



*Original Contribution*

## QUANTITATIVE VARIATIONS IN THYROID HORMONES - T<sub>3</sub> AND T<sub>4</sub> -IN PIGS OF VARIOUS BREEDS, GENDER AND AGE

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### ABSTRACT

The purpose of the present study was to follow out the quantitative variations in thyroid hormones T<sub>3</sub> and T<sub>4</sub> in pigs of various breeds, gender and age. 135 pigs, 9 in each group, were included. First group – according to the age – three, four and five month-old female Danish Yorkshire pigs and four-month-old male Danish Landrace pigs. Second group – according to breed and sex, consisted of Danish Duroc /DD ♀/, Danish Duroc /DD ♂/, Danish Landrace /DL ♀/, Danish Landrace /DL ♂/, Danish Yorkshire /DY ♀/, Danish Yorkshire /DY ♂/. The third group – according to the physiological condition comprised Danish Yorkshire replacement females /R ♀/, pregnant-first half of pregnancy /Pr.Ist ½/, pregnant- second half of pregnancy / Pr. IInd ½/, lactating sows, dry and breeding sows.

The quantitation of thyroid hormones T<sub>3</sub> and T<sub>4</sub> in Danish Duroc, Danish Landrace and Danish Yorkshire pigs allowed concluding that there were gender-, age- and breed-related differences in the blood levels of these hormones.

**Key Words:** pigs, thyroid hormones, disequilibrium

### INTRODUCTION

The thyroid gland is involved in the regulation of growth, development, adaptation and productivity of farm animals (1, 2, 3, 4, 5) The level of thyroid hormone synthesis, that regulates the rate and the direction of metabolic events, determines their physiological optimum (4, 6, 7).

The data about the influence of age and gender on thyroid function provide evidence that the parameters of thyroid hormone synthesis change together with the alterations in the other elements of the endocrine chain (8, 9). One of the controlled mechanisms of the pituitary-thyroid gland system is the regulation of anabolic and catabolic processes, especially in the early periods after birth (10).

The function of the thyroid gland, occupying an essential place in the central regulation, is greatly dependent on the geographical traits of the region, the rearing technologies, the purpose of animals, the type

and biological properties of animal feeds (8, 2; 11).

The intensification of productive traits of pigs and the increasing demands in this regard imply a quantitation of thyroid hormones T-3 and T-4 as indices of the thyroid function and age- and gender-related alterations.

The studies of some authors (12, 13) on this subject provide conflicting results on the extent and the trend of changes in thyroid hormone synthesis.

Being directly related to animal productivity, thyroid hormones exert a profound systemic effect. It is manifested through reactions from the part of both entire organs and systems as well as of specific physiological functions and morphological structures (3).

A number of authors (14, 15) have investigated the relationship between productive traits of pigs and the tension of thyroid hormone synthesis. Others, recommended a differentiated examination on thyroid hormone levels with regard to their use as parameters determining the productive traits of the new pig breeds and their crosses (1, 3, 14, 15).

On the basis of all available

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information, the present research aimed to establish the quantitative variations of thyroid hormones T<sub>3</sub> and T<sub>4</sub> in pigs of various breeds, gender and age.

**MATERIAL AND METHODS**

The studies were carried out in the commercial pig holdings “Hibriden center po svinevadstvo” Ltd, Shoumen (HCS) and “Hybrid Centre Invest” Ltd, village of R. Dimitriev, municipality of Shoumen. In the study, 135 pigs, 9 in each of the following groups, were included:

- First group – HCS Shoumen; according to the age – three, four and five month-old female Danish Yorkshire pigs and four-month-old male Danish Landrace pigs.
- Second group – HCS Shoumen – according to breed and sex: Danish Duroc /DD ♀/, Danish Duroc /DD ♂/, Danish Landrace /DL ♀/, Danish Landrace /DL ♂/, Danish Yorkshire /DY ♀/, Danish Yorkshire /DY ♂/.
- Third group – HCS Shoumen; according to the physiological condition: Danish Yorkshire replacement females /R ♀/,

pregnant-first half of pregnancy /Pr.Ist ½/, pregnant- second half of pregnancy / Pr. IInd ½/, lactating sows, breeding sows.

In each of aforementioned categories of animals, 9 pigs were included.

The breeding system was free, in pens. The animals from both centres were placed under the same conditions of feeding, immunoprophylaxis and antiparasitic treatment. The blood samples were obtained from the sinus opthalmicus.

