

Comparative Study of Haematological and Blood Biochemical Components in Milk-Fed and Conventionally-reared Hassawi Breed Calves

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Abstract :

Haematological and blood biochemical values of milk-fed and conventionally reared Hassawi calves were recorded between 2 and 14 weeks of age. Packed cell volume (PCV) and Haemoglobin (Hb), fibrinogen and iron concentrations declined between 8 and 14 weeks of age in milk-fed but not in conventionally reared calves. Results suggest that Hassawi calves raised solely on milk tend to become anaemic as a result of lack of iron in their normal diet.

Introduction:

Hassawi cattle breed is a mix of *Bos indicus* and *Bos Taurus*. The cattle are raised in the Eastern region of Saudi Arabia by farming families in mixed farming system (Mohammed and AL-Shami, 2003). The breed numbers are declining very fast from 10449 head in 1986 to an estimated maximum of 4500 head at present (Ministry of Agriculture Year Book, 1998). The breed had never been described in the literature (Smith, 1980; Mason 1996). Phenotypic characterization of the breed has been given recently (Mohammed, 1997).

The concentrations of blood components are often measured during the course of disease, either as an aid to diagnosis or to investigate the effects of the disease on metabolic processes. To enable valid use of blood values to be made of such measurements, it is necessary to take into account the factors that can modify these values during normal metabolism. Among the physiological factors that were reported to influence blood composition of calves was the breed (Figueredo et al., 1983; Rwakishaya et al., 1985). Previous investigators have found differences between blood values of various breeds of calves and between crossbred calves and their parent breeds (Figueredo et al., 1983).

The objective of this study was to compare haematological and blood biochemical components of milk – fed versus conventionally – reared Hassawi breed calves.

Materials and Methods

Animals:

Twenty healthy calves at the age of 7 days were used in the study. Calves were obtained from Hassawi herd maintained at King Faisal University Research station or purchased from local farms. The calves were divided into 2 groups.

Group1: (Milk-fed calves) Ten Calves were left to suckle their mothers at all times. Salt licks and water were made available *ad libitum*.

Group2: (Conventionally – reared calves) Ten calves were used in this group. After morning milking of cows, calves were left to suckle their mothers. Thereafter, calves were offered commercially formulated concentrate (11% protein) with alfalfa hay, salt licks and water were made available *ad libitum*. Calves were individually penned on straw. Experiments on group 1 and 2 calves were lasted for 14 weeks.

Collection of blood samples

Calves were bled from Jugular vein in three weeks intervals between 2 and 14 weeks of age. Blood was either collected into EDTA tubes for estimation of haematological components or in plain tubes for estimation of serum biochemical components.

Determination of haematological parameters:

Packed cell volume (PCV) was determined by microhaematocrit method. Haemoglobin (Hb) concentration was determined by Cyanmethaemoglobin method; red (RBC) and white (WBC) blood cells were determined by Coulter counter (model ZBI, Coulter Electronic, Hialeah, USA) Thin blood smears for differential WBC count were obtained by Haemo-Scan differential cell counter. Mean cell volume (MCV), mean corpuscular haemoglobin (MCH) and mean corpuscular haemoglobin concentration (MCHC) were obtained by calculation according to the formulae of Schalm *et al.*, (1975).

Determination of biochemical parameters:

The VETTEST 8008 biochemical analyzer (Sanofi Animal Health Ltd., England) was used to determine the serum concentration of total protein, albumin, globulin and fibrinogen using specific kits.

Serum copper, and iron levels were determined using Shimadzu AA6800 Atomic Absorption spectrophotometer.

Statistical analysis:

Data were analyzed by one way ANOVA, using GLM procedure of SAS and Duncan's multiple range test to detect significant differences among means.

Results :

Mean haematological values in milk fed calves raised solely on milk (group 1) are given in Table 1.

