

EFFECTS OF NUTRITION ON HAEMATOLOGY OF RABBITS: A REVIEW

NseAbasi N. Etim

Department of Animal Science, Faculty of Agriculture, Akwa Ibom State University, Obio Akpa Campus, Akwa Ibom State, Nigeria

Glory E. Enyenihi

Department of Animal Science, Faculty of Agriculture, University of Uyo, Uyo, Akwa Ibom State, Nigeria

Uduak Akpabio

Department of Veterinary Public Health and Preventive Medicine, College of Veterinary Medicine, Michael Okpara University of Agriculture, Umudike, Abia State, Nigeria

Edem E. A. Offiong

Department of Animal Science, Faculty of Agriculture, Akwa Ibom State University, Obio Akpa Campus, Akwa Ibom State, Nigeria

Abstract

This review examined the effects of nutrition on haematology of rabbits. The physiology of farm animals is influenced by several factors, one of which is nutrition. The nutritional status of an animal is dependent on dietary intake and effectiveness of metabolic processes. Dietary contents affect blood profile of farm animals. Haematological studies represent a useful process in the investigation of the extent of damage to the blood. Examination of blood provides the opportunity to clinically investigate the physiological, nutritional and pathological status of an animal. And changes in haematological parameters are often used to determine stresses due to nutrition. Reports by different researchers indicated that different diets fed to rabbits had different effects on haematological parameters, some of which were detrimental while others improved their haematological indices as they remained within the normal range of values for rabbits.

Keywords: Effects, nutrition, haematology, farm animals

Introduction

The physiology of farm animals is affected by several factors, one of which is nutrition (Ajao *et al.*, 2013). Nutritional status of an individual is dependent on dietary intake and effectiveness of metabolic processes. These

can be determined by either or combinations of chemical, anthropometric, biochemical or dietary methods (Bamishaiye *et al.*, 2009). Feed is an important aspect of livestock production. The importance of feed supplementation in animal production has increased in the last few years (Sharifi *et al.*, 2011). Increase in meat production can be achieved through proper nutrition, inclusion of feed ingredients at normal or required levels (Etim and Oguike, 2010). According to Schalm *et al.* (1975) blood pictures of animals might be influenced by certain factors, one of which is nutrition. Swenson (1970) and Addass *et al.* (2012) posited that nutrition affects blood values of animals. Dukes (1955) also documented that haematological values of farm animals are influenced by nutritional status. Processing of feed could have effect on haematological parameters of farm animals (Aya *et al.*, 2013). Dietary content affect the blood profile of healthy animals (Odunsi *et al.*, 1999; Yeong, 1999; Iheukwumere and Herbert, 2002; Kortuglu *et al.*, 2005). Isaac *et al.* (2013) stated that haematological components, which consists of red blood cells, white blood cells or leucocytes, Mean Corpuscular Haemoglobin and Mean Corpuscular Haemoglobin Concentration are valuable in monitoring feed toxicity, especially, with feed constituents that affect the blood as well as the health status of farm animals. Aro and Akinmoegun (2012) and Aro *et al.* (2013) reported that haematological parameters like haematocrit value, haemoglobin concentration, white blood cell count, red blood cell count among others are used in routine screening for the health and physiological status of livestock and even humans. Adejumo (2004) reported that haematological traits especially Packed Cell Volume (PCV) and Haemoglobin (Hb) were correlated with the nutritional status of the animal. Isaac *et al.* (2013) stated that PCV is involved in transport of oxygen and absorbed nutrient. Other blood parameters like blood viscosity are often neglected in routine clinical and physiological investigations. Blood viscosities are however, also affected by nutrition, especially, when processed agro-industrial wastes are taken into consideration. Livestock blood, for instance, may be subjected to hyperviscosity syndrome consequent on the feed they consume which may ultimately affect other blood values like haematocrit and erythrocyte sedimentation rate (Rosencranz and Bogen, 2006; Aro *et al.*, 2013). Blood viscosity can also help to unravel clinical case of blood abnormalities like polycythemia and reduced plasma volume (Jain, 1993; Aro and Akinmoegun, 2012).

