COMPONENTS OF RED BLOOD IN YOUNG MOOSE

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ABSTRACT: Investigating moose domestication at the Pechora–Ilych Reserve provided an opportunity to study the development of respiration blood activity. Respiration (gas transportation) blood activity plays an important role in moose adaptation. Characteristics of the gas–transporting function of blood of moose after birth are not synchronic, and this process is not completed by the age of 1 year. But the process of gas transporting in moose organs develops faster than that of domesticated hoofed animals and is dependent on their environment.

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Key words: agricultural animals, blood components, blood protein, hemoglobin, lactation, ontogenesis, physiological anemia, red blood cell, respiration activity

MATERIALS AND METHODS

I experimented with 23 moose on the Pechora–Ilych Reserve. Blood was taken from the jugular vein and stabilized with geparin. Morphofunctional parameters of red blood were determined by methods generally used in laboratory, clinical, and veterinary practice (Kudrjavtsev 1952).

Electrophoresis of hemoglobin (Hb) was done in 0.8–1.0% agar gel (Agar "Difko–Bakto" without additional cleaning) according to the Strekalov (1967a, b) method in Kachmarchik (1973); modification if pH is 7.0 of K–phosphate buffer and if the ion force of K–phosphate buffer and the ion force of solution is 0.005 in gel and 0.05 in electrode vessel and in polyacrylamide gel if pH is 8.3 tris–glycine electrode buffer used for division of gel systems and buffer solutions N1 according to Maurer (1971), modified for chemical polymerization. Alkaline resistance of Hb was determined by the modified Zinger method (Irzhak et al. 1985).

RESULTS AND DISCUSSION

Data from the first year of the study, including lactating moose and moose with calf–blood components, are given in Table 1. Erythrocyte (Er) concentration in the blood of newborn moose and those 1.0–1.5 years of age was equal, but concentration was a little higher than that of lactating moose. It is also typical for intact adult animals; the characteristics of their red blood cells are given in the works of Knorre and Knorre (1959) and Marma (1967). It is typical for mature moose.

But Hb concentration in blood of 1–day–old moose of postembryogenesis is 26–27% lower than that of 1–year–olds and intact ones. This is the component that differs between moose and reindeer and domesticated, hoofed animals. We believe that this factor depends on the sedentary life, especially in postembryogenesis.

Fetal hemoglobin (HbF), which is considered to be the main component of total Hb in blood of newborn moose, was first found by Moyseenko and Mochalov (1987) (Fig. 1). Concentration of Hb is the factor that makes the affinity of newborn moose Hb with oxygen higher than of adults; Hb newborn moose P_{50}Hb is 25% higher (Irzhak and Gladilov 1981).

During the first 2 weeks of life, microcell gipochrome anemia develops in the organs

Table 1. Characteristics of red blood in the ontogenesis of moose. Data are mean ± SE (range).

