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Levels of hematological parameters of pigs over the fattening period

Poziomy wskaźników hematologicznych świń podczas tuczu

Summary. The study was conducted on 24 pigs. Blood for the hematological tests was collected four times over the fattening period. The examinations showed that the level of hematological indices is an animal age-dependent. Advancing pig age brought about a statistically significant increase of hematocrit, red cell count and blood platelet count. This effect was accompanied by a decline of mean cell hemoglobin (MCH) and mean cell hemoglobin concentration (MCHC) in a red blood cell. A change of place and nutrition made a stressor for the pigs investigated, thus in 11 week of animal age, that is a week following pigs transportation to the fattening house, a drastic change of red cell indices and white blood cells indices was noted. A significant decrease of the level of hemoglobin (HGB), mean cell hemoglobin (MCH) and lymphocytes were observed with a simultaneous increase of neutrophiles (Neu).

Key words: pig, hematological indices, blood

INTRODUCTION

The hematological and biochemical indices of pigs are affected by a broad range of environmental and physiological factors including nutrition, age, sex and zootechnical conditions. The technological advances in animal rearing and breeding have a major impact on their health state. Intensive production of pigs and in turn, a high growth rate, as well as high carcass meatiness, have markedly changed the animal metabolism and metabolites, and thus they condition the level of biochemical and hematological parameters.

In Poland, one of the characteristic features of the livestock production is high diminution of farms, with a consistent tendency for herds to decrease in size. The most numerous group of farms comprises those with a basic herd amounting to 35–50 gilts. Although there is a low number of herds of high production concentration, a specialistic livestock farm characterized by intensive production (over 50 gilts) was selected for

monitoring purposes. Such livestock farms allow intensive breeding work, yet they need an appropriate disease prevention program so that full control of the animal health state could be maintained.

The aim of this study was to assess the hematological indices in blood serum of pigs over the fattening period.

MATERIAL AND METHODS

The studies were conducted in 2007. They included 24 healthy and free from any clinical signs barrows and gilts (1:1 sex ratio) from an individual farm of average 70 pigs in a basic herd. The animals were fed full ration feed (Tab. 1) and kept in a natural-mechanically ventilated chamber on a deep litter bed, on average 100–120 animals per chamber. According to the prophylaxis program, on days 3 and 13 the animals were administered the iron preparations. All the animals proved to be insusceptible to stress (RYR1), which was confirmed by the PCR-RLFP based test according to the methods recommended by Fujii [Fujii *et al*., 1991]. The research started in 7 week of age and lasted till the end of the fattening period. Blood for the hematological tests was collected four times, i.e. in 7, 11 weeks of animals age (a week after animals' transportation to the fattening house) and in 18 and 23 weeks of their age (4 days prior to slaughter).

Table 1. Composition and nutritive value of feed mixtures
Tabela 1. Zawartość składników pokarmowych

Metabolizable energy Energia metaboliczna	9.06 MJ
Crude protein Białko ogólne	14.00%
Crude fibre Włókno surowe	6.00%
Crude ash Popiół surowy	2.8–4.8%
Crude fat Tłuszcz surowy	3.10–5.10%
Ca	0.50%
P	0.18%
Na	0.14%
Lisine Lizyna	0.77%
Metionine Metionina	0.25%
Metionine + Cysteine Metionina + Cysteina	0.49%
Tryptophan Tryptofan	0.16%
Threonine Treonina	0.51%

Blood was taken from the neck vein, *vena cephalica* into the EDTA 2 tubes. The hematological analyses were performed using the hematology analyzer MELET SCHLOESING Laboratories (Osny, France) and the following biochemical parameters were determined: levels of hemoglobin (HGB) and hematocrit (HCT), red blood cells count (RBC), mean cell volume (MCV), mean cell hemoglobin (MCH), mean cell hemoglobin concentration (MCHC), red distribution width (RDW), platelet count (PLT), mean platelet volume (MPV), platelet distribution width (PDW), white blood cells count (WBC) as well as white blood cell indices, including lymphocytes (Lym), monocytes (Mono), neutrophil granulocytes (Neu), eosinophil (Eos) and basophil (Baso) granulocytes.

