Specifics of Immunogenesis and Metabolism in Young Hogs under Biogeochemical Conditions of Chuvash Center

R. A. Shukanov, M. N. Lezhnina, and A. A. Shukanov

Translated from *Byulleten' Eksperimental'noi Biologii i Meditsiny,* Vol. 150, No. 12, pp.674-677, December, 2010
Original article submitted January 23, 2010

Combined treatment of young hogs with Trepel food supplement and Polystim immunomodulator with consideration for specific biogeochemical properties of Chuvash Center produced immunostimulating and metabolic effects and optimized the balance between free radical oxidation response and body antioxidant potential.

Key Words: *young hogs, blood, immunogenesis, metabolism*

Development, evaluation, and introduction of new Russian biogenous compounds possessing immunophysiological and metabolic effects with consideration for biogeochemical particularities of Russian regions is a topical issue of modern science and biotechnology [1-3].

The aim of the study was to investigate specificity of natural resistance and development in young hogs receiving food supplements Trepel, Suvar, and immunomodulator Polystim under biogeochemical conditions of Chuvach Center.

MATERIALS AND METHODS

Two experimental series were carried out on young hogs (n=48) separated from mothers. The animals were matched by clinical physiological status, breed, age, gender, and body weight. The study lasted 300 days; each group consisted of 8 animals.

In both experimental series, group 1 hogs (controls) received basic ration (BR) on days 60-300 of life. In experimental series I, the animals of groups 2 and 3 received Trepel in a daily dose of 1.25 g/kg. In addition to Trepel, the animals of group 3 received Suvar in a dose of 25-50 mg/kg every 20 days with an interval of 10 days to the age of 240 days. In experimental series II, young hogs of groups 2 and 3 receiving BR were treated with Trepel. In addition, animals of group 2 received Suvar in the dose specified for series I. Group 3 animals were intramuscularly injected with Polystim in doses of 0.1, 0.03, and 0.03 mg/kg on days 60, 180, and 240 of life, respectively.

In both experimental series, cellular and humoral immunity and protein, lipid, carbohydrate, and mineral metabolism were estimated in 5 hogs from each group on days 60, 120, 180, 240, and 300 of life using modern immunological and physiological tests.

The results obtained in repeated manufacturing and scientific studies were processed by ANOVA using Microsoft Excel 2007 and Statistica for Windows software.

RESULTS

In experimental series I, erythrocyte count in experimental hogs demonstrated a wavy increase from 4.23±0.10-4.43±0.10 to 5.01±0.03-5.66±0.05 mln/μl. This parameter in 120-, 180-, 240-, 300-day-old hogs from experimental groups exceeded the control values by 4.2-17.3% (p<0.005-0.001).

In contrast, white blood cell count demonstrated a wavy decrease from the beginning of the experiment (18.5±0.20-19.0±0.40 thousand/μl) to its end (17.9±0.08-18.5±0.10 thousand/μl; p>0.05). Throughout the experiment, the proportion of auto-plaque-forming cells (APFC) in hogs fluctuated in a zigzag manner with age without any significant difference

I. Ya. Yakovlev Chuvash State Pedagogical University, Russia. ***Address for correspondence:*** merinochek@rambler.ru. M. N. Lezhnina

0007-4888/11/1506-0729

from 2.65±0.19-2.81±0.32 at the beginning of the experiment to 2.69±0.03-2.76±0.04 at the end.

Analysis of humoral immunity showed that 180-, 240-, 300-day-old hogs from groups 2 and 3 were superior to controls of the corresponding age in hemoglobin concentration by 4.8-9.5% (p<0.05-0.01).

Level of γ-globulin fraction in whole protein (WP) in animals from the compared groups steadily increased with age: from 13.8±0.70-14.0±0.70 g/liter in the beginning of the experiment to 15.7±0.28-17.5±0.28 g/liter by the end. It should be noted that 240- and 300-day-old hogs from group 3 demonstrated significantly higher level of this immunocompetent factor than group 2 animals of the corresponding age and age-matched controls.

Immunoglobulin level in blood serum of experimental hogs steadily increased with age (14.1±0.10-14.4±0.10 mg/ml in the beginning *vs*. 19.2±0.38-22.3±0.54 mg/ml by the end of the experiment); the values for 120-, 180-, 240-, 300-day-old animals from groups 2 and 3 exceeding the control values by 9.6-16.2% (p<0.05-0.001).

Analysis of protein metabolism showed that total protein content in hogs of the studied groups markedly increased from day 60 to day 240 of life (62.10±1.83-63.50±2.24 *vs*. 65.70±0.50-70.60±1.18 g/liter) and then decreased to 65.60±0.41-70.10±0.91 g/liter by the end of the experiments. Total protein concentration in 240-, 300-day-old hogs from group 3 was significantly higher than in age-matched group 2 animals and controls.

