PAPEL DO HORMÔNIO DA TIROIDE NO ESTADO METABÓLICO E FORMAÇÃO DE CARACTERÍSTICAS ECONÔMICAS BENÉFICAS EM LEITOAS DE REPOSIÇÃO DE RAÇAS DIFERENTES

THYROID HORMONE ROLE IN METABOLIC STATUS AND ECONOMIC BENEFICIAL FEATURES FORMATION IN REPLACEMENT GILTS OF DIFFERENT BREEDS

РОЛЬ ТИРЕОИДНЫХ ГОРМОНОВ В ФОРМИРОВАНИИ МЕТАБОЛИЧЕСКОГО СТАТУСА И ХОЗЯЙСТВЕННО-ПОЛЕЗНЫХ ПРИЗНАКОВ У РЕМОНТНЫХ СВИНОК РАЗНЫХ ПОРОД

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RESUMO

Foram estudadas as peculiaridades da regulação pituitária-tireoidiana do metabolismo protéico nas porcas de reposição de diferentes raças e as correlações entre os níveis hormonais e os parâmetros sanguíneos e as características economicamente benéficas. Os grupos de teste foram formados com base nos resultados da avaliação realizada quando as leitoas obtiveram 100,00 ± 10,00 kg de peso vivo. O primeiro grupo incluiu animais Duroc (n = 30), o segundo grupo - animais Yorkshire (n = 90) e o terceiro grupo - animais Landrace (n = 15). O estudo foi conduzido por métodos de pesquisa biotecnológica, bioquímica e estatística. Ficou provado que os níveis de TSH e TSH de Duroc, Yorkshire e Landrace não foram significativamente diferentes, suas concentrações hormônais variaram dentro da faixa de 7,60±0,12 a 8,61±0,28 pmol/L e 0,02±0,001 a 0,03±0,004 μIU/ml, respectivamente . Os níveis de T4 nas leitoas Landrace foram maiores que os análogos em 27,41 e 28,91% (ρ ≤ 0,05). A taxa de bioconversão da hormona tiroideia (T3 / T4) foi avaliada pela razão TSH/T3, TSH/T4 e TSH/T3 + T4. A concentração de proteínas totais, albuminas, globulinas e coeficiente Alb/Gl variou dentro da faixa de 63,73±0,72 a 65,99±0,51, 28,56±0,34 a 29,23±0,67, 34,47±1,12 a 37,43±0,61 g/L e 0,76 ± 0,02 –0,86 ± 0,04 SU, respectivamente, e não dependiam da raça. Correlações significativas foram reveladas em Durocs entre T3 - urina (r = –0,42 ± 0,15; ≤ 0,05) e TSH - ganho de peso absoluto, tempo de desmame (r = 0,52±0,13; ≤ 0,05); em Yorkshires, T3 - proteína total (r = –0,31±0,10) e T4 - ganho de peso absoluto, tempo de desmame (r = 0,51 ± 0,08; ≤ 0,05); em Landraces, T4 - proteína total (r = - 0,68±0,14; ≤ 0,05) e T4 - idade de avaliação (r = 0,66±0,15; ≤ 0,05).

Palavras-chave: *leitoas, status hipofisário-tireoidiano, proteínas, correlação, características benéficas econômicas.*

ABSTRACT

The peculiarities of pituitary- thyroid regulation of the protein metabolism in the replacement gilts of different bred and the correlations between the hormone levels and the blood parameters and economically beneficial features were studied. The test groups were formed based on the results of the assessment that was performed when the gilts gained 100.00 ± 10.00 kg of live weight. The first group included Duroc animals (n=30), the second group – Yorkshire animals (n=90) and the third group – Landrace animals (n=15). The study was conducted by biotechnological, biochemical and statistical research methods. It was proved that Duroc, Yorkshire and Landrace gilts T3 and TSH levels were not significantly different, their hormone concentration varied within the range of 7.60±0.12 – 8.61±0.28 pmol/L and 0.02±0.001 – 0.03±0.004 μIU/ml, respectively. T4 levels in Landrace gilts were higher than in analogs by 27.41 and 28.91% (p≤0.05). The rate of thyroid hormone

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bioconversion (T3/T4) was evaluated by the ratio of TSH/T3, TSH/T4,and TSH/T3+T4. The concentration of total protein, albumins, globulins, and Alb/Gl-coefficient varied within the range of 63.73±0.72 – 65.99±0.51, 28.56±0.34 –29.23±0.67, 34.47±1.12 – 37.43±0.61 g/L and 0.76±0.02 –0.86±0.04 SU, respectively, and did not depend on the breed. Significant correlations were revealed in Durocs between T3 – urine (r= –0.42±0.15; p≤0.05) and TSH - absolute weight gain, weaning time (r=0.52±0.13; p≤0.05); in Yorkshires, T3 – total protein (r= –0.31±0.10) and T4 - absolute weight gain, weaning time (r=0.51±0.08; p≤0.05); in Landraces, T4 – total protein (r= – 0.68±0.14; p≤0.05) and T4 - assessment age (r=0.66±0.15; p≤0.05).