Many feed products are fed to rabbits usually without recourse to their health and physiological implications on the animals. The commonest parameter for measuring these implications is through the haematology of the animals (Aro *et al.*, 2013). Moreover, the comparison of blood profile

with nutrient intake might indicate the need for adjustment of certain nutrients upward or downward for rabbits (Rafiu *et al.*, 2013).

Thus, this review examined the effect of nutrition on haematology of rabbits.

2. Haematological Studies

Haematological studies have been found useful for disease prognosis and for the therapeutic and feed stress monitoring (Togun and Oseni, 2005). Haematological studies are important because the blood is the major transport system of the body, and evaluations of the haematological profile usually furnishes vital information on the body's response to injury of all forms, including toxic injury (Schalm *et al.*, 1975; Coles, 1986; Ihedioha *et al.*, 2004). Haematological studies represent a useful process in the diagnosis of many diseases as well as investigation of the extent of damage to the blood (Onyeyili *et al.*, 1991). This is relevant since blood constituents' change in relation to the physiological conditions of animals. The blood transports or conveys nutrient and materials to different parts of the body. Therefore, whatever affects the blood; either drugs, pathogenic organism or nutrition will certainly affect the entire body adversely or moderately in terms of health, growth, maintenance and reproduction (Oke *et al.*, 2007; Etim, 2010). A readily available and fast means of assessing clinical and nutritional health status of animals on feeding trials may be the use of blood analysis, because ingestion of dietary components have measurable effects on blood composition (Church *et al.*, 1984; Maxwell *et al.*, 1990) and may be considered as appropriate measure of long term nutritional status (Olabanji *et al.*, 2007).

(a) Examination of Blood

The examination of blood provides the opportunity to clinically investigate the presence of several metabolites and other constituents in the body and it plays a vital role in the physiological, nutritional and pathological status of the animal (Aderemi, 2004; Doyle, 2006). It also helps to distinguish normal state from state of stress which can be nutritional (Aderemi, 2004). Haematological parameters are good indicators of the physiological status of animals (Hawkey and Dennett, 1989; Adenkola and Durotoye, 2004; Khan and Zafar, 2005). They are also excellent medium for the measurement of potential biomarkers, because its collection is relatively non-invasive and it encompasses an enormous range of physiological process in the body at any given time (Ginsbury and Haga, 2006). Haematological constituents reflect the physiological responsiveness of the animal to its internal and external environments which include feed and feeding (Esopnu *et al.*, 2001). According to Daramola *et al.* (2005), haematological values could serve as a baseline information for comparisons of nutrient deficiency,

physiology and health status of farm animals. Radostits (1994) posited that low nutritional pastures among other factors alter the blood values of sheep and goats. As reported by Adejumo (2004), haematological traits, especially, PCV and Hb were correlated with the nutritional status of the animal. Adamu *et al.* (2006) observed that nutrition had significant effect on haematological values like PCV, Hb and RBC. Togun *et al.* (2007) reported that increase in PCV coupled with the marginal increase in RBC is indicative of more efficient erythropoiesis in experimental rabbits.

(b) Changes in Haematological Parameters

Changes in haematological parameters are of value in assessing the responses of animals to various physiological and disease conditions (Schalm *et al.*, 1975; Yadav *et al.*, 2002; Khan and zafar, 2005). Changes in haematological parameters are often used to determine stresses due to nutrition and other factors (Afolabi *et al.*, 2010). Chineke *et al.* (2006) also reported that apart from genotype, age and sex, differences in haematological indices may be caused by nutritional factor. Great variation has been observed in the haematological parameters between breeds of farm animals (Tambuwal *et al.*, 2002), in this regard, it may be difficult to formulate a universal metabolic profile test for animals. These differences have underlined the need to establish appropriate physiological baseline values for various breeds of livestock in Nigeria which could help in realistic evaluation of nutrition and diagnosis of health condition (Daramola *et al.*, 2005).