Similar pattern was determined for albumin level behavior.

LPO activity in animals from control group and group 2 decreased with age in a zigzag manner from 5.87±0.36-5.90±0.39 to 5.29±0.05-5.32±0.05 mV. At the same time, it showed a wavy increase in their herdmates from group 3 from the beginning of the experiment (5.87±0.32 mV) by its end (6.06±0.03 mV), with elevation of this lipid metabolism index by 16.4-22.8% (p<0.001) in 240-, 300-day-old hogs from groups 2 and control as compared to their herdmates from group 3.

An opposite pattern was revealed for fluctuations of blood serum antioxidant system activity, which was significantly higher in 180-, 240-, 300-day-old hogs from group 3 than in group 2 animals of the corresponding age and age-matched control (Fig. 1, *a*).

It was noted that peroxidase level in the blood of experimental hogs decreased from day 60 to day 240 (42.0±1.25-42.6±1.00 and 21.1±0.65-23.4±0.70 arb. units, respectively) and tended to increase to 22.8±0.90-25.4±0.70 arb. units by day 300. In control hogs this parameter was considerably higher than in group 2 and 3 (p<0.05).

Alkaline phosphatase activity markedly increased from day 60 to 120 (1.44±0.02-1.49±0.04 and 2.28±0.15-2.40±0.06 mmol/h×liter, respectively). In 300-day-old hogs of groups 2 and 3 this parameter was below the control by 3.7% (p>0.05) and 8.8% (p<0.05), respectively.

Analysis of blood glucose concentration showed that 120-, 180-, 240-, and 300-day-old hogs were superior to age-matched controls by this parameter by 1.5-5.6%, with a significant difference reached by the end of the experiments.

Hogs of 120, 180, 240 and 300 days of age from group 3 were superior to control group in blood serum acid capacity by12.7-18.2% (p<0.05-0.001). Glucose level, acid capacity and alkaline phosphatase activity in group 2 was found in between values of group3 and control.

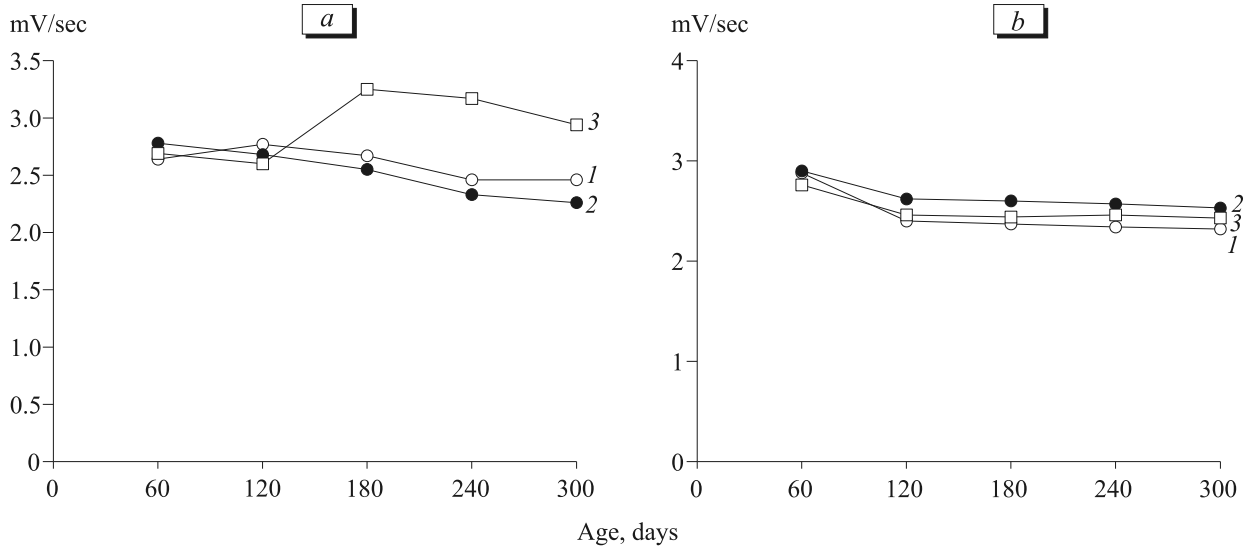

Fig. 1. Dynamics of antioxidant system activity in hogs in experimental series I (*a*) and II (*b*). *1*) group 1; *2*) group 2; *3*) group 3.

Whole calcium concentration in hogs showed wavy fluctuations in the course of the experiment (2.23±0.06-2.27±0.04 *vs.* 2.12±0.03-2.25±0.02 mmol/liter) and was higher in 240-, 300-day-old animals from group 3 by 6.0-7.1% as compared to control ($p<0.01$). Changes of inorganic phosphorus in blood serum of compared groups on the whole corresponded to that of total calcium concentration. In 240- and 300-day-old hogs of groups 2 and 3, this parameter of mineral metabolism significantly surpassed that in age-matched controls.