Table (1)
Mean (\pm SEM) haematological values in milk-fed Hassawi calves (n=10)
from 2 to 14 weeks of age

Age (Weeks)	2	5	8	11	14
PCV (4L)	0.37 \pm 0.02	0.33 \pm 0.01	0.29 \pm 0.01*	0.29 \pm 0.01*	0.30 \pm 0.01*
Hb (g/dL)	12.31 \pm 0.50	11.30 \pm 0.30	10.31 \pm 0.30	9.50 \pm 0.01*	9.66 \pm 0.22*
RBC ($\times 10^{12}$ /L)	9.20 \pm 0.71	9.47 \pm 0.51	9.33 \pm 0.25	9.25 \pm 0.20*	9.35 \pm 0.20
MCV (fL)	37.61 \pm 0.70	36.10 \pm 0.42	33.15 \pm 0.40*	32.60 \pm 0.70*	32.30 \pm 0.70*
MCHC (g/dL)	31.8 \pm 0.30	32.60 \pm 0.31	33.60 \pm 0.32	33.50 \pm 0.31	33.30 \pm 0.30
MCH (Pg)	12.30 \pm 0.30	11.80 \pm 0.08	11.20 \pm 0.30	10.20 \pm 0.20*	10.55 \pm 0.35
Differential % WBC					
Neutrophils	31.050 \pm 2.00	30.1 \pm 2.00	33.6 \pm 1.50	32.4 \pm 2.00	30.5 \pm 1.50
Lymphocytes	65.30 \pm 1.5	66.4 \pm 1.5	60.2 \pm 1.5	61.3 \pm 1.5	65.1 \pm 2.0
Eosinophils	0.4 \pm 0.11	0.6 \pm 0.12	1.4 \pm 0.12	1.5 \pm 0.10	0.8 \pm 0.12
Basophils	0.2 \pm	0.3 \pm 0.13	0.7 \pm 0.0	0.8 \pm 0.11	0.5 \pm 0.13
Monocytes	2.9 \pm 0.22	2.6 \pm 0.20	4.1 \pm 0.20	4.0 \pm 0.22	3.1 \pm 0.24

The PCV was significantly ($P < 0.001$) decreased at 8, 11 and 14 weeks of age. Mean Hb concentration followed a similar trend. MCV and MCH also decreased significantly with age. The total and percentage WBC did not change with time.

Table 2 shows the haematological values in conventionally-reared calves. PCV and haemoglobin and other haematological values did not change with age. Comparison of table 1 and 2 shows that values of eosinophils were significantly ($P < 0.05$) higher during weeks 2 and 5 in conventionally reared calves and during week 8 and 4 in milk-fed calves. Values of PCV, Hb, RBC and MCH were significantly ($P < 0.05$) higher in conventionally-reared compared to milk-fed calves.

Table (2)
Mean (\pm SEM) haematological values in conventionally-reared Hassawi calves
(n=10) from 2 to 14 weeks of age

Age (Weeks)	2	5	8	11	14
PCV (4L)	0.38 \pm 0.01	0.36 \pm 0.01	0.35 \pm 0.01	0.36 \pm 0.01	0.35 \pm 0.01*
Hb (g/dL)	12.50 \pm 0.40	12.20 \pm 0.40	11.80 \pm 0.41	11.90 \pm 0.41	12.10 \pm 0.41*
RBC ($\times 10^{12}$ /L)	9.90 \pm 0.2	10.10 \pm 0.22	10.35 \pm 0.25	11.1 \pm 0.20	11.3 \pm 0.20*
MCV (fL)	38.1 \pm 0.5	35.6 \pm	33.7 \pm	33.1 \pm	33.6 \pm
MCHC (g/dL)	33.0 \pm 0.5	33.1 \pm 0.45	32.9 \pm 0.5	32.8 \pm 0.5	33.3 \pm 0.5
MCH (Pg)	12.8 \pm 0.4	11.9 \pm 0.35	11.8 \pm 0.30	12.1 \pm 0.30	12.03 \pm 0.30*
Differential % WBC Neutrophils	30.0 \pm 0.5	29.6 \pm 0.45	29.0 \pm 0.40	30.4 \pm 0.50	30.3 \pm 0.5
Lymphocytes	65.0 \pm 0.6	66.2 \pm 0.6	67.0 \pm 0.7	65.2 \pm 0.6	64.5 \pm 0.6
Eosinophils	1.4 \pm 0.20	1.2 \pm 0.20	0.8 \pm 0.010	0.6 \pm 0.10	0.6 \pm 0.10
Basophils	0.6 \pm 0.1	0.8 \pm 0.1	0.2 \pm 0.1	0.4 \pm 0.1	0.4 \pm 0.1
Monocytes	3.0 \pm 0.20	2.2 \pm 0.20	3.0 \pm 0.20	3.4 \pm 0.20	4.2 \pm 0.25

*P<0.05, significantly different from values in milk-fed calves.