Keywords: *gilts, pituitary-thyroid status, proteins, correlation, beneficial economic features.*

АННОТАЦИЯ

Изучено влияние породы ремонтных свинок на гипофизарно-тиреоидный статус организма и взаимосвязь его показателей с параметрами белкового обмена, а также с хозяйственно-полезными признаками. Опытные группы сформированы по результатам бонитировки при достижении свинками живой массы 100,00±10,00 кг. В первую группу включены животные породы дюрок (n=30), во вторую – йоркшир (n=90) и в третью – ландрас (n=15). В работе использованы биотехнологические, биохимические и статистические методы исследования. Установлено, что свинки породы дюрок, йоркшир и ландрас не имеют достоверных отличий по уровню Т3 и ТТГ в крови, содержание гормонов колеблется в интервале 7,60±0,12 - 8,61±0,28 пмоль/л и 0,02±0,001 - 0,03±0,004 мкМЕ/мл, соответственно. Ландрасы превосходят дюрков и йоркширов по концентрация Т4 на 27,41 и 28,91% (p≤0,05). Однако скорость биоконверсии тиреоидных гормонов, оцениваемая по величине Т3/Т4, у дюрков и йоркширов выше, чемуландрасовна 47,37 и 31,58% (p≤0,05); величинасоотношенийТТГ/Т3, ТТГ/Т4 и ТТГ/Т3+Т4, наоборот, преобладает у ландрасов. Уровень белковых параметров в крови ремонтных свинок достоверно не зависит от породы. Концентрация общего белка, альбуминов, глобулинов и Alb/Gl-коэффициент колеблется в интервале, соответственно, 63,73±0,72 - 65,99±0,51, 28,56±0,34 - 29,23±0,67, 34,47±1,12 - 37,43±0,61 г/л и 0,76±0,02 - 0,86±0,04 усл. ед. Концентрация мочевины в крови дюрков и йоркширов превышает уровень ландрасов на 9,02 - 9,28%. У дюрков связь гормонов с параметрами белкового обмена, оцениваемая с помощью корреляций, максимально выражена в паре признаков Т3 – мочевина (r=-0,42±0,15; p≤0,05); у йоркширов Т3 – общий белок (r=-0,31±0,10); у ландрасов Т4 – общий белок (r=-0,68±0,14; p≤0,05). Корреляции между гормонами и хозяйственно-полезными признаками у дюрков имеют максимальное значение в паре ТТГ – абсолютный прирост, отъем (r=0,52±0,13; p≤0,05), йоркширов Т4 – абсолютный прирост, отъем (r=0,51±0,08; p≤0,05), ландрасов Т4 – возраст бонитировки (r=0,66±0,15; p≤0,05).

Ключевые слова: *свинки, гипофизарно-тиреоидный статус, белки, корреляция, хозяйственно-полезные признаки.*

INTRODUCTION

During the past years, a great number of specialized breeds of animals, which were characterized by higher breeding and productive abilities in comparison with Russian ones, were imported for increasing economic efficiency of pig breeding (Kovalenko and Kovalenko, 2012). Because of imposed sanctions, the possibility to renew the genetic resource of breeding animals by importing foreign breeds lost its relevance. This fact makes major pig breeding companies increase the quality of selection and breeding by using the genetic resources they have. One of the technological methods of this work is the selection of breeds for effective cross-breeding that allows for offspring productivity increase, feeding cost cuts, stress-resistance improvement (Babushkin, 2010).

The fundamental aspect of breeding is an evaluation of replacement gilts biological status, because individual animal peculiarities are, primarily, defined by the levels of cells and tissue metabolism, that are associated with the correlation between catabolic and anabolic processes in the body and represent the basis of

beneficial economic features. This dependence is specified by the genes, which determine animals productive qualities, realizing their action by means of influence on physiological and biochemical processes (Leonova *et al.*, 2013).

For this reason, blood attracts the researcher's interest as an interior factor, in particular, its chemical composition, that reflects the animal's metabolism, as well as their association with exterior and productive qualities (Burnos, 2015; Dauncey and Morovat, 1993; Fomina and Derkho, 2010; Nikolaev *et al.*, 2011; Nurbekova *et al.*, 2009).

Blood plays an important role in the hormone regulation processes because biological hormone effects in the organism are related to their lifetime in the blood system. In their turn, hormones regulate animal growth and development, taking part in the realization of genetic information. For this reason, their major part performs only certain biological functions. However, in animal organisms, including pigs, endocrine glands synthesize hormones of general metabolic action. In particular, these are thyroid hormones that regulate cells status in all organs and tissues, controlling metabolism and general energy and oxygen consumption (Alidzhanova *et al.*, 2012; Balabaev and Derkho, 2016; Baltabekova and Derkho, 2016).

