in livestock and poultry industries (Wekhe *et al*., 2007). Various substances including dietary energy materials have been used both in livestock and poultry to enhance production (Oruwari *et al*., 1998).

Imposition of non-specific stress on a normal animal elicits haematological changes such as decreased number of red blood cells in the peripheral blood and haemoglobin level indicating a form of anaemia with an altered number of white blood cells (Cole, 2003). The body must be provided with a powerful defenses against tumors, viral, bacterial and parasitic infections always. The number of circulating neutrophils vary often during acute bacterial infection (Taylor *et al*., 2002; John *et al*., 2003).

Recently, it was found that contaminated feeds altered the Haemoglobin (Hb), Packed Cell Volume (PCV) of goats which digest such feeds (Ngodigha *et al*., 1999). Such changes in blood chemistry may affect the status of some vital organs and impose etiology of some diseases which may include atherosclerosis considering that if any organism is severely damaged by acute non-specific notions agents, a typical syndrome by acute non-specific notions agents, a typical syndrome appears, the symptoms of which are independent of the nature of the damaging agent or the pharmacological type of drug or nutrient employed (Guyton and Hall, 2002).

Palm oil, corn meal and groundnut oil are common dietary energy sources that are used in almost every Nigerian household for both man and monogastric animals (Olabanji *et al*., 2009). These diet resources have long been used without considering their health implications. This study was therefore conducted to ascertain if the levels of these test nutrients (Palm oil, groundnut oil and corn meal) used in the dietary treatment imposed stress on the rabbits through their haematological status. The second part of this project will use niacin vitamin (B_3) drug to treat the atherosclerotic condition that is envisaged through the occlusion of the coronary arteries by fat material deposits.

Corresponding Author: M.O. Ironkwe, Department of Animal Science and Fisheries, Faculty of Agriculture, University of Port Harcourt, Choba, P.M.B. 5323, Port Harcourt, Rivers State, Nigeria

Table 1: Composition of experimental diets

	Dietary treatments			
Ingredients	Control A	Palm oil B	Groundnut oil C	Corn meals D
Palm oil	0.00	12.00	0.00	0.00
Groundnut oil	0.00	0.00	12.00	0.00
Corn meal	15.00	3.00	3.00	33.00
PKC	30.00	44.00	44.00	40.00
SMB	5.00	8.50	8.50	8.50
W/Bran	48.25	30.75	30.75	16.75
Bom meal	1.00	1.00	1.00	1.00
Salt	0.50	0.50	0.50	0.50
Vit/trt. Premix	0.25	0.25	0.25	0.25
Composition of nutrient (g/kg)				
Crude protein % (cal)	17.40	17.46	17.46	17.42
Crude protein as analyzed	16.95	16.92	19.98	16.96
Digestible energy kcal/kg (cal)	29.16	35.20	35.20	29.67
Calcium % (cal)	0.65	0.51	0.51	0.72
Available phosphorous % (cal)	0.30	0.28	0.28	0.28
Methionine (cal)	0.03	0.31	0.31	0.31
Lysine % (cal)	0.76	0.78	0.78	0.72
Fat % (cal)	3.17	13.87	13.87	2.51
Fibre % (cal)	8.53	9.30	9.30	8.64
CP:DE ratio	172.00	208.00	207.00	175.00

MATERIALS AND METHODS

Four isonitrogenous diets different in digestible energy due to the replacement of the 15% cornmeal diet included in the control with 12% palm oil, groundnut oil and the addition of 18% corn meal to the said 15% were used. The control had no addition of these dietary fat sources (Table 1). These oils were chosen because of their common usage in Nigerian households and because palm oil is basically saturated while groundnut oil is polyunsaturated.

Forty weanling rabbits comprising 20 males and 20 females were randomly allocated in a completely randomized block design, using sex as the blocking variable. The rabbits were conditioned for two weeks on a basal diet before the commencement of the experiment. The rabbits were individually caged in standard rabbit hutches, each sex representing a replicate, having ten rabbits per treatment. Each rabbit was served equal quantity of feed per day of the assigned diet. They were weighed individually at the start of the experiment and at seven days interval. Feed offered and residues were weighed daily to determine the daily feed intake.

