

INFLUENCE OF LACTATION ON SOME PLASMA BIOCHEMICAL PARAMETERS IN N'DAMA AND WHITE FULANI COWS

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Target audience: Reproduction biologists, animal breeders, veterinarians, animal scientists, dairy farmers.

ABSTRACT

Plasma samples obtained from thirty-three non-pregnant non-lactating and lactating N'Dama and White Fulani cows at Oyo, Nigeria, were analysed to determine the influence of lactation on some biochemical parameters between and within breeds. The plasma concentrations of aspartate aminotransferase (AST), alanine aminotransferase (ALT), alkaline phosphatase (AP) gamma-glutamyl transpeptidase (γ -GT), creatinine, blood urea nitrogen (BUN), albumin-globulin ratio (A:G), sodium (Na), potassium (K), sodium-potassium ratio (Na:K), chloride (Cl), bicarbonate (HCO_3), calcium (Ca), inorganic phosphate (PO_4), triglycerides and cholesterol showed no significant differences ($P > 0.05$) within and between the two breeds of cattle. The plasma levels of total protein and globulins did not differ significantly within breed but differed significantly ($P < 0.05$) between the non-lactating White Fulani and the two N'Dama groups. The relationships between plasma concentrations of albumin and globulin as well as between albumin and total protein were positive, albeit non-significantly, in all groups of the two breeds of cattle while those of globulins and total protein were very significant ($P < 0.001$) and positive in the White Fulani and non-lactating N'Dama groups. Lactation appears to have had a pronounced effect on the plasma concentrations of total protein and globulins of the White Fulani cows than the N'Dama cows. It also may have altered the relationship between plasma total protein and globulins in N'Dama cows.

Keywords: Lactation, White Fulani, N'Dama, plasma, Biochemical parameters.

DESCRIPTION OF PROBLEM:

Plasma biochemical profile of a cow is an indicator of its productive ability (1,2). The plasma biochemical profile is affected by breed, nutrition, disease and physiology (2,3,4,5,6,7). Measurements of biochemical parameters in the indigenous breeds of cattle in Nigeria have been reported in the past (7,8,9,10,11). These earlier investigations were aimed at determining the influence of season, age, sex and breed on the plasma biochemical profile. Little or no

data are available on the influence of the interaction between breed and physiological status on the reference values of parameters determined.

The present investigation is to re-examine the plasma biochemical profile of apparently healthy lactating White Fulani and N'Dama cows relative to those of non-pregnant non-lactating cows from the same breed and herd.

MATERIALS AND METHODS

Fifteen adult N'Dama (eight non-pregnant non-lactating and seven lactating) and eighteen White Fulani (nine non-pregnant non-lactating and nine lactating) cows were used for this study. The animals were selected from a herd at Oyo, Nigeria during the late dry season (i.e. January to March). The age of the cows ranged from 3 -7 years while their calves ranged from 2 - 4 months. The cows were raised on pastures with brewer's dried grains supplementation. Water was supplied *ad libitum*. They were dewormed with Mebendazole (15mg/kg), prophylactically treated against trypanosomiasis with Diminazene diacetate (5mg/kg) and vaccinated against rinderpest and haemorrhagic septicaemia.

Blood sample, obtained by external jugular venipuncture, was drawn into a potassium ethylene diamine tetra-acetic acid (K-EDTA) coated vacutainers. The samples were transported to the laboratory in ice packs within an hour and centrifuged at 3000rpm for 10minutes to obtain the plasma. The plasma samples were stored at -20°C until required for analysis.

Plasma Na and K concentrations were determined by standard flame photometry, CL by the method of Schales and Schales (12), HCO_3^- according to Toro and Ackermann (13), Ca by an atomic absorption spectrometer (Model 30L Perkin Elber Corp. Norwalk, Connecticut, USA) while inorganic PO_4 was determined using Ektachem 400 clinical analyser and estimated at 680nm. Activities of plasma enzymes were determined at 37°C in a random access clinical analyzer (R.A.1000 Technicon Instrument Corp. Tarryton, N.Y) under zero order kinetic condition. The plasma levels of cholesterol and triglycerides were determined using the direct plasma method (Hycel Inc. Houston, Texas). Total protein was determined using the buried method (14) and albumin by the method of Doumas *et al* (15). Globulin was calculated by subtracting albumin from total protein. Urea and Creatinine were determined according to Harrison (16). Analysis of variance and Pearson's correlation coefficient were determined by the procedure of a statistical analysis system software(17).

RESULTS AND DISCUSSION

The results of plasma analysis in White Fulani and N'Dama cows as well as comparison with some earlier reported findings are presented in Tables 1, 2 and 3.

Table 1: Mean \pm s.e.m plasma concentrations of some electrolytes in the cows.

Parameter	N'Dama		White Fulani	
	Dry	Lactating	Dry	Lactating
Na mmol/L	140.75 \pm 1.19	140.67 \pm 2.01	141.86 \pm 2.23	142.44 \pm 2.02
K mmol/L	4.81 \pm 0.38	4.73 \pm 0.27	4.01 \pm 0.36	4.02 \pm 0.34
Cl mmol/L	104.5 \pm 0.65	104.17 \pm 0.87	105.57 \pm 1.13	106.22 \pm 0.78
HCO ₃ mmol/L	23.75 \pm 0.37	22.83 \pm 0.75	22.57 \pm 0.053	22.56 \pm 0.47
Ca mmol/L	2.123 \pm 0.025	2.163 \pm 0.053	2.173 \pm 0.043	2.123 \pm 0.028
PO ₄ mmol/L	2.056 \pm 0.039	2.073 \pm 0.036	2.005 \pm 0.045	1.998 \pm 0.023
NA : K	30.61 \pm 2.52	30.38 \pm 2.29	37.01 \pm 3.17	56.33 \pm 20.75

Table 2: Profiles of some plasma enzyme activities in the cows (mean \pm s.e.m).