At present, there is a shortage of data on thyroid hormones biological effects in pigs organism and the association of their levels with exterior and interior qualities. Most of the studies focused on the influence of feeding on hormones levels (Bao *et al.*, 2015; Dauncey and Morovat, 1993; Derzhatkina, 2015; Derzhatkina *et al.*, 2016; Li, Q. *et al.*, 2012; Li, Y. *et al.*, 2017; Senin *et al.*, 2008) or mechanisms of their influence on physiological functions of the organism (Chapel *et al.*, 2017; Gregoraszczuk, 2000; Selmi-Ruby and Rousset, 1996; Sidorenko, 2012; Zhang *et al.*, 2017). For this reason, it is relevant to evaluate thyroid status of replacement gilts of different breeds in certain economic conditions.

The rationale for this study is to evaluate the influence of the breed on pituitary and thyroid status of replacement gilts and their association with protein metabolic parameters and economical beneficial features.

MATERIALS AND METHODS

The study was conducted in 2017 on the basis of “Agrofirma AriAnt, Llc” site. The object of the study was replacement gilts of the three breeds aged 160-170 days old that gained live weight of 100.00±10.00 kg. Three groups were formed after gilts assessment for phenotypes, performance, and productive parameters. The first group included Duroc pigs (n=30), the second – Yorkshires (n=90) and the third - Landraces (n=15).

The material of the study was blood, which was sampled from vena cava cranialis. The serum was obtained by common method (Kondratikhin, 2004).

Blood serum was tested for biochemical parameters: total protein, albumins, and urine by a colorimetric method with reagent kits “Vecor-Best” (Novosibirsk, Russia). Thyroid hormone, free thyroxin,and free triiodothyronine levels were identified by the immunoenzymatic assay kits “Vec-tor-Best” (Novosibirsk, Russia). Strips were incubated in temperature-controlled shaker “ELMI Sky Line Shaker ST-3” (ELMI Ltd., Latvia) with further assessment of optical density by microplate reader – “MINDRAY MR-96A Elisa Microplate Reader” (MINDRAY Ltd., PRC). Computational method was used for estimation of total globulin (Gl = TP – Alb, g/L), protein coefficient (Alb/Gl, SU), ratio TP/urine (SU), T3/T4 (SU), TSH/T3·100 (SU), TSH/T4·1000 (SU), where TP – concentration of total protein, g/L; Alb – albumins level, g/L; T3 – concentration of free triiodothyronine, pmol/L; T4 – concentration of free thyroxin, pmol/L; TSH – concentration of thyreotropin, μIU/ml; 100 and 1000 – normalizing coefficient.

Statistical analysis included estimation of average values and their mean errors, calculation of the feature variation coefficient and correlation coefficients, defining of the mean product of standardized deviations on each feature by the “analysis package” application for Microsoft Excel. Correlation matrixes were formed for the calculations (the calculation result for correlations of one type for each pair from the numerous P variables, measured in a quantitative scale in one sampling). The analysis of the obtained data was performed by Student’s t-test. Statistical hypothesis testing was done by the critical level of significance $p \leq 0.05$.

RESULTS

Thyroid hormone synthesizing function in pigs depends on the age and physiological condition (Senin *et al.*, 2008). It is suggested that the breed influences on thyroid hormone secretion in animals.

Comparative analysis on hormone level (TSH, T3, T4) in the blood of Duroc, Yorkshire and Landrace replacement gilts allowed the authors to identify the following peculiarities of their pituitary and thyroid.

Replacement gilts TSH levels were not significantly different. TSH biological activity defines the functional activity of thyroid due to its interaction with cells membrane receptor domains (Chatterjee *et al.*, 2001; Rodriguez and Jolin, 1991; Squires, 2010). The concentration of this hormone in animals blood (Table 1) varied in the range of 0.02±0.001 – 0.03±0.004 µIU/ml. At the same time, the feature variation in the sampling barely depended on the breed and was equal to Cv=55.35 – 60.82%. Thus, the level of TSH secretion in gilts pituitary depended, primarily, not on their genotype, but on their individual peculiarities of the organism.

The results of our studies agree with other research data (Gabitova, 2009). The authors also highlighted that normal TSH level in gilts blood varied from 0.02 to 0.05 µIU/ml.

There were no statistically significant differences between gilt breeds triiodothyronine levels. However, Landraces levels exceeded Yorkshire levels in T4 levels by T4 27.41% and 28.91% ($p \leq 0.05$). At the same time, gilts blood thyroxin levels exceeded T3 levels by more than 3.59 times, regardless of the breed (Table 1).

