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Effect of source and sex on blood protein fractions of West African Dwarf Goats (WADG)

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Abstract

Source and sex effects on the total blood protein and its various fractions were studied using juvenile West African Dwarf goats derived from Southern Nigeria. The goats were sourced from three distinct towns in the humid tropics namely, South-East (Umuahia), South-South (Ugheli) and South-West (Akure) at the rate of 6 males and 18 females per location. The mean values of the total blood plasma protein and its fractions obtained for the WADGs from different zones are 10.01±0.07 g/100ml, 10.07±0.08 g/100ml and 10.16±0.35 g/100ml (total plasma protein); 9.62±0.10 g/100ml, 9.68±0.08 g/100ml and 9.68±0.09 g/100ml (total serum protein), 0.38±0.03 g/100ml, 0.39±0.01 g/100ml, and 0.38±0.04 g/100ml (plasma fibrinogen), 5.62±0.23 g/100ml, 5.78±0.24 g/100ml and 5.45±0.26 g/100ml (serum albumin), 4.00±0.19 g/100ml, 3.89±0.29 g/100ml, and 4.12±0.25 g/100ml (serum globulin), and 1.41±0.27, 1.49±0.15 and 1.34±0.12 (albumin/globulin ratio) for the goats from South-East (Umuahia), South-South (Ugheli) and South-West (Akure) respectively. The studies also indicate that albumin accounts for 53-58% of the total serum protein; globulin accounts for 42-47% serum protein, and the plasma fibrinogen 3.6-4% of the total plasma protein. sex and source interaction had no significant (P>0.05) effects on serum proteins; plasma fibrinogen is sex dependent, and the source of goat affects the proportions of the serum albumin, globulin, and albumin/globulin ratio characteristics of the experimental goats.

Keywords: Goats, Sex, Protein Fractions

Introduction

Blood is composed of a liquid constituent known as the plasma and of corpuscles (Allison, 1999). The blood plasma is a pale straw coloured liquid which consists of 90% water and 10% of a variety of substances either in solution or suspension (Graw, 2002).

Plasma proteins are the key constituents of plasma and play a special role in maintaining the body homeostasis. Total plasma protein consists of three fractions namely; albumin, globulin and fibrinogen. Fibrinogen is the precursor of fibrin, the substance of the blood clot. Harper et al. (1977) recorded that fibrinogen maintains homeostasis by preventing loss of blood from the ruptured blood vessels. Fibrinogen is produced in the liver and in a situation where there is excessive destruction of liver tissue; a sharp fall in the blood fibrinogen occurs (Frandson, 1981). The author claimed that the production of fibrinogen is aided by vitamin K; in the absence of vitamin K in diet, poultry and livestock can develop haemorrhage. A fibrinogen range of 100-400mg/100ml of plasma has been reported by various researchers for man and livestock (Ritter, 1996; Scott, 1999; Singh, 2004).

Serum albumin is the most abundant fraction (52-62%) of the blood protein and like fibrinogen, it is synthesized in the liver (Harper et al., 1977; Zubcic, 2001). A low level of albumin in serum may be due to heavy loss of albumin in urine, or loss of protein in the alimentary tract, or decreased production by the liver probably as a result of insufficient intake of protein in diet (Scott, 1999; Daramola et al., 2003; Singh, 2004). Lazzaro (2001) reported an albumin level of 3.5g/100ml for West African Dwarf goats (WADG), while Daramola et al. (2003) recorded the range of 4.3-7.0g/100ml for different breeds of goats. The values ranging from 2.4 to 4.4g/100ml have been reported by Scott (1999), while Singh (2004) gave the range of 3.5-5.0g/100ml for man.

The globulin of the serum accounts for 29.5-54% of the total plasma protein both in man and livestock (Harper et al., 1977; Grabkowski and Rutkowiak, 1989; Chineke et al., 2002; Tambuwal et al., 2002). It is

associated with the transportation of hormones, lipids, vitamins, iron, cholesterol and antibodies.

The study was conducted to determine the total plasma protein and its fractions in the West African Dwarf goats (WADG) derived from different locations in the humid tropics and to obtain the effects of sex, location and interaction of sex and location on these parameters.

Materials and Methods

The experiment was conducted using 2 × 3 factorial designs to test the effects of sex, location and sex and location interaction on the blood protein fractions of the WADG. The goats were sourced from three locations in the humid tropics namely, South-East (Umuahia), South-South (Ugheli) and South-West (Akure) numbering 6 males and 18 females per location.

Blood samples collected for these analyses were centrifuged at 4000 revolutions per minute for 15minutes. Another 10ml of blood per experimental goat was later collected, put in a tube without anti-coagulant and it was allowed to clot. Then, the total plasma protein, plasma fibrinogen, serum albumin and globulin were determined using the outlined procedures.