At the 15th week of the experimental period, 24 rabbits (12 males and 12 females) were randomly selected for sampling. Blood was taken by cervical cutting in unheparinized tubes. The blood was stored in refrigerator at 4°C. Each tube of blood sample was analyzed for Hb, PCV, neutrophils, lymphocytes and White Blood Cell (WBC). Table 2 shows the effect of the high dietary treatment (palm oil, groundnut oil and corn meal used on the blood parameters of all the rabbits, all data were subjected to analysis of variance and the means separated by Duncan multiple range test (Gill, 1978).

The remaining 16 rabbits after 24 of the 40 rabbits been slaughtered for blood collection (8 of each sex) were treated orally with niacin vitamin (B_3) for eight weeks, the dosage of 1000 mg/daily rabbit were administered three times daily. At the end of the treatment period, the formulation tended to improve (a) HDL levels, size and function, (b) shift low density lipoprotein particle distribution to larger particle size and (c) lower lipoprotein, an alterosclerosis promoting genetic variant of low density lipoprotein.

RESULTS AND DISCUSSION

Mean Haemoglobin (Hb), Packed Cell Volume (PCV), neutrophils, lymphocytes and White Blood Cells (WBC) of the rabbits fed the test diets are presented in Table 2. The observed significance ($p<0.05$) in all blood parameters measured apart from the control and groundnut oil diets tended to show that the dietary treatments of 2 (palm oil) and 4 (corn meal) imposed stress on the blood constituents, this is consistent with Priya and Krishnakumari (2009) that reduction in Hb, PCV and neutrophil values are associated with diseased animals. Shakoori *et al.* (1992) also suggests that decrease in Hb is an indication of increase damage to erythrocytes. The observed no significance ($p>0.05$) effect seen in treatments A and C would have been because of no deposition of the fat materials in the coronary arteries which did not led to blood clots inside the artery lumen. There were no clots as in treatments B and D where the clots shrunk leaving stenosis (narrowing) of the arteries or even in case of palm oil complete closure and therefore insufficient blood supply to the tissues and organs they feed. But the artery lumen of rabbits on diets I (control) and 3 (groundnut oil) were clear of fat material deposits and normal erythropoiesis took place as there was no damage of the erythrocytes.

Table 2: Effect of high dietary treatment on blood parameters of the rabbits

Dietary treatment	Hb (g/d)	PCV	Neutrophil	Lymphocyte	WBC (mm^3)
Control (A)	10.710±2.48[a]	31.800±0.806[a]	29.500±2.951	68.400±3.579[a]	5672±521.155[b]
Palm oil (B)	10.000±0.254[c]	33.700±0.721[c]	27.700±2.639[d]	62.200±3.022[c]	5064±466.1325[c]
Groundnut oil (C)	09.970±0.275[d]	31.778±0.790[b]	31.778±2.891[b]	64.778±3.311[b]	6062±510.625[a]
Corn meal (D)	10.163±2.54[4]	29.818±0.721[d]	28.167±2.369[c]	60.727±3.022[d]	4372±466.135[d]

Data of means±SE of 24 replicates (blood parameters) of 2 replicates from each treatment.
[a,b,c,d]Means within the same column with different superscripts are significantly different

Table 3: Effect of rabbits treated with niacin on blood parameters

Dietary treatment	Status	Hb (g/dl)	PCV	Neutrophil	Lymphocytes	WBC (mm^3)
Control (A)	Untreated	10.710±2.48	31.800±806	29.500±2.951	68.400±3.579	5672±521.155
	Treated	10.700±0.482[d]	30.750±168[d]	28.667±5007[d]	67.333±5.734[d]	5250±884.429[c]
Palm oil (B)	Untreated	10.000±0.254	33.700±0.721	27.700±2.639	62.200±3.022	5064±466.135
	Treated	8.250±0.322[a]	28.224±.117[a]	25.525±3.338[a]	58.248±2.424[a]	4524±722.133[a]
Groundnut oil (C)	Untreated	9.970±0.275	31.778±0.790	31.778±2.891	64.778±3.311	6062±510.625
	Treated	8.770±0.317[b]	30.250±4.72[c]	30.250±4.72[c]	63.6615±2.540[c]	5845±484.220[d]
Corn meal (D)	Untreated	10.050±0.360	10.163±0.254	28.167±2.891	60.727±3.022	4372±466.135
	Treated	8.525±0.224[c]	8.255±0.115	27.021±2.481[b]	58.527±3.113[b]	4025±325.115[b]