The obtained data allowed the authors to state that free triiodothyronine in replacement gilt organism had a higher metabolism rate than thyroxin. Probably, this resulted from biological effects of thyroid hormones due to T3 action, which, according to the research data (Falk, 1997), shows better affinity with target receptors than T4. To prove this hypothesis, the authors estimated the correlation between T3/T4 for indirect evaluation of triiodothyronine biosynthesis rate by thyroxin deiodination (Balabaev and Derkho, 2017; Baltabekova and Derkho, 2017; Navarro *et al.*, 1997; Shushkevich, 2009).

The T3/T4 ratio was minimal in Landraces and equal to 0.19±0.03 SU (Table 1). The ratio in Durocs and Yorkshires was higher than in Landraces by 47.37% and 31.58% ($p \leq 0.05$). Thus, thyroxin deiodination rate in gilts from groups I and II was higher than in group III and resulted from thyroid hormone synthesizing activity. According to other research data (Dezhatkina, 2015), it reflected the rate of the main metabolism in gilts organism, including carbohydrates, fats,and proteins catabolism, tissue oxygen consumption, the activity of enzymatic reactions and energy consumption.

The results of the study agree with other researchers (Gudilin and Lazareva, 2008; Sidorenko, 2012), who also stated the relation between thyroid activity, evaluated by the T3/T4 ratio, animals physiological condition and productivity level.

It is known that the biological activity of TSH is realized within the system “pituitary – thyroid”. It defines the biosynthetic activity of thyrocytes and, consequently, the level of thyroid hormones in gilts blood. For indirect evaluation of TSH influence on thyroid hormones levels, the authors defined its ratio with these hormones.

Thus, the highest ratio values of TSH/T3, TSH/T4, and TSH/T3+T4 were observed in Landraces (Table 1). Durocs and Yorkshires levels differed from the ones in Landraces by 69.56%, 26.15%, 25.49% and 56.00%, 32.26%, 23.08% ($p \leq 0.05$), respectively. Hence, the pig breed influenced the TSH biologic activity realization rate in animals, which resulted from the differences in genotype, which define the “pituitary-thyroid” system mechanism functioning rate feedback.

Thyroid hormones in animals influence the metabolism rate, especially, aerobic, which has an impact on organism energy consumption and, consequently, on animals condition. In gilts, hormone biologic effects define, primarily, the formation and establishment of physiological systems. Naturally, this is associated with activity and targeting of protein metabolism, which is directly connected with the realization of the genetic program (protein synthesis is performed according to the information, coded in the genes by the nucleotide sequences). Besides, the protein composition of the body is one of the parameters that characterize the level and target of gilts productivity (Li, Q. *et al.,* 2012; Lodyanov and Ganzenko, 2014).

The analysis of the blood protein profile showed that the breed did not influence significantly on total protein levels in the blood (Table 1). This conclusion was confirmed by the

feature variation value in general totality (Cv=4.89–7.44%). Hence, the availability of protein for vital processes satisfied the gilts physiological needs. Probably, this parameter was rather defined by the conditions of feeding and nutrition balance in protein and essential amino acids than by the gilts breed.

Total protein level in blood characterizes the organism provision in proteins with protein substrates. At the same time, total protein in blood represents the sum of all proteins that circulate in the blood. The main protein fractions are albumins and globulins, which differ significantly from each other in physiological functions.

Thus, being highly hydrophilic, albumins take part in the regulation of water balance, maintenance of osmotic pressure and blood viscosity, and perform transport functions. They are important plastic material and, when necessary, can be used for energetic consumption as a source of free amino acids (Lodyanov and Ganzenko, 2014; Sereda and Derkho, 2014; Li, Y. *et al., 2017)*.

Replacement gilts breed did not influence significantly on albumins levels in the blood (Table 1). In other words, the animals were characterized by similar albumin synthesizing activity of hepatocytes (Table 1). Based on the fact that blood albumins transport not only low-molecular compounds but also cover the cells and tissues needs in amino acids, being their depot (Gorelik, 2015), it is suggested that growth and development processes in replacement gilts are provided by the plastic material.

Although the gilts globulins levels were not significantly different (Table 1), their levels were the highest in Yorkshire blood (37.43±0.61 g/L; Cv=15.44%), and the lowest in Landraces (34.47±1.12 g/L; Cv =12.63%). Since globulins mainly consist of protective proteins, it can be stated that Yorkshires exceeded their analogs in immune protection status.

In test groups, albumin and globulin levels in gilts blood defined the protein coefficient, which varied within the range from 0.79 to 0.87 SU (Table 1).

Urine is the main degradation product of proteins. It is produced by the liver from ammonia and is excreted by kidneys (Volkova, n.d.). The breed influenced on the urine level in replacement gilts, but not significantly. The lowest levels were observed in Landraces blood (3.76±0.24 mmol/L; Cv=24.82%). The levels in Durocs and Yorkshires exceeded the ones in their analog breed Landrace by 9.02–9.28% (Table 1).