Parameter	N'Dama		White Fulani	
	Dry	Lactating	Dry	Lactating
GGT U/L	27.75 \pm 3.27	20.33 \pm 4.5	32.86 \pm 3.3	29.56 \pm 2.98
AST U/L	102.75 \pm 19.37	89.67 \pm 21.85	45.29 \pm 19.32	56.33 \pm 20.75
ALT U/L	35.38 \pm 4.94	50.67 \pm 12.0	33.71 \pm 3.62	39.33 \pm 4.7
AP U/L	165.4 \pm 15.33	173.5 \pm 23.8	155.71 \pm 17.2	131.67 \pm 10.44

Lactation did not significantly influence the plasma concentrations of electrolytes, lipids, non-protein nitrogen (NPN), albumin, A:G and Na:K either within or between the breeds of cattle.

The electrolyte concentrations obtained in this study are similar to those of earlier workers (9,11) except for the higher inorganic phosphate and lower calcium. The decrease in Ca concentration during lactation is due to functional demand (18). The stable concentrations of lipids, which is in agreement with the earlier report of Maynard *et al* (19), enzymes, NPN, albumin, A:G and Na:K during the course of our study further confirms the health status of the experimental animals. The slightly higher level of plasma albumin in the White Fulani cows relative to the N'Dama cows agrees with the observation by Little (20) that cows giving higher milk yields have higher albumin concentrations.

Table 3: Profiles of some clinical chemical parameters in the cows (mean \pm s.e.m).

Parameter	N'Dama		White Fulani	
	Dry	Lactating	Dry	Lactating
BUN mmol/L	4.953 \pm 0.396	4.69 \pm 0.604	4.114 \pm 0.486	4.144 \pm 0.481
Creatinine μ mol/L	121.11 \pm 7.96	104.312 \pm 15.03	94.586 \pm 10.61	104.312 \pm 10.61
Total protein G/L*	68.3 \pm 3.6 ^b	65.8 \pm 0.9 ^b	80.4 \pm 3.9 ^a	73.4 \pm 3.0 ^{ab}
Albumin G/L	26.3 \pm 0.9	24.7 \pm 1.6	27.7 \pm 0.9	27.6 \pm 0.8
Globulin G/L*	42 \pm 3.4 ^{ab}	37.8 \pm 3.2 ^b	52.3 \pm 3.6 ^a	45.9 \pm 3.1 ^{ab}
A : G	0.66 \pm 0.05	0.69 \pm 0.06	0.55 \pm 0.05	0.64 \pm 0.05
Cholesterol mmol/L	2.647 \pm 0.273	2.521 \pm 0.384	2.172 \pm 0.106	2.506 \pm 0.1712
Triglycerides mmol/L	0.698 \pm 0.058	0.671 \pm 0.075	0.728 \pm 0.0203	0.693 \pm 0.0591

* P<0,05

Values on the same horizontal row with different superscripts are significantly different

Lactation appeared to have had a non-significant ($P>0.05$) depleting effect on the plasma concentration of total protein within each breed while its between breed effect was significant ($P<0.05$). The White Fulani cow, a better milker, had a 08.71% decrease while the N'Dama cow, a poor milker, had a 03.66% decrease relative to their respective non-lactating control groups. The non-lactating White Fulani cow had a significantly higher plasma total protein than N'Dama cows.

Plasma globulin concentrations within breeds were lowered, non-significantly, by lactation. The decrease, relative to the non-lactating control of each breed, was more pronounced in the White Fulani (-16.1%) than in the N'Dama (-10.0%) cows. However, the between breed effect of lactation on plasma globulin was significant ($P<0.05$), the non-lactating White Fulani cows' concentration being higher than the lactating N'Dama cows.

The observed decreases in plasma total protein and globulin concentrations appear to be proportional to the milking ability of the breed. A decrease during late pregnancy and early lactation is a common phenomenon in dairy cows and women (21,22). It is mainly due to transfer of immunoglobulins from the plasma into colostrum (23). It could also be attributed to increased demand for precursors for the production of milk proteins resulting in a reduction in the synthesis of other proteins in cows on a minimal protein diet (24). The White Fulani and N'Dama cows used in this study were well nourished since blood urea nitrogen and

albumin, the major indicators of acute and chronic low protein status, respectively, especially during lactation (24), were not markedly altered in this study. Thus, the observed hypoproteinaemia and hypoglobulinaemia are probably physiological adaptations during lactation.

Albumin, globulin and total protein were positively correlated in the breed under study. Plasma total protein and globulin values had very significant positive correlation in the non-lactating N'Dama and the groups of White Fulani cows ($r = 0.97, P < 0.0001$; $r = 0.99, P < 0.0001$; and $r = 0.972, P < 0.0001$; respectively). A non-significant ($P > 0.05$) relationship was observed between total protein and globulin during lactation in the N'Dama cows ($r = 0.629, P > 0.1$). Plasma concentrations of albumin and total protein as well as albumin and globulin were not significantly correlated.

The observed positive relationship between albumin and globulin is contrary to the reported finding of Little (20). The alteration in the relationship between plasma globulin and total protein observed in the lactating N'Dama cows suggests that lactation was more stressful to the N'Dama cows than the White Fulani cows.

CONCLUSION AND APPLICATION

1. Lactation influenced plasma concentrations of total protein and globulin between breeds of cows under investigation.
2. Further investigation should be conducted on relationship between the rate of decrease in plasma protein and globulin levels and the milking ability of individual cows.
3. The result may be a useful guide to condition.

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