Data of means±SE of 16 rabbits (niacin) of two replicates from each treatment untreated and treated respectively).
[a,b,c,d]Means within the same column with different superscripts are significantly different ($p<0.05$)

The significant pattern was almost the same when the effect of niacin treatment was considered in another analysis (Table 3). Niacin (B) 1000 mg/day was specifically administered to each rabbits, three times a day in this study for reducing blood lipid metabolites deposits and consequently, atherosclerosis (Das *et al*., 2006). The noted significance ($p<0.05$) in palm oil and corn meal showed that niacin (B_3) treatment boosted HDL levels, size and function, lowered low density lipoprotein accumulation and enabled gradual clearance of low density lipoproteins.

The pattern of significance in Haemoglobin, packed cell volume, neutrophils and lymphocytes and significant white blood cell apparently indicate that the high dietary treatment actually raised the fat materials in treatments 2 and 4. This subsequently increased glucocorticoids, hyperplasia of the granupoitic tissue in the bone marrow which acted as barrier for blood cell formation. Whereas the dead blood cells at the sites of blood clots increased white blood cell formation (Szubartowaka *et al*., 1991).

The data were further examined in another statistical analysis in Table 3 which shows the influence of niacin and the dietary treatments (tagged treated). In all the treatments measured, there were significant difference between the levels of fat materials deposition, blood cell formation and clearance of the fats deposition from the artery lumen. Considering the significant pattern of the analysis in the Table 2 and 3, it appeared that the diets were stressogenic and according to Das *et al*. (2006) niacin has a reversal effect. Thus investigating the pattern of fat material deposits through the histopathological study of the carotid arteries as affected by the dietary treatment. This study went further to view the exercised carotid arteries extracted from the sixteen rabbits that were treated with niacin tablet at 3000 mg/day per rabbit for eight weeks. The photomicrograph of the viewed arteries were taken. These when compared with the photomicrograph of arteries of rabbits fed in a previous study with the same high dietary energy sources showed a clear indication that most of the fat material deposits were cleared.

Conclusion: In conclusion, the blood parameters of the rabbits that were fed treatments B and D (Palm oil and corn meal diets) had their Haemoglobin, Packed cell volume and Lymphocytes reduced and distorted. This implies that the dietary treatments imposed stress as a result of the disease condition (narrowing) of the Lumen of the coronary arteries by fat material deposit that ensured, oxygen supply was affected thereby disturbing, normal erythropoiesis from taking place but there was low significant effect in the neutrophils and white blood cells. The blood parameters for rabbits that were fed treatments A and C (control and groundnut oil diets) remained normal as the dietary energy sources did not impose stress on the animals and subsequently their blood was not altered. The niacin drug that was administered for 8 weeks at the dosage of 3000 mg/per rabbit/day 16 animals was found to clear the fat materials deposits on animals in diets A and D as indicated by blood parameters. The exercised arteries in a histopathological study of the said 16 rabbits were viewed under microscope. The photomicrograph showed a high degree of clearance of the deposited fat materials on the lumen of the coronary arteries.

Recommendations: Analysis of the considered treatment effects showed that corn meal at 33% level of inclusion was atherogenic to rabbits as palm oil at 12% inclusion, although palm oil rabbits as palm oil at 12%

inclusion, although palm oil demonstrated greater propensity than corn meal as observed by the level of low density lipoprotein in the palm oil treatment. It is therefore recommended that corn meal at 33% is high as well as palm oil at 12% even though they serve as energy sources. The results obtained showed that niacin treatment reduced the fat material deposits and improved erythropoiesis thereby supplying enough oxygen to the organs and tissues. The high density lipoprotein level was also improved by the administration of the drug. It is therefore recommended that the dosage of niacin should be increased and the duration of treatment should take a longer period. This will go a long way to relieve the atherosclerotic disease that may result from high blood pressure (heart attack) due to the consumption of high cholesterol diets.

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