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# Fattening and meat qualities of pigs peitrain breed with dna markers

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*Analysis of fattening and meat quality of young pigs Peitrain depending on genotype polymorphism at genes RYR1 and MC4R showed that the best fattening qualities celebrated young heterozygous genotype AGNn that has the lowest age of achieving a live weight of 100 kg due to higher average daily growth . Minimum thickness of the bacon and the highest rating of the exterior and the inherent genotype GGnn GGNn.*
***Keywords:*** *fattening, meat quality, polymorphism, genotype, RYR1, MC4R.*

Introduction. The major gene QTL (quantitative trait loci - loci of quantitative traits), which in Ukraine evaluate pigs include: rianodynovoho receptor gene RYR1, prolaktynovoho receptor PRLR, estrogen receptor ESR1 and melanokortyn receptor MC4R [1-8].

In pig undesirable genetic load , causing significant economic loss industry is a mutation in the gene for the receptor - rianodin RYR1. The economic value of mutant RYR1 gene for animals is reduced through impaired quality of meat increased their deaths during transport and during cultivation , reducing resistance to adverse factors hold. However, it streschutlyvi pigs characterized by better development of the dorsal part of the carcass , reduced fat and generally higher compared to stresstiykymy animals m'yasnosti performance . Therefore , intensive breeding to enhance m'yasnosti ink is usually not accompanied by improvement of the quality of pork and can be associated with a decrease in adaptive traits of animals [1-8 ].

Melanokortyn receptor associated with the regulation of digestion, assimilation of nutrients, control of energy balance and, consequently, an increase in live weight gain . Melanokortyn receptor (MC4R or PRUM) - one of the few genes that are used in genetic diagnostics. Mutation of this gene in codon 298 resulting in replacement of aspartic acid (Asp) to asparagine (Asn), which leads to obesity [8 ]. Today in Ukraine analyze genotypes of pigs by gene melanokortyn MC4R receptor is not yet widely used in breeding. The aim of our study was to examine the MC4R gene polymorphism for species in Landrace and Large White genotypes and identifying relationships with their animal fattening qualities.

Thus, the well-known work on the distribution of the mutant allele and RYR1 gene melanokortyn MC4R receptor in swine populations of different species [1-8]. However, publications on the distribution of alleles of genes RYR1 and MC4R in pigs Peitrain ADN French selection as a fundamentally new breed for Ukraine is not enough.

**Material and methods research.** Research experiments conducted under conditions loudspeaker pedigree breeding pigs Peitrain of "Artsyz meat company" Artsyz district of Odessa region, evaluation of slaughter and meat quality - to own

the factory of the company, laboratory (DNA research , physico-chemical quality of meat) - the Institute pig breeding them. A. Kvasnitsky UAAN.

Slaughter and meat quality of pigs at slaughter determined young pigs with a live weight of 100 kg, respectively at the age of 165 days narodzhennnya in compliance with the "Methodology of evaluation of boars and sows seed in quality in terms of breeding centers and reproducers" [9]. Morphological composition of carcasses was determined by diking and right half-carcasses weighing meat, fat and bones. [9]. Determination of biometric parameters was performed by the method of M. Plohynskoho.

**Results of Trials.** RYR1- mutation of the gene responsible for streschutlyvist pigs present in the genome of animals breed Peitrain French selection «ADN». Animals with heterozygous genotype Nn are somewhat better growth and development compared with animals with homozygous genotype nn. Thus, during the execution of the experiment was found to be heterozygous animals had greater live weight at different ages (Table 1). At 2 months of age with genotype Nn pigs for RYR1- gene tended to advantage over peers with homozygous genotype nn 0.39 kg or 1.71 at % at 4 months of age with genotype Nn pigs for RYR1- gene are significantly dominated peers with homozygous genotype nn 1.7 kg or at 2,88% (P> 0,99), at 6 months of age the pigs this benefit amounted to 1.16 kg or at 1,04% (P> 0, 99), at 8 months of age this benefit amounted to 2.06 kg or 1.43 at % (P > 0.99 ).

