

## ORIGINAL PAPER

**EFFECT OF THE NUMBER OF REARING KITS ON SELECTED PARAMETERS IN BLOOD OF POLAR FOXES FEMALE****WPLYW LICZBY ODCHOWYWANYCH SZCZENIĄT NA WYBRANE WSKAŹNIKI KRWI LISIC POLARNYCH****Roman SZYMECZKO, Anna PIOTROWSKA, Joanna BŁASZYK, Monika BOGUSŁAWSKA-TRYK, Katarzyna BURLIKOWSKA**

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The aim of the research was to determine the effect of the number of rearing kits on selected blood parameters in polar fox females in the fifth week of lactation. The haematological parameters were tested in the blood of polar fox females with small (group A-mean number of pups: 3.5) and large (group B-mean number of pups: 10.7) litter. In female polar foxes rearing 9-13 kits (group B) there was found a lower number of red blood cells, a lower haematocrit value and lower concentration of haemoglobin. No significant ( $P<0.05$ ) effect of litter size on the number of white blood cells was observed, however there was an essential ( $P<0.05$ ) increase in the percentage of neutrophils as well as lowering of lymphocytes in the total count of leucocytes in the female of polar foxes from B group. A large number of pups in litter significantly ( $P<0.05$ ) lowered the content of glucose in female blood on the 35<sup>th</sup> day of lactation.

**KEY WORDS: polar fox, lactation, litter size, haematological parameters****STRESZCZENIE**

Celem badań było określenie wpływu liczby odchowywanych szceniąt w miocie na wybrane parametry krwi lisic polarnych w piątym tygodniu laktacji. Wskaźniki hematologiczne określono w krwi lisic odchowujących małe (grupa A - średnia liczba szceniąt: 3,5) i liczne (grupa B - średnia liczba szceniąt: 10,7) mioty. U samic odchowujących 9-13 szceniąt (grupa B) stwierdzono mniejszą liczbę erytrocytów, niższą wartość hematokrytu i mniejszą koncentrację hemoglobiny w krwi. Nie stwierdzono istotnego ( $P<0,05$ ) wpływu wielkości miotu na ogólną liczbę krwinek białych, odnotowano natomiast istotny ( $P<0,05$ ) wzrost procentowego udziału neutrocytów oraz obniżenie procentowego udziału limfocytów w krwi lisic z grupy B. W 35-tym dniu laktacji w krwi samic karmiących liczne mioty stwierdzono również istotnie ( $P<0,05$ ) mniejszą zawartość glukozy.