	Age									
Characteristic	1 day	1 week	2 weeks	3 weeks	4 weeks	5 weeks	1 year	1.5 years	Adult lactating females = 8	Moose with calf, 4 years
Er concentration, min/mm	6.53±0.20 (5.87–7.85)	4.91±0.24 (4.30–5.41)	5.37±0.14 (4.52–5.91)	5.71±0.25 (5.46–6.12)	6.19±0.11 (5.74–6.69)	6.18±0.09 (5.90–6.62)	6.24±0.16 (5.72–6.76)	6.50±0.28 (6.11-6.75)	4.71±0.11 (4.00–5.45)	5.14
Reticulocytes %	26.07±2.24 (11.90–33.84)	45.56±5.78 (14.60–62.50)	74.35±7.43 (46.71–109.47)	74.14±7.31 (45.00–115.00)	67.73±11.33 (33.85–120.39)	1.06±0.30 (0.00–2.26)	5.56±1.70 (1.90–13.75)	2.61±0.42 (1.08-4.92)	8.97±1.94 (2.80–30.54)	12.40
Hb concentration, g %	9.37±0.36 (8.00–11.40)	6.70±0.13 (6.40–7.20)	6.88±0.27 (5.20–7.60)	7.94±0.22 (7.20–8.80)	9.75±0.10 (9.30–10.04)	11.36±0.20 (11.00–12.60)	12.85±0.26 (12.00–13.80)	12.73±0.08 (12.60–13.00)	10.99±0.19 (9.60–11.80)	11.80
Hematocrit, %	34.09±1.12 (27.50–40.70)	23.65±0.20 (22.80–24.31)	24.04±0.91 (18.80–27.40)	28.14±0.64 (24.60–30.60)	32.45±0.54 (29.85–35.12)	34.25±0.77 (32.73–39.05)	36.19±1.18 (32.67–41.67)	36.73±0.23 (36.11–37.46)	33.60±0.78 (28.40–38.54)	36.11
Er. Volume, mkm	52.39±1.59 (45.01–59.71)	48.36±1.83 (43.44–56.53)	44.70±0.99 (40.61–48.30)	49.27±0.99 (44.81–52.04)	52.55±0.98 (47.43–56.95)	55.46±1.09 (51.30–61.69)	57.99±1.21 (52.79–67.73)	56.68±0.96 (54.55–59.95)	71.49±1.28 (61.83–77.23)	70.25
Er. Diameter, mkm	6.97±0.09 (6.78–7.25)	6.78±0.05 (6.64–7.03)	6.72±0.03 (6.54–6.86)	6.70±0.02 (6.63–6.76)	6.91±0.07 (6.58–7.06)	6.68±0.06 (6.22–6.92)	6.97±0.06 (6.73–7.08)	6.94±0.08 (6.86–7.05)	7.11±0.04 (6.83–7.43)	7.43
Er. Width, mkm	1.36±0.04 (1.21–1.45)	1.34±0.05 (1.26–1.46)	1.26±0.02 (1.16–1.38)	1.40±0.02 (1.30–1.50)	1.38±0.04 (1.21–1.49)	1.57±0.03 (1.49–1.69)	1.52±0.02 (1.44–1.62)	1.55±0.01 (1.48–1.70)	1.80±0.04 (1.55–2.05)	1.62
Er. Sphericity index	0.195±0.004 (0.176–0.208)	0.199±0.003 (0.188–0.208)	0.200±0.003 (0.173–0.207)	0.200±0.003 (0.173–0.207)	0.200±0.008 (0.196–0.226)	0.283±0.006 (0.227–0.271)	0.218±0.005 (0.202–0.235)	0.277±0.000 (0.216–0.217)	0.254±0.006 (0.218–0.300)	0.218
Er. Surface square, mkm	91.69±2.17 (86.59–99.02)	86.77±0.94 (84.55–93.14)	85.16±0.94 (80.57–88.63)	84.63±0.44 (82.82–86.06)	89.96±1.74 (81.54–93.89)	85.25±2.33 (72.86–96.00)	91.63±1.63 (85.30–96.60)	88.78±0.07 (88.63–88.92)	95.31±1.07 (87.86–103.99)	103.99
Hb concentration, %	27.55±0.79 (23.32–30.63)	28.34±0.54 (26.33–30.64)	28.65±0.57 (26.28–31.67)	28.26±0.64 (25.49–30.51)	30.87±0.30 (28.47–31.16)	33.33±0.91 (28.17–37.10)	35.67±0.77 (33.12–37.95)	34.67±0.32 (33.64–35.49)	32.70±0.45 (30.10–35.33)	32.68
Hb content, pg	14.31±0.23 (13.09–15.60)	13.62±0.30 (12.52–14.88)	12.77±0.23 (11.50–13.64)	13.90±0.31 (13.11–15.71)	15.80±0.35 (14.05–17.49)	18.39±1.13 (17.38–19.03)	20.62±0.23 (19.91–21.68)	19.64±0.48 (18.61-21.28)	23.43±0.34 (21.65–26.50)	22.96