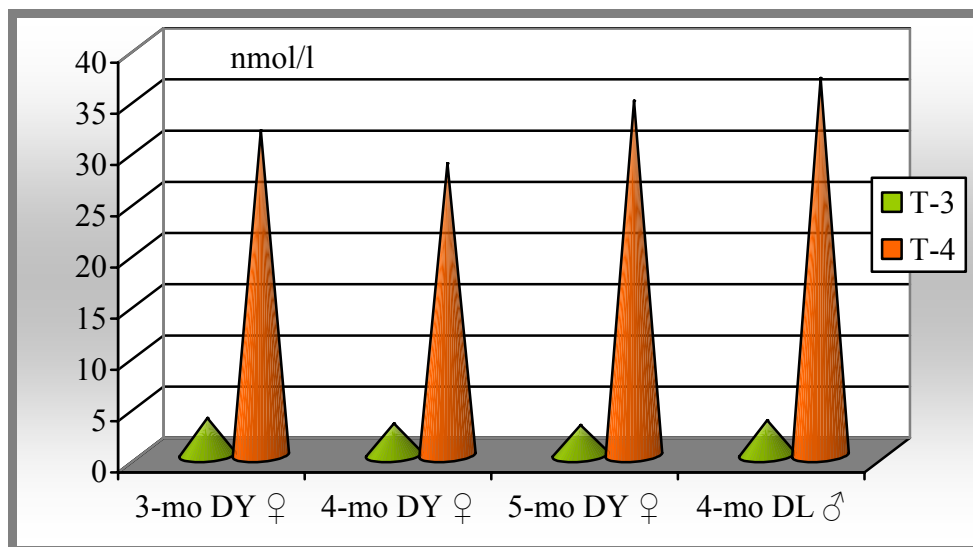
**Quantitation of thyroid hormones**

The levels of thyroxin (T<sub>4</sub>) and triiodothyronine (T<sub>3</sub>) were determined by means of commercial RIA-mat kits for radioimmune competitive analysis Thyro-com, Thyro-cap (Issokommerz).

The data were statistically processed by the Student's t-test.

**RESULTS AND DISCUSSION**

The alterations in blood T<sub>3</sub> and T<sub>4</sub> concentrations depending on the age and gender are shown on **Figure 1** and **Table 1**.



**Figure 1.** Age- and gender-related variations in blood thyroid hormones in HCS Shoumen

**Table 1.** Age- and gender-related variations in blood thyroid hormones in HCS Shoumen

Age / Parameter	3-mo ♀ DY	4-mo ♀ DY	5-mo ♀ DY	4-mo ♂ DL
	$\bar{x} \pm S \bar{x}$			
T-3- nmol/l	3.61±0.12	3.10±0.08	2.95±0.06	3.40±0.11
T-4 nmol/l	31.70±2.1	28.50±1.02	34.60±1.2	36.80±1.30

The levels of T<sub>3</sub> in introduced pigs varied between 2.95±0.6 and 3.61±0.12 nmol/l. The lowest concentrations were observed in female 3-month-old pigs (3.61±0.12) compared to 4- and 5-month old of the same

breed and gender, the differences being significant (p<0.01). Male 4-month-old pigs had T<sub>3</sub> levels of 3.4±0.11 nmol, which were significantly different from female 5-month-old pigs.

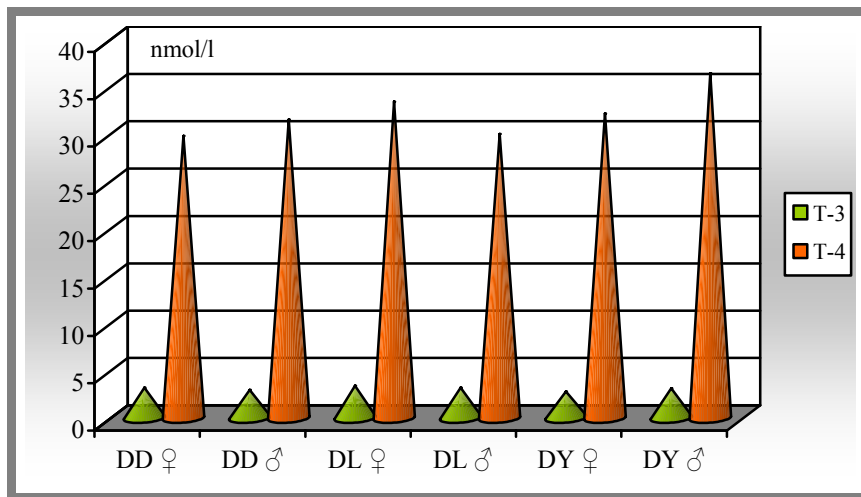
T<sub>4</sub> concentrations in female and male Yorkshire pigs ranged from 28.50±1.02 to 36.80±1.3 nmol/l. There was a significant (p<0.01) difference between 4-month-old females (28.5±1.02) and males of the same age (36.8±1.3). A similar tendency was reported as well (16); moreover, the T<sub>3</sub> levels in the Cambarrow hybrid decreased with age. The same trend was exhibited by Yorkshire pigs imported from Denmark – reduction in T<sub>3</sub> levels in females at the age of 3 months (3.61±0.12) and 5 months (2.95±0.06; p<0.01). These significant changes reflect the relationship between the level of thyroid hormones' synthesis and the age. Similar data are also reported (1, 9). In male pigs, T<sub>4</sub> concentrations were higher than in females at