Total plasma protein was determined using a digital Refractor meter. 0.2ml of the plasma sample was collected using pasture pipette. This was gently dropped on the surface of the meter screen. It was closed and then read on a bright light. The readings were taken directly from the machine.

For determination of fibrinogen, 2ml of calcium chloride was added to 2ml of plasma. It was mixed and incubated in a water bath at 37°C for 2 hours, and at the end, the clot formed was removed by pressing it against the beaker. After that, the clot was washed in a small volume of Normal saline and transferred into a test tube. 5ml of the reagent in the burette was added into the test tube and incubated at 37°C for 10 minutes. Later, the clot was added and mixed. It was then taken to the Colorimeter and the absorbance was measured at 540 nm against blank.

Then, the blood fibrinogen was calculated as:

$$\text{Blood fibrinogen} = \frac{T - B}{S - B} \times \frac{750}{1}$$

Where

T= Test sample; S= Standard and B= Bank

For determination of serum albumin, the test tubes were labelled blank, standard and sample specimens. Then 0.01ml of distilled water and 3.0ml of BCG reagent were pipetted into the test tube labelled blank. 0.01ml of standard and 3.0ml of BCG reagent were added into the test tube labelled standard and 0.01ml of the appropriate sample specimen and 3.0ml of BCG reagent were pipetted into the test tubes labelled sample specimen. They were thoroughly mixed and incubated at 25 °C for 5minutes. The absorbance values of the samples and the standard against the blank were read.

$$\text{Then, Albumin conc.} = \frac{\Delta \text{ Sample}}{\Delta \text{ Standard}} \times \text{Conc.}$$

Total serum protein was calculated as the total plasma protein minus fibrinogen content.

Statistical Analysis

The data obtained were plugged into the model:

$Y_{ijk} = \mu + L_i + S_j + LS_{ij} + e_{ijk}$

Y_{ijk} = is the plasma protein or its fraction (albumin, globulin, or albumin/globulin) observed to have occurred due to:

μ = the population mean,

L_i = the effect of the ith location to which the animal belonged, and S_j = the effect of j^{th} sex of the animal.

LS_{ij} = is the interaction between location and sex, and

e_{ijk} = is the error term associated with the experiment-tion (Harvey, 1990).

Results

The mean total plasma protein, plasma fibrinogen, serum protein, albumin and albumin-globulin ratio as obtained for different genders of the Nigerian goats are presented in Table 1.

There were no statistically differences (P>0.05) between the Buck and Doe in total blood plasma protein, and serum protein fractions. Also the albumin – globulin ratio is the same in males as in females. But a significant difference was observed between the bucks and does in plasma fibrinogen fraction.

Table 2 presents the mean values of the total plasma protein, serum protein, plasma fibrinogen, serum albumin and globulin, and albumin/globulin ratio according to their location of origin. Total plasma protein, serum protein, plasma fibrinogen and globulin are not statistically affected (P>0.05) by location differences. However, serum albumin and albumin-globulin ratio indices are location dependent. The serum albumin and albumin-globulin ratio indices are low in the WADG derived from Akure, compared to those derived from other locations, and the goats from Ugheli are significantly higher (P<0.05) than those from Umuahia in albumin/globulin ratio.

Table 1: Mean blood protein fractions and albumin-globulin ratio in Bucks and Does

Sex	Total plasma protein (g /100ml)	Total serum protein (g/100ml)	Plasma fibrinogen (g/100ml)	Serum albumin (g/100ml)	Serum globulin (g/100ml)	Albumin/ globulin (g/100ml)
Male	10.05±0.39 [a]	9.55±0.11 [a]	0.40±0.02[a]	5.68±0.24 [a]	3.94±0.16[a]	1.45±0.12 [a]
Female	10.09±0.05 [a]	9.72±0.06 [a]	0.37±0.04 [a]	5.59±0.29 [a]	4.03±0.29[a]	1.40±0.15 [a]

Means bearing the same superscript letter along the same column are not statistically different (P>0.05).

Table 2: The mean value of plasma protein, blood protein fractions and albumin-globulin ratio according to their locations

Location	Total plasma protein (g/100ml)	Total serum protein (g/100ml)	Plasma fibrinogen (g/100ml)	Serum albumin (g/100ml)	Serum globulin (g/100ml)	Albumin/ globulin (g/100ml)
UMU	10.01±0.07[a]	9.62±0.10[a]	0.38±0.03[a]	5.62±0.23[b]	4.00±0.19[ab]	1.41±0.27[b]
UGH	10.07±0.08[a]	9.68±0.08[a]	0.39±0.01[a]	5.78±0.24[b]	3.89±0.29[a]	1.49±0.15[c]
AKUR	10.16±0.35[a]	9.68±0.09[a]	0.38±0.04[a]	5.45±0.26[a]	4.12±0.25[b]	1.34±0.12[a]

[a-c] Means bearing the same superscript letter along the same column within the same breed are not statistically different (P>0.05).