*Table 1*

**The live weight of experimental animals at different ages, kg**

| Age, months | Groups of animals of different genotypes for RYR1-gene | | | |
|---|---|---|---|---|
| | RYR-1Nn (n=20) | Cv,% | RYR-1 nn (n=9) | Cv,% |
| 2 | 23,17±0,20 | 3,97 | 22,78±0,22 | 2,89 |
| 4 | 60,70±0,30** | 2,21 | 59,00±0,29 | 2,46 |
| 5 | 86,30±0,34** | 2,80 | 84,55±0,47 | 2,67 |
| 6 | 112,60±0,38** | 2,53 | 111,44±0,52 | 2,13 |
| 7 | 133,80±0,46** | 2,56 | 131,66±0,47 | 2,07 |
| 8 | 146,50±0,42** | 2,30 | 144,44±0,60 | 2,25 |

*P>0,95; ** P≥0,99.

In the study of patterns of growth performance replacement chicks of different genotypes (Table 2 ) found that the average daily gain of animals heterozygous RYR1 gene Nn for the period from 2 to 8 months to 9.28 g higher than animals homozygous genotype nn for RYR1 gene. For relative growth difference is absent, but the intensity was forming in animal carriers of the mutant gene to 0.04. Index voltage increase to 0.06 higher than in animals with homozygous dominant genotype. However, the uniformity of growth ( Il ) in animals nenosiyiv recessive allele was higher at 0.02.

Young pigs heterozygous genotype at RYR1 gene Nn previously reached a live weight of 100 kg per day or 2.54 to 1.51% with less feed 0.06 feed. units. or by 1.95%. Young pigs homozygous genotype at RYR1 gene nn was less than the thickness of bacon 0.15 mm or 1.55 at% (lifetime score) and increased performance assessment exterior by 0.11 points or by 2.33%.

In addition, young pigs homozygous genotype at RYR1 gene nn tended to Increased area of "muscle cells " on 4.33 cm2 or 8.6 % at less than the thickness of the bacon 6.7 oz. vertebra to 0.34 mm or 3.52% at ( postmortem evaluation). Study

*Table 2*

**Performance evaluation of growth patterns of replacement chicks**

| Indicators | Groups of animals of different genotypes for RYR1-gene | |
|---|---|---|
| | RYR1Nn (n=20) | RYR1 nn (n=9) |
| Live weight at 60 -day age , kg | 23,17±0,20 | 22,78±0,22 |
| Live weight in 180 -day age , kg | 112,60±0,58** | 111,44±0,53 |
| The average increase ( 60-180 days), g | 745,21±5,27 | 733,89±4,17 |
| The relative increase ( 60-240 days) ,% | 145,38 | 145,50 |
| The intensity of the formation of animal (Δt) | 0,14 | 0,18 |
| Indices of voltage increase (In) | 0,61 | 0,67 |
| Uniformity of growth ( il ) | 0,39 | 0,37 |
| Age achieve a live weight of 100 kg , days | 165,90±0,90 | 168,44±0,98 |
| Feed consumption , feed. U / kg increase | 3,02 | 3,08 |
| Backfat thickness , mm | 9,70±0,23 | 9,55±0,53 |
| Evaluation exterior points | | |
| - Development of the longest back muscle | 4,72±0,09 | 4,83±0,12 |
| - The development of the front and rear hams | 4,72±0,09 | 4,83±0,12 |
| Slaughter yield ,% | 73,33±0,67 | 73,67±0,89 |
| Half- length , sm | 94,67±0,33 | 95,00±0,57 |
| Backfat thickness of 6-7 oz. vertebra , mm | 9,67±0,33 | 9,33±0,33 |
| Area "muscle cells " cm2 | 50,33±1,85 | 54,66±0,88 |
| Morphological carcass composition ,%: | | |
| - meat | 72,67±0,67 | 73,57±0,53 |
| - fat | 14,67±0,33 | 13,67±0,58 |
| - bones | 12,66±0,33 | 12,76±0,33 |

of the morphological structure of the carcass revealed the advantages meat content of 0.9 %, a low content of fat by 1.0 % with almost the same content of bones. Between these genotypes have only tended to the benefits of all fattening , slaughter and meat quality in the side of a genotype as the difference between genotypes are statistically improbable .