According to other research data (Glushko *et al.*, 2016), protein, contained in feed, is spent on the gilts organism needs, defined by the genetic productivity program. Due to this fact, it can be stated that replacement gilts genotype defined the uptake and excretion rate of feeding protein. These parameters were higher in Landraces than in Durocs and Yorkshires. This conclusion agreed with the value of TP/urine, which reflected the rate of protein nitrogen retention in animals.

The results of the present study agree with other researchers results (Pavlov, 2017), that showed that proteins, being genetically controlled structures, form their pool in blood and organism cells based on the protein and essential amino acids availability, limited by the genetic merit.

It is known that thyroid hormones in animals realize their biological effects due to the presence of intracellular receptor in targetcells. It is used for controlling gene activity, transcription and mRNA synthesis (Li, Y. *et al.,* 2017; Selmi-Ruby and Rousset, 1996), which influences the activity of catalytic proteins and metabolism (Baltabekova and Derkho, 2017). For this reason, the authors defined the association between thyroid hormones levels and blood protein parameters by calculating respective correlation coefficients. The analysis of these correlations showed the following results (Table 3):

1. The number of direct correlations between the Durocs features was 50.0% of the total amount, Yorkshire – 45.23% and Landraces – 42.85%. In other words, hormones in “pituitary – thyroid” system, primarily, indirectly influenced protein metabolism in gilts, which defined parameter levels in the blood.

2. The number of significant correlations between hormones, their ratios, and protein blood parameters in Durocs was only 7.15%, in Yorkshires 30.95% and Landraces 21.42% of the total amount. Hence, the gilts breed influenced the mechanism of “pituitary – thyroid” system hormones influence protein metabolism.

Thus, statistically significant correlations were identified in the following pairs of features in Durocs: T3 – TP (r=0.39±0.16), T3 – Gl (r=0.41±0.16), T3 – urine (r=-0.42±0.15). In other

words, biological effects of thyroid hormones realized due to triiodothyronine.

The maximal amount of significant correlation coefficients was observed in Yorkshire group. They were identified in pairs of features: T3 – TP (r=-0.31±0.10), T3 – Gl (r=-0.24±0.10), T3 – urine (r=-0.21±0.10), T4 – TP (r=-0.30±0.10), T4 – Gl (r=-0.30±0.10), T4 – Alb/Gl (r=0.26±0.10), TSH – TP (r=-0.24±0.10), TSH – Gl (r=-0.30±0.10), TSH – Alb/Gl (r=0.23±0.10), T3/T4 – Gl (r=0.21±0.10), T3/T4 – Alb/Gl (r=-0.21±0.10), TSH/T3 – Gl (r=-0.23±0.10), TSH/T3 – Alb/Gl (r=0.21±0.10). It can be seen that protein parameters in blood are regulated by triiodothyronine, thyroxine,and TSH.

In Landrace group statistically significant coefficients of correlation were identified in pairs of features: T4 – TP (r=-0.68±0.14), T4 – Gl (r=-0.57±0.17), T4 – Alb/Gl (r=0.45±0.20), T4 – urine (r=-0.48±0.20), ТТГ – urine (r=-0.47±0.20), TSH – TP/urine (r=0.52±0.19), T3/T4 – TP (r=0.70±0.13), T3/T4 – Gl (r=0.50±0.19), T3/T4 – urine (r=0.48±0.20).

According to other research data (Krasnoperov *et al.*, 2013), the correlation between hormones in hypothalamic-pituitary-thyroid system and protein blood parameters results from the influence thyroid hormones on the transcriptions of numerous genes, defining the synthesis of structural and transport proteins and other substances.

Of special interest for the breeders are correlations between blood parameters and economically beneficial features because their identification allows the breeders to increase breeding efficiency. In the present study, the authors defined correlation coefficients between the hormones (T3, T4, TSH), their ratios (T3/T4, TSH/T3, TSH/T4, TSH/T3+T4) and 34 parameters that characterize beneficial economic features. Significant correlation coefficients between the studied features are presented in Table 3.

General analysis of correlations allowed the authors to identify the following peculiarities:

1. The number of negative correlation coefficients in Durocs was 46.21% from the total amount, in Landraces – 47.89%, in Yorkshires – 47.19%. In general, the gilt breed did not influence the association of thyroid hormones levels and their correlations with the studied economic beneficial features.

It should be noted that the biggest amount of negative correlations was observed between hormones ratios (T3/T4, TSH/T3, TSH/T4, TSH/T3+T4) and exterior parameters, which indicated on the absence of prognostic significance of these parameters.

2. The general amount of significant correlations in Durocs was 24.79% from the total amount, in Landraces – 28.15% and in Yorkshires – 22.69%. Qualitative comparative analysis of correlations between the breeds did not show universal interrelations. Hence, animal genotype influenced the character of pituitary and thyroid system associations with gilts growth and development processes, defining their constitutional peculiarities.