The biochemical values in milk-fed Hassawi calves are given in Table 3. Total serum protein did not change with age, but albumin and globulin ratio increased significantly (P<0.001) between two and eight weeks of age. Mean fibrinogen concentration decreased with time (P<0.001). Mean serum iron but not copper also significantly (P<0.001) decreased with time.

Table 4 shows the biochemical values in conventionally-reared calves. Again total protein and albumin-globulin ratio did not change with age. Serum fibrinogen and iron were significantly (P<0.001) lower at 8 weeks of age then gradually increased (P<0.001) at 11 and 14 weeks of age. Values of fibrinogen and iron were significantly (P<0.001) greater than those in milk-fed calves at 11 and 14 weeks of age.

Table (3)
Mean (\pm SEM) serum biochemical values in milk-fed Hassawi calves (n=10) from 2 to 14 weeks of age

Age (Weeks)	2	5	8	11	14
Serum protein (g/L)	64.10 \pm 0.50	62.1 \pm 0.50	63.0 \pm 0.50	62.5 \pm 0.45	63.5 \pm 0.55
Albumin (g/L)	31.5 \pm 0.20	32.00 \pm 0.50	33.00 \pm 0.40	32.40 \pm 0.40	33.3 \pm 0.45
Globulin (g/L)	33.6 \pm 0.25	30.1 \pm 0.50	30.00 \pm 0.50	30.10 \pm 0.50	30.5 \pm 0.50
Fibrinogen (g/L)	6.40 \pm 0.30	4.2 \pm 0.30	3.59 \pm 0.35*	3.89 \pm 0.30*	3.70 \pm 0.30*
Serum iron (μ mol/L)	34.5 \pm 0.51	32.1 \pm 0.40	25.3 \pm 0.30*	18.1 \pm 0.25*	18.6 \pm 0.25*
Serum copper (μ mol/L)	12.1 \pm 0.51	12.6 \pm 0.40	12.0 \pm 0.40	12.6 \pm 0.30	12.3 \pm 0.30

Table (4)
Mean (\pm SEM) serum biochemical values in conventionally-reared Hassawi calves (n=10) from 2 to 14 weeks of age

Age (Weeks)	2	5	8	11	14
Serum protein (g/L)	64.5 \pm 0.41	61.8 \pm 0.40	64.0 \pm 0.50	62.4 \pm 0.40	63.6 \pm 0.41
Albumin (g/L)	31.0 \pm 0.50	31.0 \pm 0.50	33.0 \pm 0.40	32.4 \pm 0.46	33.2 \pm 0.40
Globulin (g/L)	33.5 \pm 0.40	30.8 \pm 0.40	31.0 \pm 0.60	30.0 \pm 0.60	30.4 \pm 0.50
Fibrinogen (g/L)	6.25 \pm 0.30	4.4 \pm 0.40	3.50 \pm 0.40*	4.6 \pm 0.40	5.05 \pm 0.50
Serum iron (μ mol/L)	34.0 \pm 1.1	31.01 \pm 1.2	25.6 \pm 1.5*	29.6 \pm 0.81	31.1 \pm 0.83
Serum copper (μ mol/L)	12.5 \pm 0.6	11.5 \pm 0.5	12.1 \pm 0.6	11.6 \pm 0.5	11.8 \pm 0.5

Discussion:

The PCV and Hb concentration of blood from milk-fed Hassawi calves were lower than those from conventionally-fed calves. Similar results were previously reported (Rwakishaya *et al.*, 1985). The decline in PCV and Hb values in postnatal period which known as physiological anaemia (Reece,

1997) has been attributed to the intake of large quantities of milk by calves at early weeks of development, but which might result into iron deficiency. The significant decline in MCV and MCH while MCHC remained stable, was consistent with the development of microcytic normochromic anaemia in milk-fed calves (Reece, 1997), hypochromia could develop only when calves become very anaemic (Howard, 2004).