**SŁOWA KLUCZOWE: lis polarny, laktacja, wielkość miotu, parametry hematologiczne**

## STRESZCZENIE SZCZEGÓŁOWE

Celem badań było określenie wpływu liczby odchowywanych szceniąt w miocie na wybrane parametry krwi lisic polarnych w piątym tygodniu laktacji. Badania przeprowadzono na dwunastu samicach pochodzących z krajowej fermy reprodukcyjnej. Wyodrębniono dwie, liczące po 6 samic ( $n=6$ ) grupy doświadczalne A i B. Samice z grupy A odchowywały średnio 3,5 (od 2 do 5 lisiąt), a samice z grupy B średnio 10,7 (od 9 do 13 lisiąt) szceniąt w miocie. Zwierzęta żywione były standardowymi paszami stosowanymi w fermie w żywieniu lisic w okresie odchowu szceniąt. W 35-tym dniu laktacji, przed rannym karmieniem, od wszystkich samic pobrano z żyły ramieniowej krew do oznaczeń. W próbach pełnej krwi oznaczono przy użyciu analizatora hematologicznego ADVIA 120 następujące parametry: liczbę krwinek czerwonych, stężenie hemoglobiny, wskaźnik hematokrytowy, liczbę krwinek białych i liczbę trombocytów. Określono również wartości wskaźników czerwonekrwinkowych: średnią objętość krwinki czerwonej (MCV), średnią masę hemoglobiny w krwince czerwonej (MCH) i średnie stężenie hemoglobiny w krwince czerwonej (MCHC) oraz udział poszczególnych rodzajów krwinek białych w ogólnej liczbie leukocytów w krwi. Zawartość glukozy oznaczono w surowicy krwi, przy użyciu analizatora biochemicznego Olympus AU 400. Analizę statystyczną wyników przeprowadzono za pomocą testu t-Studenta dla prób niezależnych, z wykorzystaniem programu Statistica 5.5 PL [12]. Istotność różnic ustalono przy  $P<0,05$ . Uzyskane wyniki badań przedstawiono w tabeli 1. Mimo, iż samice grupy B odchowywały 3-krotnie większą liczbę szceniąt, to w odniesieniu do większości badanych wskaźników nie stwierdzono statystycznie istotnych różnic pomiędzy grupami. W krwi samic grupy B stwierdzono jednak mniejszą liczbę erytrocytów, niższą wartość hematokrytu i mniejszą koncentrację hemoglobiny w krwi oraz niższe wartości wskaźników czerwonekrwinkowych, co dowodzi możliwości rozwoju niedokrwistości wynikającej z niedoboru żelaza u lisic rodzących i odchowywujących liczne potomstwo [3, 13]. U samic obu grup doświadczalnych stwierdzono wysoką, znacznie przewyższającą wartości referencyjne dla dorosłych lisów polarnych liczbę leukocytów w krwi [3], nie odnotowano jednak istotnego wpływu liczby odchowywanych szceniąt na ogólną liczbę krwinek białych. Analiza obrazu białokrwinkowego wykazała istotny ( $P<0,05$ ) wzrost procentowego udziału neutrocytów (grupa A i B odpowiednio: 52,0% i 64,7%) oraz obniżenie procentowego udziału limfocytów (grupa A i B odpowiednio: 38,2% i 27,2%) w krwi samic odchowywujących liczne mioty. W 35-tym dniu

laktacji stwierdzono statystycznie istotnie ( $P<0,05$ ) niższy poziom glukozy w krwi samic grupy B ( $93,83 \text{ mg}\cdot\text{dl}^{-1}$ ) w porównaniu do samic grupy A ( $118,83 \text{ mg}\cdot\text{dl}^{-1}$ ) karmiących mniejszą liczbę szceniąt, co dowodzi dużego wysiłku ze strony organizmu laktujących samic [2].

Wyniki badań hematologicznych wskazują, że duża liczba odchowywanych szceniąt w miocie wpływa na pogorszenie parametrów morfologicznych oraz obniża koncentrację glukozy w krwi laktujących lisic.

## INTRODUCTION

Over the first three weeks of life the mother's milk is the only source of nutrients for kits. Over the next 3-4 weeks of rearing the share of milk in the kit diet decreases gradually. According to Ahlström et al. [2], over lactation blue fox females suckling numerous litter (8-12 kits) lose even from 20 to 30% of the body weight. This enormous effort made by the female body is reflected in her physiological condition. The research reported by Stanisławska [9, 10] demonstrated changes in morphological and biochemical blood parameters in polar fox females depended on the period of pregnancy and lactation. Similarly the number of born and reared kits affected the blood parameters in lactating females [11]. The available domestic and international literature seems to offer no other reports on the effect of the litter size on morphological and biochemical blood parameters in polar fox females.

The aim of this research was to determine the effect of the number of reared kits per litter on selected hematological blood parameters in polar fox females in the fifth week of lactation.

## MATERIAL AND METHODS

The research involved twelve polar fox females obtained from the domestic reproduction farm. The experimental factor determining the selection of female foxes was the number of the kits they reared. There were identified two, 6 females each, experimental groups A and B. Group A females reared, on average, 3.5 (from 2 to 5 kits), while group B females – on average of 10.7 (from 9 to 13 kits) kits per litter. The health status of fox females was good; all the experimental females were clinically healthy. The experimental animals, similarly as the rest of the farm foxes, were fed with standard feeds used on the farm in the nutrition of fox females during lactation period.

In the 35<sup>th</sup> day of lactation from all the experimental fox females vein blood was sampled for determinations.