3. Correlation coefficients ranging by their values allowed the authors to identify that in Durocs the levels of T3 had the highest correlation with the average daily weight gain postweaving (r=0.42±0.15), T4 – with the absolute weight gain postweaving (r=0.42±0.15) and chest depth (r=0.42±0.15), TSH – with absolute weight gain postweaving (r=0.52±0.13).

In Yorkshire group triiodothyronine levels were characterized by the highest value of correlation coefficient with relative weight gain postweaving (r=0.34±0.09), thyroxin – with absolute weight gain postweaving (r=0.51±0.08), TSH – body weight at weaving (r=0.36±0.09) and absolute weight gain postweaving (r=0.36±0.09).

T3 levels in Landraces were better correlated with fat depth in point R2 (r=-0.49±0.20), T4 – with assessment age (r=0.66±0.15), TSH – with absolute weight gain from birth, (r=-0.55±0.18) and Pastern girth (r=-0.55±0.18).

The obtained data showed that in Duroc and Yorkshire gilts, which have a sound constitution, pituitary-thyroid system and its hormone synthesizing activity, primarily, defined productive parameters at weaving. At the same time, hormone levels in Landraces had the highest correlation with the age of gaining 100 kg: the established hormone levels and their biologic effects in replacement gilts primarily defined fat depth in point R2 and pastern girth parameters.

CONCLUSIONS:

The following conclusions were made

based on the results of the study:

1. The levels of T3 in Duroc, Yorkshire,and Landrace replacement gilts blood were not significantly different and varied within the range of 7.60±0.12 – 8.61±0.28 pmol/L and 0.02±0.001 – 0.03±0.004 μIU/ml. T4 levels in Landraces were higher than in Durocs and Yorkshires by 27.41 and 28.91% ($p \leq 0.05$).

2. The relation T3/T4 that characterized hormone bioconversion rate was higher in Durocs and Yorkshires than in Landraces by 47.37 and 31.58% ($p \leq 0.05$), respectively, and the levels of TSH/T3, TSH/T4,and TSH/T3+T4, that reflect TSH biological effects rate, are higher in Landraces.

3. Protein metabolism rate in blood in replacement gilts did not depend significantly on the breed and varied within the following ranges: 63.73±0.72 – 65.99±0.51 g/L (Cv=4.89 – 7.44%), albumins 28.56±0.34 – 29.23±0.67 (Cv=8.86 – 13.26%), globulins 34.47±1.12 – 37.43±0.61 g/L (Cv=12.63-15.44%), Alb/Gl-coefficient 0.76±0.02 – 0.86±0.04 SU (Cv=19.23-30.18%). Urine levels in Durocs and Yorkshire blood were higher than in Landraces by 9.02 – 9.28%, but the difference was insignificant.

4. The number of positive and significant correlations between hormone levels (T3, T4, TSH) and their relations (T3/T4, TSH/T3, TSH/T4, TSH/T3+T4) and blood protein parameters in Durocs was 50.00 and 7.15% from the total amount, in Yorkshires – 45.23 and 30.95% and in Landraces – 42.85 and 21.42%. The highest correlation coefficient in Durocs was in the pair of features T3 – urine (r=-0.42±0.15; $p \leq 0.05$), in Yorkshire T3 – TP (r=-0.31±0.10), in Landraces T4 – TP (r=-0.68±0.14; $p \leq 0.05$).

5. The number of positive and significant correlation coefficients between the hormones (T3, T4, TSH), their relations (T3/T4, TSH/T3, TSH/T4, TSH/T3+T4) and economical beneficial features in Durocs was equal to 53.79 and 24.79% from the total amount, in Landraces – 52.11 and 28.15%, in Yorkshires – 52.81 and 22.69%. The highest features correlation was observed in Durocs in the pair TSH – absolute weight gain postweaving (r=0.52±0.13; $p \leq 0.05$), in Yorkshires in the pair T4 – absolute weight gain postweaving (r=0.51±0.08; $p \leq 0.05$), in Landraces in the pair T4 – age of assessment (r=0.66±0.15; $p \leq 0.05$).

RECOMMENDATIONS

The data, that characterizes some peculiarities of biological passport of Duroc, Yorkshire and Landrace replacement gilts, grown on “Agrofirma AriAnt, Ltd.” site and selected by the assessment for reproduction, can be used as reference data during evaluation of gilts physical condition, as well as inbreeding.

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1. Intermediate report on the research program that included the results on evaluation of breeding animals biological status (Part 1): the description and main parameters of biological passport of breeding animals; the research program on blood parameters testing of replacement gilts used in breeding.

2. Intermediate report on the research program that included the results on breeding animals biological status evaluation (Part 2): The analysis results of replacement gilts lab tests and the description of associations between productive parameters and main parameters, that characterize biological properties of an organism.