The values recorded for total WBC and percentage lymphocytes and neutrophils in all calves agreed with those previously reported for calves of a similar age (Tennant *et al.*, 1974 and Rwakishaya *et al.*, 1985). Values for eosinophils were not constant, they were sometimes higher in milk-fed and at othertimes higher in conventially reared calves.

The increase in albumin-globulin ratio was expected as such value will reflect the dietary intake of protein (Payne *et al.*, 1973). Mean blood fibrinogen concentration was significantly higher when calves were first bled than at any subsequent age in milk-fed calves.

Significantly higher values of fibrinogen concentration were recorded for conventionally-reared calves compared to milk-fed calves.

The initial decrease in serum iron concentration in milk-fed calves maybe due to an increase in plasama volume associated with intake of large amount of milk diet (Reece, 1997). Such decline in iron concentration continued upto 14 weeks of age. Serum iron concentration was observed in conventionally-reared calves suggesting that serum iron decrease immediately after birth would not increased until there was an increase in iron intake. These findings also suggest that calves raised solely on milk tend to become anaemic as a result of lack of iron in their normal diet which is cow's milk.

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References

1. Figueredo, J.M., Denis, M., Sardina, J.M. and Castillo, M. (1983). Haematological values in Holstein and 5/8 Holstein x 3/8 Zebu calves. *Revista Salud Animal* 5, 231-241.
2. Howard, P. (2004). Investigation of calf health and welfare on dairy farms in South-West England. *The Veterinary record* 28, 262-264.
3. Mason, I.L. (1996). *World dictionary of livestock breeds types and varieties*. 4th ed., C. A.B. International.
4. Ministry of Agriculture Year Book (1998). Riyadh, Saudi Arabia.
5. Mohammed, T.A. (1997). Phenotypic characterization of the Saudi Arabia Hassawi cattle breed. *AGRI (FAO/UNEP)*, 21, 35-42.
6. Mohammed, T.A. and AL-Shami, S.A. (2003). Production characteristics and body dimensions of the Hassawi cattle of Saudi Arabia. *Assiut Veterinary Medical Journal* 49, 54-61.
7. Payne, J.M., Dew, S.M., Manston, R. and Faulks (1973). The use of metabolic profile test in dairy herds. *Vet. Rec.*, 87, 150-158.
8. Reece, W.O. (1997). *Physiology of domestic animals*. 2nd edition, Williams and Wilkins, Iowa, USA.
9. Rwakishaya, E., Larkin, H., and Kelly, W.R. (1985). Some haematological and blood biochemical components in conventionally reared calves. *Irish Veterinary Journal* 39, 118-123.
10. Schalm, O.W., Jain, N.C. and Carroll, E.J. (1975). The influence of the age on blood composition. In: *Veterinary Haematology*. Third edition, pp 122-131. Philadelphia: Lea and Febiger.
11. Smith, A.B. (1980). Domesticated cattle in the Sahara and their introduction into Western Africa. In M.A.J. Williams and H. Faure eds. *The Sahara and the Nile: quaternary environments and prehistoric occupation in Netherlands*, Balkema.
12. Tennant, B., Harrold, D., Reina-Guerra, M., Kendrick, J.W. and Laben, R.C. (1974). Haematology of the neonatal calf: Erythrocyte and leucocyte values of normal calves. *Cornell Veterinarian* 64, 515-532.

مقارنة المعايير الدموية و البيوكيميائية في عجول الأبقار الحساوي المرباه على الحليب فقط وعلى نظام التربية التقليدي

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الملخص :

تم في هذه الدراسة قياس المتغيرات الدموية والبيوكيميائية في عجول الأبقار الحساوي المرباه على الحليب فقط أو على نظام التربية التقليدي عند عمر ٢ إلى ٤ أسابيع. لقد تم ملاحظة انخفاض حجم خلايا الدم المتراصة والهيموجلوبين والفيبرينوجين والحديد عند عمر ٨ إلى ١٤ أسبوع في العجول المرباه على الحليب فقط مقارنة بالتي تم تربيتها على النظام التقليدي مما نتج عنه أن العجول المرباه على الحليب فقط قد تصاب بالأنيميا نسبة لعدم وجود الحديد في الحليب.