3. Effects Of Different Diets On Haematology Of Rabbits

A study was conducted by Olayinka *et al.* (2010) on the haematology indices of weaned rabbit fed loofah gourd (*Luffa aegyptiaca*) seed meal (LGSM) at 0%, 5%, 10% and 15%. Haematological parameters such as the Haemoglobin (Hb), Packed Cell Volume (PCV), White Blood Cell Count (WBC) and Red Blood Cell Count (RBC) were monitored. Olayinka *et al.* (2010) stated that 5% LGSM can be included in the diets of rabbits without any serious adverse effect on their haematological characteristics. Olafadehan *et al.* (2010) carried out a study on the effect of residual cyanide in processed cassava peel meal on haematological indices of growing rabbits and observed that with exception of neutrophil and eosinophil, other haematological parameters were significantly affected by the dietary treatments. An experiment was also carried out by Lawrence-Azua *et al.* (2013) on the haematological indices of growing rabbits fed enzyme supplemented cocoa bean shell. Four dietary treatments were formulated to contain 0%, 10%, 20% and 30% of cocoa bean shell as a replacement for maize. The result revealed significant differences in values obtained for white blood cells. Lawrence-Azua *et al.* (2013) stated that enzyme treated

cocoa bean shell can be included in rabbits diet upto 30% inclusion levels without any detrimental effect on their haematological indices.

Another study was carried out by Ewuola *et al.* (2010) on haematology of weaned rabbits fed dietary prebiotics (Biotronic®) and probiotics (BioVET®-Yc) at the recommended rates of 500g/tonne and 4kg/tonne respectively. The control diet had neither probiotic nor pre-biotic while prebiotic, probiotic and symbiotic (prebiotic + probiotic) was added at the recommended rates to diets 2, 3 and 4 respectively. Results showed that the erythrocytes and leukocytes of the rabbits were not significantly affected by the dietary treatments. The haemoglobin of the rabbits on diets 3 and 4 were significantly the same, with the control and higher than those of 2. The PCV was significantly higher in rabbits fed diets 3 and 4 compared to those on diet 2. The MCV and MCH of the rabbits fed diets 3 and 4 were significantly higher than those on the control diet while MCHC was significantly affected by the diets. Jiya *et al.* (2008) in a study on effect of replacing fish meal with silkworm caterpillar (*Anapheinfracta*) on the haematological parameters of weaned rabbits observed differences in PCV, RBC and WBC which they stated were common in domestic animals and rabbits and suggested that the differences were due to gradual increase in Hb, RBC and PCV concentration after birth which continued until adult stage.

(a) Haematological values of Rabbits and their Significance

Mitruka and Rawnsley (1977) reported that the normal ranges of value for rabbits are as follows: PCV: 30 – 35%, Hb: 9.3 – 19.3g/dl and RBC: $4.00 - 8.60(\times 10^6/\text{mm}^3)$. According to Togun *et al.* (2007), when the haematological values fall within the normal range reported for rabbits by Mitruka and Rawnsley (1977), it is an indication that the diets did not show any adverse effects on haematological parameters during the experimental period, but when the values fall below the normal range, it is an indication of anaemia (Mitruka and Rawnsley, 1977; Radostits, 1994; Ameen *et al.*, 2007). Low haematological values such as 30% Packed Cell Volume (PCV), Haemoglobin Concentration (Hb) of 10.30g/dl and Red Blood Cell (RBC) counts of $7.10 \times 10^6/\text{ml}$ as reported by Bawala *et al.* (2007) could be due to the harmful effects of high dietary content. Differences observed in Packed Cell Volume (PCV) and MCV for animals in different treatment groups may be attributed to the physiological and nutritional status of the animals (Esonu *et al.*, 2001). Higher WBC count may explain the reason for disease resistance which has been reported by Nwosu (1979) or the prevalence of disease condition. It may also explain longevity as reported by Mbanasor *et al.* (2003). Lower than normal White Blood Cells (WBC) count suggests a greater challenge to the immune system of rabbits. Eheba *et al.* (2008) noted that a decrease in WBC count, however, reflected a fall in the production of defensive mechanism to combat infection. Togun *et al.* (2007) reported that a

significantly lower lymphocyte count was an indication of a reduction in the ability of the experimental rabbits to produce and release antibodies when infections occur (Campbell and Lasley, 1975). White Blood Cells Count (WBC) of 5 – 13 ($\times 10^9/l$) is considered to be within normal range according to Burke (1994). Furthermore, Poole (1987) reported a PCV range of 30 – 50%. Anon (1980) documented mean values for rabbits as shown below.

Table 1: Haematological Values for Rabbits

PCV (%)	31.0 – 51.0
RBC ($\times 10^6/mm^3$)	5.0 – 8.0
WBC ($\times 10^3/mm^3$)	3.0 – 12.5
Hb (g/dl)	8.0 – 17.0

Source: Annon (1980)

Olabanji *et al.* (2007) recorded the following mean values for rabbits.