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Table 1. *Gilts blood biochemical parameters*

Parameter	Breed								
	Group I Duroc (n=30)			Group II Yorkshire (n=91)			Group III Landrace (n=15)		
	X±Sx	Cv, %	min-max	X±Sx	Cv, %	min-max	X±Sx	Cv, %	min-max
T_3, pmol/L	8.61± 0.28	17.85	5.22-14.37	7.60± 0.12	15.33	5.18-12.59	7.66± 0.31	16.15	5.42-9.72
T_4,pmol/L	30.94± 1.99*1	35.36	14.76-59.12	30.58± 1.43*2	44.41	15.04-73.18	39.42± 1.57	44.92	18.71-64.17
TSH. µIU/ml	0.02± 0.002	60.50	0.003-0.053	0.019± 0.001	60.82	0.004-0.045	0.03± 0.004	55.35	0.003-0.048
T_3/T_4,SU	0.28± 0.02*1	33.48	0.10-0.51	0.25± 0.01*2	34.59	0.10-0.50	0.19± 0.03	48.82	0.10-0.43
TSH/T_3,SU	0.23± 0.03*1	66.92	0.03-0.88	0.25± 0.01*2	55.98	0.07-0.72	0.39± 0.06	61.92	0.04-0.73
TSH/T_4,SU	0.65± 0.07*1	54.08	0.18-1.44	0.62± 0.04*2	60.56	0.12-1.60	0.82± 0.16	74.04	0.06-1.97
TSH/T_3+T_4,SU	0.51± 0.05*1	50.94	0.13-0.99	0.52± 0.03*2	58.04	0.03-1.36	0.64± 0.11	68.40	0.05-1.42
Total protein,g/L	63.73± 0.72	6.26	51.4-69.2	65.99± 0.51	7.44	54.0-75.7	63.69± 0.80	4.89	60.00-64.80
Albumins, g/L	27.87± 0.70	13.26	21.33-33.42	28.56± 0.34	11.26	20.64-34.95	29.23± 0.67	8.86	24.08-32.92
Globulins,g/L	35.81± 0.92	14.19	19.51-45.10	37.43± 0.61	15.44	27.08-49.70	34.47± 1.12	12.63	27.50-40.50
Alb/Gl,SU	0.78± 0.04	30.18	0.52-1.63	0.76± 0.02	22.85	0.41-1.23	0.86± 0.04	19.23	0.59-1.18
Urine, mol/L	4.10± 0.18	24.22	2.32-5.83	4.12± 0.08	20.50	2.58-5.92	3.76± 0.24	24.82	2.32-5.55
TP/urine,SU	16.03± 0.90	30.60	0.92-27.84	16.41± 0.40	22.39	0.59-24.10	17.85± 1.13	24.58	11.67-27.84

Note: *1 - p≤0.05 between Duroc and Landrace, *2 - p≤0.05 between Yorkshire and Landrace, TP – total protein, SU – standard units, Alb – albumins, Gl – globulins.

Table 2. *Hormone and blood parameters correlation*

Parameter	T_3, pmol/L	T_4, pmol/L	TSH, μIU/ml	T_3/T_4, SU	TSH/T_3, SU	TSH/T_4, SU	TSH/T_3+T_4, SU
Group I Duroc (n=30)							
Total protein, g/L	0.39± 0.16*	-0.10± 0.18	0.06± 0.18	0.27± 0.17	-0.10± 0.18	0.12± 0.18	0.10± 0.18
Albumins, g/L	-0.14± 0.18	0.09± 0.18	-0.10± 0.18	-0.04± 0.18	-0.04± 0.18	-0.20± 0.18	-0.20± 0.18
Globulins, g/L	0.41± 0.16*	-0.14± 0.18	0.12± 0.18	0.24± 0.17	-0.10± 0.18	0.22± 0.17	0.20± 0.18
Alb/Gl, SU	-0.33± 0.15	0.08± 0.18	-0.10± 0.18	-0.10± 0.18	0.10± 0.18	-0.10± 0.18	-0.10± 0.18
Urine, mol/L	-0.42± 0.15*	-0.09± 0.18	-0.04± 0.18	0.01± 0.18	-0.10± 0.18	-0.03± 0.18	-0.04± 0.18
TP/urine, SU	0.08± 0.18	0.06± 0.18	0.11± 0.18	0.05± 0.18	0.12± 0.18	0.20± 0.18	0.14± 0.18
Group II Yorkshire (n=91)							
Total protein,g/L	-0.31± 0.10*	-0.30± 0.10*	-0.24± 0.10*	0.16± 0.10	-0.20± 0.10	-0.03± 0.11	-0.10± 0.11
Albumins, g/L	-0.05± 0.11	0.11± 0.10	0.12± 0.10	-0.10± 0.10	0.13± 0.10	0.08± 0.10	0.09± 0.10
Globulins, g/L	-0.24± 0.10*	-0.30± 0.10*	-0.30± 0.10*	0.21± 0.10*	-0.23± 0.10*	-0.10± 0.10	-0.10± 0.10
Alb/Gl, SU	0.13± 0.10	0.26± 0.10*	0.23± 0.10*	-0.21± 0.10*	0.21± 0.10*	0.06± 0.11	0.09± 0.11
Urine, mol/L	-0.21± 0.10*	-0.20± 0.10	-0.10± 0.11	0.05± 0.11	-0.03± 0.11	0.03± 0.11	0.03± 0.11
TP/urine, SU	0.05± 0.11	0.07± 0.10	0.01± 0.11	-0.03± 0.11	-0.04± 0.11	-0.03± 0.11	-0.04± 0.11
Group III Landrace (n=15)							
Total protein, g/L	0.37± 0.22	-0.68± 0.14*	-0.12± 0.25	0.70± 0.13*	-0.22± 0.25	0.31± 0.23	0.25± 0.24
Albumins, g/L	-0.07± 0.16	0.14± 0.25	-0.13± 0.25	-0.01± 0.26	-0.11± 0.26	-0.11± 0.25	-0.13± 0.25
Globulins, g/L	0.30± 0.23	-0.57± 0.17*	-0.01± 0.26	0.50± 0.19*	-0.09± 0.26	0.29± 0.24	0.26± 0.24
Alb/Gl, SU	-0.24± 0.24	0.45± 0.20*	-0.10± 0.26	-0.35± 0.23	-0.02± 0.26	-0.27± 0.24	-0.26± 0.24
Urine, mol/L	0.05± 0.26	-0.48± 0.20*	-0.47± 0.20*	0.48± 0.20*	-0.38± 0.22	-0.05± 0.26	-0.10± 0.26
TP/urine, SU	0.07± 0.27	0.26± 0.24	0.52± 0.19*	-0.23± 0.24	0.38± 0.22	0.21± 0.25	0.23± 0.25