Table 1. Haematological indices in blood of polar fox female  
Tabela 1. Wskaźniki hematologiczne krwi lisic polarnych

Index Wskaźnik	Group <sup>(1)</sup> Grupa <sup>(1)</sup>	
	A	B
Erythrocytes, Erytrocyty [ $T \cdot l^{-1}$ ]	8.45 <sup>(2)</sup> ± 0.53 <sup>(3)</sup>	8.01 ± 0.68
Haematocrit, Hematokryt [ $l \cdot l^{-1}$ ]	0.47 ± 0.03	0.45 ± 0.03
Haemoglobin, Hemoglobina [ $g \cdot dl^{-1}$ ]	15.2 ± 0.96	13.9 ± 1.27
MCV [fl]	56.03 ± 0.73	55.03 ± 1.53
MCH [pg]	18.0* ± 0.3	17.2 ± 0.4
MCHC [ $g \cdot dl^{-1}$ ]	32.12 ± 0.37	31.47 ± 0.95
Leucocytes, Leukocyty [ $G \cdot l^{-1}$ ]	13.38 ± 4.66	11.61 ± 2.46
Lymphocytes, Limfocyty [%]	38.2* ± 5.0	27.2 ± 6.9
Neutrophils, Neutrocyty [%]	52.0* ± 5.3	64.7 ± 8.4
Eosinophiles, Eozynocyty [%]	4.5 ± 2.6	1.8 ± 2.4
Basophiles, Bazocyty [%]	0.8 ± 1.2	0.2 ± 0.4
Monocytes, Monocyty [%]	3.8 ± 1.6	5.5 ± 1.6
Thrombocytes, Trombocyty [ $G \cdot l^{-1}$ ]	644.17 ± 125.81	588.17 ± 59.92
Glucose, Glukoza [ $mg \cdot dl^{-1}$ ]	118.83* ± 18.00	93.83 ± 15.09

<sup>1)</sup> Mean number of kits per litter, średnia liczba szczeniąt w miocie: A - 3,5; B - 10,7.

<sup>2)</sup> Mean value [ $\bar{x}$ ], wartość średnia

<sup>3)</sup> Standard deviation [SD], odchylenie standardowe

\* P<0.05

Blood was taken in the morning (8<sup>00</sup> – 10<sup>00</sup>) prior to animal feeding. The use and handling of animals for this experiment were approved by the Local Ethical Committee in Bydgoszcz. In the samples of full blood, secured from coagulation, the following parameters were determined with the use of ADVIA 120 hematological analyzer: the number of red blood cells, haemoglobin concentration, haematocrit indicator, the number of white blood cells and number of thrombocytes. Similarly the values of red blood cell parameters were defined: mean cell volume (MCV), mean cell haemoglobin (MCH) and mean cell haemoglobin concentration (MCHC) as well as the percentage of respective kinds of white blood cells in the total count of leucocytes in blood, while the content of glucose was determined in the serum with the use of Olympus AU 400 biochemical analyzer. The statistical analysis of the results obtained was made with the t-Student test for independent samples, using Statistica 5.5 PL [12]. The significance of differences was set up at P<0.05.

## RESULTS AND DISCUSSION

The level of haematological indices is a measure of the physiological condition and health in animals. Table 1 presents the results of determinations of morphotic

components and the content of glucose in the blood of polar female foxes rearing small (group A) and large litters (group B). Even though group B females reared 3-time higher number of kits, as for most indices researched, there were found no significant differences across the experimental groups. In the blood of females suckling large litters, however, a lower number of red blood cells was found, a slight decrease in the haematocrit value and a lower content of haemoglobin. Such changes demonstrate a possibility of anemia development in group B female foxes, which is confirmed by the values of specific red blood cell indices. A lower volume of red blood cells (MCV), lower mean cell haemoglobin concentration (MCHC) and significantly (P<0.05) lower mean cell hemoglobin (MCH) show a development potential of anemia as a result of iron deficit in group B female foxes giving birth and rearing large litter [3, 13]. One shall note that the values of the above discussed blood parameters in group B females fall within the lower limits of the reference values defined for adult polar foxes [3]. The lactation period in foxes is still scarcely known. Only few reports cover biochemical and morphological indices in fox females depending on the reproductive cycle [1, 9, 10, 11]. Study by Stanisławska et al. [11] on the effect of the number of born and reared kits and the value of selected blood indices in polar fox females demonstrate that a

large number of kits clearly decreases the concentration of haemoglobin and the value of haematocrit index throughout the pregnancy and lactation, as compared with female foxes rearing two-fold smaller litter, which was confirmed in the present research, however both the content of haemoglobin (group A and B, respectively, 15.2 and 13.9 g·dl<sup>-1</sup>) and the value of haematocrit index (group A and B, respectively, 0.47 and 0.45 l·l<sup>-1</sup>) in experimental female fox blood were lower, as compared to the values and these parameters recorded by the authors given earlier in the comparable lactation period (content of haemoglobin: 19.07 and 17.04 g·dl<sup>-1</sup>, haematocrit index: 0.49 l·l<sup>-1</sup> in females rearing on average: 6.2 and 12.8 kits per litter).