Table 2: Haematological Values of Rabbit

Hb (g/dl)	$7.02 \pm 1.21 - 9.92 \pm 0.58$
PCV (%)	$21.0 \pm 3.53 - 30.0 \pm 1.84$
RBC ($\times 10^6/mm^3$)	$3.53 \pm 0.57 - 5.05 \pm 0.31$
MCV (fl)	$59.4 \pm 0.67 - 59.8 \pm 0.34$
MCH (pg)	$19.7 \pm 0.03 - 19.8 \pm 0.24$
MCHC (g/dl)	$33.1 \pm 0.15 - 33.3 \pm 0.49$
WBC ($\times 10^3/mm^3$)	$4.68 \pm 0.36 - 5.9 \pm 0.69$
Neutrophils (%)	$32.17 \pm 1.82 - 34.5 \pm 1.80$
Lymphocytes (%)	$52.17 \pm 1.71 - 59.3 \pm 1.28$
Monocytes (%)	$0.67 \pm 0.21 - 1.50 \pm 0.34$
Eosinophils (%)	0

Source: Olabanji *et al.* (2007)

According to Olabanji *et al.* (2007) the values for all the parameters fall within the normal range established by Mitruka and Rawnsley (1977) for rabbits. Oyebiji *et al.* (2007) reported mean values of $3.80 \pm 0.23 - 4.13 \pm 0.61$ for White Blood Cells (WBC) ($\times 10^3/mm^3$) and stated that they were lower than the normal range of values reported by Mitruka and Rawnsley (1977). Post Graduate Committee on Veterinary Sciences (PGCVS) (1990) reported a standard WBC range of 2.5 – 12.5 ($\times 10^3/mm^3$). Reilly (1993) opined that normal range of values for WBC indicated that the animals were healthy because decrease in number of WBC below the normal range is an indication of allergic conditions, anaphylactic shock and certain parasitism.

Togun *et al.* (2007) recorded mean values for rabbits as shown in Table 3.

Table 3: Haematological Values of Rabbits

PCV (%)	40.0 – 40.2
Hb (g/dl)	13.2 – 13.4
RBC ($\times 10^6/mm^3$)	6.65 – 6.68
WBC ($\times 10^3/mm^3$)	8.72 – 9.56

Polymorphs (%)	64.8 – 67.4
Lymphocytes (%)	31.6 – 33.8
Monocytes (%)	0.6 – 1.4
MCV (N ³)	60.15 – 60.18
MCH (Pg)	19.85 – 20.06
MCHC (%)	3.30 – 3.33

Source: Togun *et al.* (2007)

Togun *et al.* (2007) stated that the observed values for haematological parameters in their study fell within the normal range reported for rabbits by Mitruka and Rawnsley (1977). They further stated that; it was an indication that the experimental diets (Pigeon pea; *Cajanus cajan*) grain or leaf meal did not have any detrimental effects on haematological parameters during the experimental period.

Schalm *et al.* (1975) reported a normal PCV range of 31 – 50%. Harkness and Wagner (1989) reported a RBC range of 4.8 – 6.3 ($\times 10^6/\text{mm}^3$). Brown *et al.* (2000) opined that increased RBC values are associated with high quality dietary protein and with disease free animals. PGCVS (1990) reported a normal range of values for Hb of 8 – 17g/dl. Normal range of values for Hb indicated that the vital physiological relationship of haemoglobin with oxygen in the transport of gases (oxygen and carbon dioxide) to and from the tissues of the body has been maintained and was normal (Njidda *et al.*, 2006). According to Isaac *et al.* (2013) Packed Cell Volume is involved in the transport of oxygen and absorbed nutrients. Njidda *et al.* (2006) posited that MCV, MCH and MCHC are used in diagnosing anaemic conditions. Ahmed *et al.* (1994) observed that MCHC values decrease with increase in the level of protein.

Conclusion

Dietary contents influence the blood profile of rabbits. Haematological studies represent a useful tool in assessing the effects of different diets on blood parameters of farm animals and haematological values of farm animals are influenced by the nutritional status of the animals under consideration.

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