The results of determinations were presented in the tables, giving the arithmetic means (M) and standard deviation (SD). The level of the determined parameters in each series was compared statistically, using Anova test.

RESULTS AND DISCUSSION

Results of the biochemical tests are presented in Table 2. The present research showed that animal age was a major factor differentiating each parameter value. Advancing in pig age brought about a statistically significant increase of hematocrit, red cell count and blood platelet count. This effect was accompanied by a decline of the mean cell hemoglobin (MCH) and the mean cell hemoglobin concentration (MCHC) in a red blood cell. Especially in 11 week of animal age, that is a week following pig transportation to the fattening house, there occurred a marked fall of hemoglobin content (HGB) (at $p \leq 0.01$) as well as mean cell hemoglobin (MCH) in a red blood cell. The changes recorded are not consistent with the research results of other authors who indicated an upwards tendency for all the red blood cell indices [Friendship *et al*. 1984, Markiewicz *et al*. 1970].

The mean cell and concentration of hemoglobin in a red cell persisted at a low level, far below the reference values established by Winnicka [2004] and Kuleta [1993], yet found within the ranges mentioned by Friendship *et al*. [1984] and showing the minimum values at the fattening period end.

The hematological analysis exhibited that prophylactic iron preparations administered in the first days of pigs life protected the animals against the anemia incidence. However, the changes observed in red cell indices in older pigs indicate a necessity of the iron deficiency supplementation in the following fattening weeks as well. As the research showed, among the numerous factors contributing to anemia occurrence, the major ones include inappropriate nutrition, stress, as well as the indoor maintenance system. Rearing pigs in confinement eliminates any contact of animals with iron from soil. The pigs with access to an outdoor area had a higher, even by 30%, hemoglobin content in blood.

Throughout the research period, the mean leukocyte count slightly exceeded the upper limits [Winnicka 2004]. According to Odink *et al*. [1990], a decrease of leukocyte count, BSR, fibrinogen concentration and the total amount of protein in blood accompanied by a decline in hematocrit value, hemoglobin level and albumin and iron content in serum gave evidence of the inflammation status in organism. This dependence, though, has not been proven in the present research. An increase of leukocyte number might result from both stress or so-called physiological leukocytosis, always occurring in animals after feeding.

Thus, in the case of pigs with free access to feed, this raise should not be taken into consideration.

Table 2. Changes of hematological parameters values over the fattening period (n = 24)
Tabela 2. Zmiany wartości parametrów hematologicznych podczas tuczu (n = 24)

Parameter Wskaźnik	Unit Jednostka	Week of age Tydzień życia							
		7		11		18		23	
		M	SD	M	SD	M	SD	M	SD
HGB	$g \cdot dl^{-1}$	12.83 A	0.67	10.59 B	2.11	11.13	1.24	12.05	0.74
HCT	%	40.29	2.47	34.95 A	6.52	36.58 A	4.49	44.58 B	2.83
RBC	$mln \cdot m^{-3}$	7.50	0.36	6.73 a	1.28	7.05	0.58	7.85 b	0.59
MCV	fl	54.14	3.15	52.16	2.19	51.88	3.47	56.93	2.63
MCH	pg	17.19 A	1.00	15.66 B	0.81	15.73 B	0.85	15.33 B	0.97
MCHC	$g \cdot dl^{-1}$	31.82 Aa	0.65	30.12 A	1.90	29.94 b	2.12	26.97 B	0.74
RDW		12.13	1.30	12.99	1.23	13.29	1.04	13.33	0.99
PLT	$thous. \cdot mm^{-3}$ $tys. \cdot mm^{-3}$	331.81	11.13	314.94	116.09	270.33 a	67.28	362.50 b	93.93
MPV	fl	10.21	0.27	10.02	0.39	9.63	0.23	10.20	0.25
PDW		8.81	0.74	13.93	21.37	8.00	0.70	8.65	1.47
WBC	$thous. \cdot mm^{-3}$ $tys. \cdot mm^{-3}$	20.08	3.69	24.97	7.07	22.30	3.92	20.30	2.27
Lym	%	61.86 A	5.61	49.48 B	8.42	53.82	11.98	56.65	4.66
Mono	%	3.60 A	0.81	4.49	0.98	5.08 B	0.99	3.17 A	0.56
Neu	%	28.99 A	8.17	42.89 B	7.94	33.78	13.19	34.12	4.76
Eos	%	5.60	4.52	2.71 A	1.21	6.98 B	3.02	5.68	2.00
Baso	%	0.30	0.22	0.44	0.25	0.35	0.24	0.38	0.31