In carnivorous animals the number of leukocytes in blood is very variable; the changes can affect both the total number of white blood cells, and the relative percentage of the content of their respective kinds [3]. Generally in the course of lactation of polar fox females there is observed a systematic increase in the number of leucocytes (except for an early perinatal period), accompanied by an increased number of neutrophils, basophiles, monocytes and the tendency to lactation lymphopenia [10]. These processes are accompanied by a change in the level of total protein and respective protein fractions of serum, including gamma globulin [8]. The results of the experiment in the blood of fox females of both experimental groups demonstrated a high, double the reference values in adult polar foxes [3], number of leukocytes, which suggests an occurrence of lactation leukocytosis. There was found no significant effect of the number of reared kits on the total number of white blood cells in the blood of female foxes in the 5<sup>th</sup> lactation week. In the above reports by Stanisławska et al. [11] the content of leukocytes in the blood of regularly-lactating female foxes increased along the course of lactation and reached a maximum, remaining until the day of kit weaning, level on the 38<sup>th</sup> day of lactation (10.82 G·l<sup>-1</sup>). The authors also recorded a regular increase in the number of reared kits on the increase in the level of leukocytes in the blood of female foxes in the 3<sup>rd</sup> and 5<sup>th</sup> week of lactation.

The analysis of the while blood cell image demonstrated in the blood of female foxes suckling numerous litter (group B) the lowest number of lymphocytes, eosinophiles and basophiles and a higher percentage of neutrophils and monocytes, as for lymphocytes and neutrophils the differences were significant (P<0.05). One shall stress that both the amount of lymphocytes and neutrophils in the total number of white blood cells in the blood of fox females of both groups fall within a wide range of reference values for this animal species [3]. The interpretation of the leukogram results obtained

in the blood of lactating fox females is not simple as the level fluctuations depend on a number of factors. A significant decrease in the percentage of lymphocytes in the blood of fox females rearing numerous litter can suggest lactation shortage and weakened defense mechanism of the body, while a significant increase in the number of neutrophils as related to a high number of leukocytes can demonstrate the effect of the stress factor which is, especially in farm fur animals, blood-taking. Stress leukocytosis found in dogs and cats, as a result of an increased number of neutrophils, can 2-7 -fold increase the number of leukocytes in peripheral blood [13]. Mink experiments demonstrated that the number of leukocytes, granulocytes and lymphocytes in the blood at the end of lactation is also affected by the diet fat quality at a varied number of born and reared kits [4, 6].

The content of glucose in carnivorous fur animal blood serum is high and in adult polar foxes is 125 mg·dl<sup>-1</sup> [3]. A physiological decrease in the amount of blood glucose in animals is observed during pregnancy and lactation, which is a result of an additional demand for glucose to make up for foetus growth and milk sugar synthesis [5]. Luick et al. [7] in their experiment which involved lactating bitches found that glucose is a substrate not only for the synthesis of lactose but also of milk protein and fat. One of the factors affecting the intensity of glucose metabolism in the body of lactating females is the number of born and reared kits [5, 8]. Reports by Ahlstrøm et al. [2] on foxes showed that the amount of milk produced and energy utilization, including nutrients in milk, increases along with the number and age of weaned kits. The present experiment shows a significantly (P<0.05) lower level of glucose in the blood of fox females rearing numerous litter (93.83 mg·dl<sup>-1</sup>), as compared with group A females (118.83 mg·dl<sup>-1</sup>) suckling a lower number of kits, which suggests a large effort of the body of lactating females.

The results of haematological research show that a large number of reared kits per litter deteriorates morphological parameters and decreases the glucose concentration in the blood of lactating fox females.

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