the age of 3, 4 and 5 months (p<0.01), as also communicated by others (6, 5).

The parameters of thyroid hormone synthesis in both genders of Danish Yorkshire pigs are highly correlating with data of other investigators (1). At the same time, the differences in groups based upon gender- and age-related features, demonstrated a more profound influence of these factors upon the synthesis of thyroid hormones and could be interpreted as traits of the Yorkshire pig breed.

The levels of thyroid hormones in Duroc, Landrace and Yorkshire pigs in connection with the gender, are shown on **Figure 2** and **Table 2**.

**Figure 2.** Breed- and gender-related variations in blood thyroid hormones in Duroc (DD), Landrace (DL) and Yorkshire (DY) pigs; HCS Shoumen



**Table 2.** Breed- and gender-related variations in blood thyroid hormones in Duroc (DD), Landrace (DL) and Yorkshire (DY) pigs; HCS Shoumen

Age Parameter	DD ♀	DD ♂	DL ♀	DL ♂	DY ♀	DY ♂
	$\bar{x} \pm S_x$					
T-3 nmol/l	3.20±0.11	2.96±0.06	3.40±0.09	3.20±0.14	2.80±0.12	3.14±0.09
T-4 nmol/l	29.80±1.40	31.50±1.20	33.40±1.04	30.00±1.25	32.16±0.9	36.41±1.32

T<sub>3</sub> concentrations in both genders of the three pig breeds varied between 2.80±0.12 and 3.40±0.09 nmol/l. Taking into consideration the effect of breed and sex, it was found that the representatives of all three breeds possessed a rather big potential of adaptation and largely varying hormonal levels in males and females. The lowest significant values were observed in female Danish Yorkshire (2.80±0.12), and the highest in female Danish Landrace (3.40±0.09 - p<0.01). Among pigs of various gender and breeds were also significant differences: between female Danish Yorkshire and Danish Duroc (p<0.01);

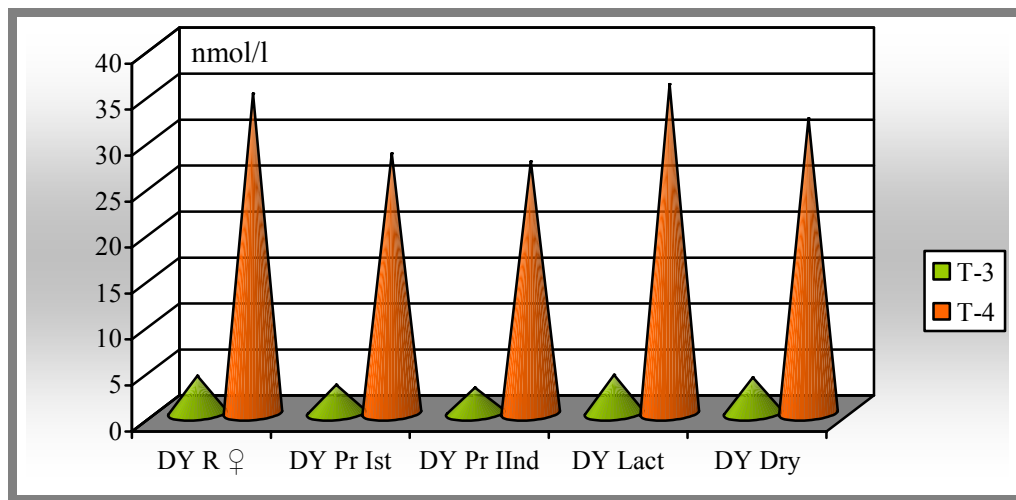
between female Danish Duroc and female Danish Landrace (p<0.01); male Danish Duroc and male Danish Landrace (p<0.01) and male Danish Duroc vs male Danish Yorkshire (p<0.01). The analysis of T<sub>4</sub> levels showed that these parameters varied within a narrower range from 29.80±1.4 to 36.41±1.32 nmol/l. The highest concentrations were measured in male Danish Yorkshire (36.41±1.32) with significant differences vs male Danish Duroc (31.50±1.20 – p<0.01) and Danish Landrace (30.0±1.25 – p<0.05). Significant differences were also established between females of different breeds: female