a, b… – values denoted with the same letters differ significantly at $p \leq 0.05$ (a, b…) and $p \leq 0.01$ (A, B…)
a, b… – wartości zaznaczone tymi samymi literami różnią się statystycznie dla $p \leq 0.05$ (a, b…) i $p \leq 0.01$ (A, B…)

Some significant differences confirmed statistically were observed in the leukogram. A change of place and nutrition made a stressor for the pigs investigated, thus in 11 week of age a drastic change of white blood cells indices was noted. Neutrophil count increased substantially with a simultaneous drop of lymphocytes, so N:L ratio increased. As the investigations revealed, this index raise in young animals is likely to be associated with the stress induced by transportation, litter mixing, glucocorticoid fluctuation (physiology), a change of pathogen or environment and the adaptation to a new feed [Stull *et al*. 1999]. The stress situations induce a simultaneous drop of eosinophils [Wrońska 1982]. This effect is confirmed in the research results which show that the

mean percentage of eosinophils after animals transportation to another place declined from 5.60% to 2.71% (Tab. 2).

A comparison of the results obtained from the healthy pigs and those presented by other authors proves to be a difficult task due to some biological differences, like body weight, age, breed, as well as the feeding regime, animal maintenance system and the mode of blood collection. Standardization of methods and establishment of reference values for each productive group, breed and their crosses, as well as animal age may be useful for efficient diagnostics of the breeding herd health state. Quick and accurate diagnostic procedures make the basis for the successful breeding work under the conditions of increasing production concentration and a growing percentage of specialistic farms within the structure of swine rearing and breeding.

Pigs as a species sensitive to stress develop a strong response to the changing conditions. Despite the breeding efforts aiming at elimination of mutated porcine stress-sensitivity RYR1 gene from herds, it is hard or even impossible to provide animals with the stress-free environment over the breeding season.

The examinations showed that the level of hematological indices is animal age-dependent. Advancing pig age brought about a statistically significant increase of hematocrit, red cell count and blood platelet count. This effect was accompanied by a decline of mean cell hemoglobin (MCH) and mean cell hemoglobin concentration (MCHC), in a red blood cell. A change of place and nutrition made a stressor for the pigs investigated; thus, in 11 week of animal age, that is a week following pigs transportation to the fattening house, a drastic change of red cell indices and white blood cells indices was noted. A significant decrease of the level of the hemoglobin (HGB), mean cell hemoglobin (MCH) and lymphocytes was observed with a simultaneous increase of neutrophiles (Neu).

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Streszczenie. Badaniami objęto 24 świnie. Krew do analiz hematologicznych pobierano czterokrotnie podczas całego tuczu. Przeprowadzone badania wykazały, że poziom hematologicznych wskaźników był zależny od wieku zwierząt. Wraz z wiekiem świń obserwowano statystycznie istotny wzrost poziomu wartości hematokrytowej oraz liczby krwinek czerwonych i płytek krwi. Towarzyszył temu spadek średniej masy (MCH) i stężenia (MCHC) hemoglobiny w pojedynczej krwince czerwonej. Zmiana pomieszczenia, żywienia, stanowiły dla badanych świń czynnik stresujący, stąd w 11 tygodniu życia, tj. tydzień po wprowadzeniu zwierząt do tuczarni, nastąpiła radykalna zmiana udziału niektórych wskaźników czerwonokrwinkowych i białokrwinkowych. Odnotowano istotny spadek poziomu hemoglobiny (HGB), średniej masy hemoglobiny w krwince czerwonej (MCH) i limfocytów z jednoczesnym wzrostem udziału neutrofili (Neu).

Słowa kluczowe: świnia, wskaźniki hematologiczne, krew