Note: p≤0.05

Table 3. *Significant correlations of hormones with economic beneficial features*

Parameter	Group I Duroc (n=30)			Group II Yorkshire (n=90)			Group III Landrace (n=15)		
	T_3,pmol/L	T_4,pmol/L	TSH, µIU/ml	T_3,pmol/L	T_4,pmol/L	TSH, µIU/ml	T_3,pmol/L	T_4,pmol/L	TSH, µIU/ml
Weight at birth (g)			-0.30± 0.16	-0.30± 0.10	-0.23± 0.10			-0.40± 0.22	
Weight at weaving (kg)		0.40± 0.15	0.49± 0.14	0.29± 0.10	0.50± 0.08	0.36± 0.09			
Age at weaving (days)						0.23± 0.10		0.52± 0.20	
Absolute weight gain at weaving (kg)		0.42± 0.15	0.52± 0.13	0.32± 0.09	0.51± 0.08	0.36± 0.09			
Average daily weight gain, postweaving (g)				0.23± 0.10	0.31± 0.10			-0.42± 0.22	
Relative weight gain, postweaving (%)		0.37± 0.16	0.49± 0.14	0.34± 0.09	0.45± 0.08	0.31± 0.10			
Age of assessment (early maturation), (days)					0.30± 0.10	-0.20± 0.10		0.66± 0.15	-0.48± 0.20
Live weight (kg)	-0.31± 0.16	0.37± 0.17					-0.41± 0.21		-0.54± 0.18
Absolute weight gain from the birth, kg	-0.31± 0.16						-0.41± 0.21		-0.55± 0.18
Average daily weight gain from the birth (g)	-0.40± 0.15							-0.47± 0.20	
Average weight gain from the birth (%)								0.41± 0.21	
Absolute weight gain at weaving (kg)					-0.30± 0.10	-0.20± 0.10			
Average daily weight gain, postweaving (g)	0.42± 0.15								
Relative weight gain, postweaving (%)	0.31± 0.17	0.31± 0.16							
Chest girth behind the blade bones (cm)									-0.48± 0.19
Chest depth (cm)		0.42± 0.15			0.20± 0.10				
Chest breadth (cm)		0.39±0. 16				-0.20± 0.10			
Pastern girth (cm)								0.62± 0.16	-0.55± 0.18
Legs length index (%)		-0.31± 0.16							
Lengthiness index (%)								0.43± 0.21	
Chest index (%)	0.34± 0.18				0.20± 0.10	-0.20± 0.10	-0.45± 0.20		
Massiveness index (%)			0.30± 0.16					0.44± 0.21	-0.54± 0.18
Fat depth (in P1 point, mm)			0.34± 0.16	0.21± 0.10				-0.46± 0.20	
Fat depth (in P2 point, mm)		0.31± 0.16		0.25± 0.10	0.20± 0.10		-0.49± 0.20		
Fat depth (in P3 point, mm)					0.26± 0.10		-0.44± 0.21		

Note: p≤0.05