Discussion

The mean of the total plasma protein obtained for the WADG was 10.02±0.09 g/100ml, and it is slightly higher than the values reported by some researchers (Daramola et al., 2003; Zubcic, 2001; Jovanovic et al., 1989). The high values of total plasma protein recorded in the study could be as a result of higher accuracy in determination since modern kits were used. So, all the animals have high protein deposits in the body.

The total serum protein is statistically the same (P>0.05) in the bucks and does used, while location effects on serum protein concentration were minimal. This is so because, the goats used were completely under the same feeding and environmental conditions prior to sample collection.

The mean plasma fibrinogen observed for the goats from South-East, South-South and South-West are presented in Table 2. Significant location effects (P<0.05) were recorded. Nevertheless, all the values fall within the range reported by most researchers (Daramola et al., 2003; Scott, 1999; Ritter, 1996; Jovanovic et al., 1989). The result also agreed with the findings of Singh (2004) who maintained that fibrinogen accounts for 4-6% of the total blood plasma protein, and gave the range of 0.36-0.45 g/dl for man.

Though locations do not affect fibrinogen levels in the blood (Table 2), bucks have significant higher (P<0.05) concentrations of fibrinogen than the does. Harper et al. (1977) and Singh (2004) outlined the factors that affect plasma fibrinogen levels to include: age, sex, species and productivity. According to Scott (1999) excessive fibrinogen in the blood causes thrombus (blockage of blood vessels) and extreme low level leads to haemorrhage.

The serum albumin obtained for the WADGs in this study, according to the three locations, lies within the range of 4.30-7.00 g/100ml which agree with the report of Daramola et al. (2003) for goats. The range accounted for 51-60% of the total plasma protein which agreed with the findings of Harper et al. (1977) and Singh (2004) who noted that total plasma protein contained 52-65% albumin. Some researchers however, gave a lesser range of 2.4 to 4.4 g/100ml (Scott, 1999), which might depend on the technique used in the determination, physiological state and/or nutritional status of the animals.

Location and sex interaction and gender differences (P>0.05) were not observed in blood serum albumin of the goats, which agree with the reports of Kelly (1974), and Schalm et al. (1975). Hypoalbuminia (decline in serum albumin) in livestock will impair productivity, and it is caused by prolonged malnutrition, or loss of protein in urine (Campell, 1955; Jovanovic et al., 1989; Scott, 1999).

The percentage of globulin in relation to the total plasma protein obtained in this work (40-45%) lies within the range of 29.5-54% as reported by Harper et al. (1977), Grabkowski and Rutkowiak (1989), Jovanovic et al. (1989) and Chineke et al. (2002). The serum globulin concentrations as obtained by location (Table 2) are within the range of 3.6-4.6g/100ml recorded by Tambuwal et al. (2002) for goats and Nottidge et al. (1999) for cats. Like the serum albumin, location differences (P<0.05) were observed in the globulin levels, but in the reverse order. No gender effect was observed in globulin concentrations as in albumin.

The albumin-globulin ratio recorded according to the locations in this study (Table 2) tied with the literature values for different classes of livestock and

man (Oduye and Adadveoh, 1976; Harper et al., 1977; Kaushish and Arora, 1977; Grabkowski and Rutkowiak, 1989; Chineke et al., 2002; Graw, 2002; Meesbrough, 2004; Singh, 2004). Generally, location has significant effects on albumin-globulin ratio. These results confirm the view of Orji et al. (1987) that the serum albumin and globulin vary both among the breeds and within the breeds depending on location.

Conclusion

The blood protein profile of the WADG breed ranged from 10.01-10.02 g/100ml. The albumin/globulin ratio of the WADG breed from various areas is 1.41±0.27, 1.49±0.15 and 1.34±0.12 g/100ml, for the South-East, South-South and South-West, respectively. Serum albumin accounts for 53-58% of the total serum protein, while globulin accounts for 42-47% serum protein, and the plasma fibrinogen accounts for 3.6-4% of the total plasma fibrinogen. Sex, location, sex and location interaction have no effects on the total serum protein and its fractions. However, plasma fibrinogen is sex dependent, while location affected the proportions of the serum albumin, globulin, and albumin/globulin ratio fractions.

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