Thus, combined administration of Trepel and Suvar was followed by a more pronounced immunophysiological effects in comparison with Trepel alone.

In experimental series II, erythrocyte count in experimental hogs steadily increased with age from 5.18±0.05-5.23±0.06 to 5.39±0.08-5.47±0.07 mln/μl ($p>0.05$). The count of white blood cells in the studied groups gradually decreased from the beginning to the end of the experiment (21.6±0.29-21.9±0.34 *vs.* 19.7±0.15-20.0±0.14 thousands/μl) without significant difference between observation terms. The dynamics of APFC activity corresponded to the pattern of fluctuation and erythrocyte count ($p>0.05$).

Analysis of humoral immunity showed that 120-, 180-, 240-, 300-day-old hogs from groups 2 and 3 were superior to age-matched controls by hemoglobin concentration by 1.9-6.8% ($p<0.05$-0.001). The dynamics of γ-globulin level was generally in line with that of hemoglobin. The concentration of blood serum immunoglobulins in experimental hogs increased with age from 12.8±0.13-14.6±0.10 to 16.7±0.21-19.1±0.23 mg/ml and in 120-, 180-, 240-, 300-day-old hogs from experimental groups significantly exceeded the control values. It should be noted that this parameter in 180- and 240-day-old animals of group 3 were significantly higher than in group 2 animals of the corresponding age.

Analysis of protein metabolism showed that total protein content in animals of the studied groups increased from the beginning to the end of the experiment (58.2±0.30-58.6±0.58 and 62.6±0.90-66.3±1.18 g/liter, respectively); this parameter in 180-, 240-, 300-day-old hogs of group 2 and 300-day-old hogs of group 3 was significantly surpassed the control. Similar pattern was revealed for albumin fraction and total protein.

LPO activity increased in all groups from day 60 to day 120 (5.95±0.10-6.09±0.24 and 6.74±0.23-6.99±0.12 mV, respectively) and then decreased by the end of the experiment to 4.73±0.25-5.25±0.11 mV. This parameter in 120-, 180-, 240-, 300-day-old hogs of group 2 was lower than group 3 animals of the corresponding group and age-matched controls by 8.2-11.5% ($p<0.05$-0.005).

Other regularity was found for antioxidant system activity (Fig. 1, *b*): it gradually decreased with age from 2.76±0.08-2.90±0.12 to 2.32±0.04-2.53±0.04 mV/sec; in 120-, 180-, 240-, 300-day-old hogs of group 2 and 300-day-old hogs of group 3 this parameter was significantly increased compared to the control.

Blood peroxidase level in experimental hogs steadily decreased with age from 43.0±0.75-43.4±1.70 to 20.6±0.68-22.6±0.95 arb. units and was below control in animals of groups 2 and 3 at all terms of the experiment ($p>0.05$).

Analysis of carbohydrate metabolism showed that serum alkaline phosphatase activity significantly increased in compared groups from day 60 to day 120 (from 1.50±0.03-1.52±0.04 to 2.29±0.03-2.38±0.05 mmol/h×liter) with subsequent gradual decrease to 2.22±0.02-2.29±0.07 mmol/h×liter by the end of the experiment; it should be noted that in all experimental groups this parameter was lower than in the control throughout the experiment ($p>0.05$).

A different relationship was revealed for glucose concentration in experimental hogs: it steadily increased with age from 4.68±0.17-4.71±0.18 to 4.97±0.05-5.27±0.03 mmol/liter. This parameter in 240-, 300-day-old hogs from group 3 significantly surpassed the control values.

A different regularity was found for acid capacity level: in 180-, 240-, 300-day-old animals from group 2 it exceeded the control values by12.7-16.7% ($p<0.05$). Serum calcium concentration underwent similar changes: in 180-, 240-, 300-day-old hogs of group 2 this parameter surpassed the control. On the contrary, the levels of inorganic phosphorus wavy increased with age from 1.34±0.03-1.37±0.03 to 1.74±0.01-1.82±0.01 mmol/liter ($p>0.05$).

Thus, treatment with Trepel, Suvar and Polystim under biogeochemical conditions of Chuvash Center produced positive immunophysiological effects, with more pronounced immunostimulating effect observed after combined Trepel and Suvar administration and immunotropic and metabolic effects following combined Trepel and Polystim administration.

REFERENCES

1. E. S. Voronin, A. M. Petrov, M. M. Serykh, and F. A. Devrishov, *Immunology* [in Russian], Moscow (2002).
2. A. M. Dygay, E. G. Skurikhin, O. V. Pershina, *et al., Bull. Exp. Biol. Med.*, **147,** No. 5, 540-543 (2009).
3. S. B. Cheknev, *Immunologia*, No. 4, 212-215 (2006).