# EFFECTS OF STAGE OF GESTATION, STAGE OF LACTATION AND MILK YIELD ON SOME BLOOD COMPONENTS OF BELGRAVIA DAIRY CATTLE IN THE SUDAN

*BY*

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## Introduction

The major reason for renewed interest in blood as a diagnostic and health check in dairy cattle, as stated by Hewett (1974) is more likely to be reflected by changes in the blood profile. The analytical methods used to monitor such changes are generally more accurate and considerably more automated than previously.

The aim of the present work was to investigate to what extent blood components are affected by stage of gestation, stage of lactation and milk yield in dairy cattle.

## Materials and Methods

Animals used consisted of 102 dairy cows and 30 pregnant heiferes of Sudanese-Friesian or Jersey cross resident at Belgravia Dairy farm at Khartoum North. The heifers material was intended mainly as a basis for the study of the effect of gestatoin on the blood profile, since the effect of lactation is absent. All the animals were apparently healthy and the cows were at different stages of lactation with an average age of seven years. The animals were group-fed with cotton-seed cakes, dura grains, wheat bran, brewery byproducts and green fodder consisting of berseem and maize together with mineral supplements.

Blood was collected from the jugular vein in two separate tubes: the one which was intended for whole blood contained the anticoagulant EDTA (Ethylene-Diamine-Tetra-Acetic acid), while the other tube which was intended for serum preparation did not contain any anticoagulant.

The components measured in whole blood portion were: Haemoglobin (Hb), packed cell volume (PVC), and glucose, while those measured in the serum portion were: total protein, albumin, urea-N, calcium (Ca), inorganic phosphate ($P_i$), magnesium (Mg) potassium (K), and sodium (Na). Globulin was calculated as the difference between total protein and albumin concentrations.

Haemoglobin was determined colorimetrically as cyanmethaemoglobin (Schalm, 1975), and PCV was done using a Hawksley microhaematocrit centrifuge. Blood glucose was determined according to the method of Varley (1969) and was corrected for variations in PCV values using the formula :

Corrected glucose conc. =

$$\frac{(100 - \text{overall PCV}) \times \text{observed glucose conc}}{(100 - \text{individual PCV})}.$$

Urea-N, total protein and albumin were done according to the methods of Evans (1968) King (1964) and Bartholomew and Delaney (1964) respectively.

Elements Ca, Mg and $P_i$ were performed according to Ferro and Ham (1957), Spare (1962) and Varley (1969) respectively. Na and K were determined by Flame photometry (Evans Electroselenium Ltd., England) as described by Varley (1969).

Statistical analyses were done according to Snedecor and Cochran (1974).

## Results

Overall means and standard deviations of the blood components at different stages of gestation and lactation average milk yields on the day of sampling are shown in Table 1.

Hb, PCV, urea-N, total protein, globulin and Ca concentrations fell ($P < 0.05$) during the course of gestation. The most significant ($P < 0.05$) changes were confined to the period close to calving. While Hb, PCV, and glucose concentrations decreased ($P < 0.05$) during the first two months after calving, urea-N, total protein, globulin, Ca, Na, and K concentrations increased ($P < 0.05$), but albumin and Mg concentrations remained fairly constant. However, $P_i$ concentrations were inconsistent.

Analyses of variance showed that lactation stage, irrespective of level of milk yield, had a significant ($P < 0.05$) effect on all the blood components determined except for total protein, albumin, Ca, and Na concentrations.

Regression analyses showed negative correlations between milk yield and Hb, PCV and glucose concentrations. On the other hand, a positive correlation was observed between milk yield and globulin, Mg and K concentrations. However, total protein, albumin, Ca and Na concentrations were not affected significantly ($P < 0.05$) by milk yields.

**Discussion**

The fall of Hb, PCV, urea-N, total protein, globulin, and Ca concentrations during late gestation in heifers is hard to explain. Various reports on the effects of gestation on different blood components exist in literature (Schalm **et al.**, 1975; Hassan and Imbabi, 1968) but these usually relate to effects observed in pregnant lactating cows. It is, therefore, difficult to attribute much significance to such observations, since the variations occurring may be the combination of a falling lactation and an advancing pregnancy, the individual effects of which may be difficult to distinguish.