Danish Duroc vs Danish Landrace ( $p < 0.01$ ); female Danish Duroc vs Danish Yorkshire ( $p < 0.05$ ). The only exception was the difference between female Danish Landrace and female Danish Yorkshire that was not significant. The levels of thyroid hormones  $T_3$  and  $T_4$  observed during the present study showed considerable differences among the animals of the six groups formed on the basis of gender and breed. The other studies (1, 6) on the relationship of gender vs. age in pigs require a differentiated investigation of the

effect of rearing technology and the feeding pattern on thyroid hormonal levels in order of their utilization as control parameters of the condition of new pig breeds and their productive traits (15).

The results from the quantitation of thyroid hormones in the blood of pigs from HCS Shoumen according to their physiological state are presented on **Figure 3** and **Table 3**.

**Figure 3.** Variations in blood thyroid hormones in Danish Yorkshire pigs - HCS Shoumen, according to the physiological condition



**Table 3.** Variations in blood thyroid hormones in Danish Yorkshire pigs - HCS Shoumen, according to the physiological condition

Age Parameter	DY R ♀	DY Pr Ist	DY Pr IIInd	DY Lact	DY Breeding
	$\bar{x} \pm S \bar{x}$				
T-3- nmol/l	4.10±0.06	3.12±0.12	2.81±0.04	4.20±0.09	3.91±0.14
T-4 -nmol/l	34.80±1.12	28.30±0.96	27.40±0.85	35.80±1.21	32.10±1.14

For the Danish Yorkshire breed,  $T_3$  concentrations were found to be within  $2.81 \pm 0.04$  and  $4.20 \pm 0.09$  nmol/l, with lowest values in pregnant sows in the 2<sup>nd</sup> half of gestation ( $2.81 \pm 0.04$ ). There were significant differences between lactating sows ( $4.20 \pm 0.09$ ), dry and breeding sows ( $3.91 \pm 0.14$ ) and replacement pigs ( $4.10 \pm 0.06$ )  $p < 0.01$ ). Our results are in agreement with other reports (17). The established significant negative correlation between the changes in  $T_3$ ,  $T_4$  and milk productivity seen only in high milk-yield animals support our results.

With regard to  $T_4$  levels, they were again the lowest in pregnant sows during the 2<sup>nd</sup> half of the gestation period ( $27.40 \pm 0.55$ ) and those in the first half ( $28.30 \pm 0.96$ ). These levels were significantly different ( $p < 0.01$ )

compared to lactating sows ( $35.80 \pm 1.21$ ) and replacement female pigs ( $34.80 \pm 1.12$ ;  $p < 0.01$ ) as well as in breeding sows ( $32.10 \pm 1.14$ ;  $p < 0.05$ ).

It is known that at a tissue level, under the action of the enzyme 5' desiodase, a large part of circulating  $T_4$  is converted into the significantly more active  $T_3$  that is bound to specific receptors on the surface of cells, in the cytoplasm, mitochondria and especially in the nucleus. The physiological changes in pigs observed by us correlated with the results reported by other authors (18, 19).

The significant serum concentrations of  $T_3$  and  $T_4$  during pregnancy show that the elimination of thyroid hormones from blood plasma is much more intensive during the pregnancy than in other physiological states.

Triiodothyronine correlates strongly and positively among the animals from these physiological groups, that is resulting from the similarity in the time course of the hormone in pigs in a different physiological state and that is corresponding to data by others (18, 20).

## CONCLUSIONS

1. The analysis of blood levels of T<sub>3</sub> and T<sub>4</sub> in Danish Duroc, Danish Landrace and Danish Yorkshire pig breeds showed the presence of gender-, age- and breed-related differences in their concentrations. The highest T<sub>3</sub> levels were observed in the youngest (3-month-old) pigs, and they decreased with age whereas for T<sub>4</sub>, the contrary was true – lowest levels in the youngest, increasing with age.
2. Danish Landrace pigs exhibited the highest T<sub>3</sub> levels, whereas the Danish Yorkshire breed – the lowest. The highest blood T<sub>4</sub> concentrations were quantitated in Danish Yorkshire pigs and the lowest – in Danish Duroc pigs.
3. T<sub>3</sub> concentrations in blood were higher in female Danish Duroc and Danish Landrace and in male Danish Yorkshire, whereas T<sub>4</sub> was higher in male Danish Duroc and Danish Yorkshire and in female Danish Landrace pigs.

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