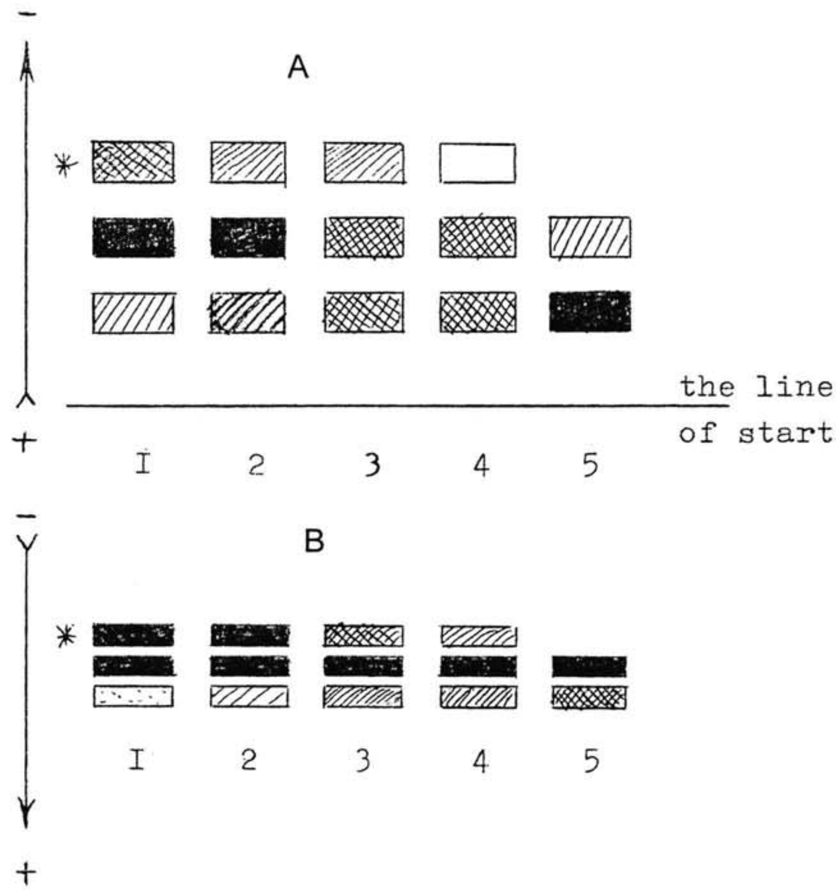

Fig 1. Graphical representation of migration of components of moose hemoglobin under electrophoresis in a polyacrylamide gel. Numbered lanes represent samples from moose of different ages: 1 – aged 1 day; 2–aged 2 week; 3–aged 2 weeks; 4–aged 3 weeks; 5–aged 1 year and adult. A–Gel Agar. B–Polyacrylamide Gel. The direction of movement in the electrical field is shown by the arrows. Protein level changes in some components are shown in black colour.

of moose. Concentration of Er decreases to 24%, Hb to 29%, hematocrit to 31%, average diameter of Er to 4% ($P < 0.05$), average volume Er to 15%, average surface to 7% ($P < 0.05$), and average Hb in the cell to 11%. But Er osmotic resistance increases, the limits of resistance being wider. Reticulocyte concentration (Rt) increases 3 times during the same period (Table 1).

This phenomenon is typical for most placental mammals, and it is known as physiological anemia of newborn animals. This phenomenon is caused when placental respiration changes into pulmonic with a subsequent loss of iron. It is known that (Kushner 1940) iron loss causes microcytosis. But when the animals are 1–month–old, the processes of anemia stabilize due to increasing Er and Hb in moose organs, which is the intensive growth dependent on the irregular, particular features of the environment. Agricultural animals such as cows and sheep have a low concentration of Er and Hb in blood until the end of the lactation period.

Er of 1–month–old moose differs from Er of other age–group animals on some morphofunctional parameters (Table 1) of osmotic resistance. The process of HbF synthesis is still going on. Morphophysiological parameters of Er are not finished during the first year of life and continue at various rates. The concentration of Hb in blood increases during the first year. Accordingly, Hb saturation in Er changes. We discovered higher concentration of Hb in the blood of moose of different age groups than that described in the literature because we dealt with the result of 40 years of work on domestication of moose. Nearly 40 years of selection in moose productivity and behavior should cause the changing of functionally connected organs and systems, although the latter could not have selectional symptoms.

The process of HbF synthesis stops when the moose reaches the age of 1.0–1.5 months. For domestic cattle the same process lasts until the age of 1.5–2.0 and even to 5.0 months, depending on the strains of cattle and environment (Mickle and Merkurjeva 1963, Sleptsov et al. 1977). We think that this process continues due to the rapid growth of moose after their birth, depending on environment. A high level of alkaline resistance is typical for other adult hoofed animals. But alkaline resistance of Hb of moose is lower then that of reindeer. Osmotic resistance of Er of moose is lower than that of reindeer although the latter are larger.

Characteristics of the gas–transporting function of blood of moose after birth are not synchronic, and this process is not completed by the age of 1 year. But the process of gas transporting in moose organs develops faster than that of domesticated, hoofed animals and is dependent on their environment. Respiration (gas transportation) activity of blood plays an important role in moose adaptation.

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