Lactation stage, irrespective of level of milk yield, was shown to have a significant effect on all the blood components studied except for total protein, albumin, Ca, and Na. Regression analyses on Hb, PCV, and blood glucose indicate that an increase in milk yield causes a decrease in these concentrations. The marked fall during early lactation could be associated with the considerable demands made by a high milk yield, low appetite of cows at this stage of lactation (Hewett, 1974), combined with the difficulty in perfectly covering the cow's requirements at this time. This could apply to the supply of energy, and trace elements. It is not only a question of these substances in the ration, but also their biological availability. The subsequent rise in these values probably reflects the cow's ability to more easily meet her production requirements later in the lactation when milk yields are low. Similar observations were made by Kossila (1970), and Payne **et al.**, (1970). However, not all workers have found a negative correlation between Hb concentrations and milk yield (Land & Campbell, 1969). Factors other than milk yield may influence Hb concentrations (Hewett, 1974). The fact that in the present work Hb and PCV values were already falling before calving, suggests that they were related to stage of gestation.

The effect of lactation stage on urea-N was fairly marked. The rise in early lactation and the fairly consistent fall towards the end of lactation were probably associated with variations in protein intake.

Serum total protein concentrations were not affected significantly (P 0.05) by milk yield which suggests that the rise in concentrations in the early stage of l.ction might be interpreted as a partial reflection of fluctuations in the supply and requirement of protein at different stages. Globulin seemed to be the main cause of variation on total protein concentrations.

In this study it has been shown that glucose concentrations may provide some measure of balance between energy intake and requirement. This is in accordance with Kronfeld, (1972). Blowey **et al.**,(1973) concluded that changes in blood concentrations of glucose, urea-N, and albumin appeared to be useful in monitoring energy and protein intake. Eggum (1974) reported that albumin was not a very sensitive indicator of protein adequacy but that urea-N concentrations may give good indirect measurements of protein adequacy. Muir **et al.** (1972), found a high correlation between dietary nitrogen and plasma urea-N in sheep and Nomani and Evans (1972), found that serum urea-N, albumin and total protein concentrations rose with increasing dietary nitrogen in steers.

In the present work, Ca concentrations were not significantly affected by stage of lactation or milk yield, while $P_i$ concentrations were inconsistent. Lane **et al.** (1968) reported that both Ca and $P_i$ were affected by stage of lactation. Seidel and Schroter (1970), stated that Ca concentrations remained relatively constant in lactating cows during a period of one year's observation. The inconsistency in $P_i$ concentrations might be interpreted as a partial reflection of fluctuations in the balance between $P_i$ input and output during the lactation.

The significance of milk yield on Mg concentrations meant that high yielders had, on average, slightly higher Mg values which might have been due to a slightly greater relative uptake and/or mobilisation of Mg by high yielders than low yielders (Lane **et al.**, 1968).

Na concentrations were not affected significantly by the stage of lactation. The significant effect of milk yield on K concentrations was manifested in a tendency towards higher values in high yielding cows. It is likely that this effect represents an electrolytic reaction to changes in pH associated with high concentrate intakes in high yielders, since elevated K levels are most frequently the result of acidosis (Tasker, 1971).

**Summary**

A 102 dairy cows at different stages of lactation,

and 30 pregnant heifers at different stages of pregnancy were used. The animals were of Sudanese-Friesian or Jersey cross resident at Belgravia Dairy farm in Khartoum North. The heiferes material was intended mainly as a basis for the study of the effect of gestation on the blood profile, since the effect of lactation was absent.

The components measured were: Hb, PCV, blood glucose, serum urea-N, total protein, albumin, Ca, inorganic phosphorus ($P_i$) Mg, Na, and K. Globulin was calculated as the difference between total protein and albumin concentrations.

Results showed a tendency of Hb, PCV, urea-N, total protein, globulin and Ca concentrations to fall during the course of gestation. The most significant changes were confined to the period close to calving. While Hb, PCV, and glucose concentrations decreased during the first two months of lactation, urea-N, total protein, globulin, Ca, Na, and K concentrations increased. Albumin and Mg concentrations remained fairly constant during same period. However, $P_i$ concentrations were inconsistent.

Stage of lactation was shown to have a significant ($P < 0.05$) effect on all the blood components studied except for total protein, albumin, Ca, and Na.

Milk yield showed a negative correlation with Hb, PCV and glucose concentrations and a positive correlation with globulin, Mg and K concentrations. However, total protein, albumin, Ca and Na concentrations were not affected significantly ($P < 0.05$) by milk yield.

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**Table 1.**

Mean Concentrations (± Standard Deviation) of the Blood Components and Average Miik Yield at Different Stages of Gestation and Lactation.

| | Non-lactating heifers<br>Stage of gestation, d before calving | | | Lactating Cows<br>Stage of lactation, d after calving | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Earlier than | —60 to— 31: | —30 to 0 | 1 to 30 | 31 to 60 | 61 to 120 | 121 to 180 | 181 to 240 | More than 240 |
| No. of samples | | | | | | | | | |
| Haemoglobin, g/100 ml | 11.0±1.30 | 11.2±1.12 | 10.5±1.21 | 9.4±1.35 | 9.0±1.39 | 8.8±0.99 | 9.9±1.19 | 10.1±1.04 | 9.5±1.40 |
| Packed cell volume, % | 37.0±3.51 | 37.4±3.22 | 35.1±3.31 | 30.0±2.42 | 28.3±2.30 | 28.8±2.24 | 32.4±3.11 | 33.8±2.91 | 31.0±2.85 |
| Blood glucose, mg/100 ml | 38.4±6.90 | 37.8±5.84 | 38.1±6.40 | 36.8±9.20 | 36.2±8.53 | 36.6±8.38 | 38.2±6.45 | 40.4±5.73 | 39.1±6.18 |
| Urea-N, Mg/100 ml | 25.4±2.90 | 22.3±2.60 | 18.8±3.10 | 22.6±2.94 | 25.5±2.45 | 25.7±2.56 | 24.8±2.82 | 24.2±3.12 | 23.5±2.95 |
| Total protein, g/100 ml | 10.7±0.71 | 10.4±0.80 | 9.5±0.69 | 10.0±0.76 | 10.3±0.82 | 10.1±0.79 | 9.8±0.83 | 10.0±0.91 | 10.1±0.88 |
| Albumin, g/100 ml | 4.7±0.22 | 4.5±0.31 | 4.3±0.34 | 4.2±0.40 | 4.0±0.39 | 4.2±0.41 | 4.1±0.37 | 4.1±0.34 | 4.0±0.40 |
| Globulin, g/100 ml | 6.0±0.62 | 5.9±0.73 | 5.2±0.66 | 5.8±0.70 | 6.3±0.78 | 5.9±0.65 | 5.7±0.59 | 5.9±0.63 | 6.1±0.75 |
| Ca, mg/100 ml | 9.7±0.63 | 9.5±0.80 | 9.1±0.89 | 9.5±0.87 | 9.8±0.68 | 9.7±0.72 | 9.5±0.64 | 9.4±0.82 | 9.6±0.76 |
| $P_i$, mg/100 ml | 5.4±1.20 | 5.3±1.10 | 5.2±1.18 | 5.5±1.24 | 5.2±1.09 | 5.6±1.13 | 5.5±1.21 | 5.3±1.11 | 5.4±1.07 |
| Mg, mg/100 ml | 2.3±0.04 | 2.4±0.03 | 2.5±0.04 | 2.6±1.10 | 2.6±0.09 | 2.4±0.04 | 2.3±0.04 | 2.2±0.05 | 2.2±0.03 |
| Nam m-equiv./l | 136.2±2.40 | 136.9±2.24 | 137.6±3.40 | 139.2±4.10 | 139.4±4.21 | 140.0±2.43 | 139.5±3.34 | 139.2±3.41 | 139.6±3.25 |
| K, m-equiv.e/ | 5.2±0.40 | 5.1±0.32 | 5.1±0.40 | 5.5±0.35 | 5.6±0.38 | 5.3±0.30 | 5.2±0.42 | 5.2±0.37 | 5.1±0.29 |
| Milk yield, lb/day | — | — | — | 21.4±3.5 | 24.5±6.2 | 17.0±5.5 | 15.2±3.8 | 14.4±4.2 | 12.6±2.4 |