The results of physico-chemical analysis of meat and fat pigs Peitrain (Table 3) with different genotypes for RYR1-gene indicate a lack of significant difference between the groups, but only a trend for excellence on all parameters of meat (pH tenderness, water-retaining capacity, intensity of color, loss during heat treatment, the content of dry matter, protein, fat, ash and energy values) and fat (hygroscopic moisture, melting point, with no difference in terms of the number of refraction).

*Table 3*

**The results of physico- chemical analysis of meat pigs with different genotype Peitrain for RYR1- gene (n = 3)**

| Genotype at RYR1- gene | pH | Tenderness , sec | Volohoutry muyucha power,% | color intensity units. extracted . x 1000 | losses during heat treatment ,% |
|---|---|---|---|---|---|
| RYR1Nn | 5,83±0,04 | 13,20±0,97 | 58,00±1,00 | 68,67±4,83 | 16,75±0,87 |
| RYR1nn | 5,72±0,05 | 12,22±0,76 | 57,33±1,66 | 64,06±3,77 | 17,46±0,99 |
| TS* | 5,20-5,80 | 8,30-12,20 | 53,00-64,00 | 51,00-82,00 | - |
| Chemical analysis of meat, fat | | | | | |
| Indicators | | Groups of animals of different genotypes for RYR1-gene | | | |
| | | RYR1Nn | | RYR1nn | |
| Results of chemical analysis of meat | | | | | |
| Moisture, % | | 74,27±0,67 | | 74,32±0,74 | |
| Dry matter, % | | 25,71±0,70 | | 25,68±0,81 | |
| Protein, % | | 22,94±0,51 | | 23,26±0,53 | |
| Fat, % | | 1,67± 0,24* | | 1,34± 0,22 | |
| Ash, % | | 1,10± 0,03 | | 1,08± 0,02 | |
| Energy value, kcal | | 109,58 | | 107,82 | |
| Results of chemical analysis of fat | | | | | |
| Hygroscopic moisture, % | | 8,73±0,54 | | 9,75±0,73 | |
| Melting point, $^{o}$C | | 32,30±0,25 | | 32,39±0,27 | |
| Number of refraction | | 1,461 | | 1,461 | |

* - Technological standards

Fattening and meat quality of young pigs Peitrain depending on the genotype at MC4R gene are shown in Table 4 , which shows that young pigs heterozygous genotype AG for MC4R gene tended to benefits in terms of live weight in 2 month age. Further by leveling differences in terms of body weight, which was almost equal to 6 months of age , between different genotypes for MC4R gene is no difference in performance achieving 100 kg live weight , average daily gain. However, young pigs homozygous genotype GG for MC4R gene had lower feed costs per unit increase by 0.13 feed. units. , thinner bacon to 0.88 mm or 8.24 at % ( lifetime score) and increased performance assessment exterior points or by 0.54 to 12.10 % ( all young pigs homozygous genotype GG for MC4R gene without exception, received the highest score for the longest back muscle development and front and rear hams ).

Analysis of fattening and meat quality of young pigs Peitrain depending on genotype polymorphism at genes RYR1 and MC4R showed that the best fattening qualities celebrated young heterozygous genotype AGNn that has the lowest age of achieving a live weight of 100 kg due to higher average daily growth . Minimum thickness of the bacon and the highest rating of the exterior and the inherent genotype GGnn GGNn.

*Table 4*

**Відгодівельні та м'ясні якості молодняку свиней породи п'єтрен в залежності від генотипу за геном MC4R**

| Indicators | Genotype at MC4R gene | | |
|---|---|---|---|
| | AA | AG | GG |
| n | - | 13 | 16 |
| Age achieve a live weight of 100 kg, days | | 23,15±0,28 | 22,96±0,19 |
| Average daily. increase (60-180 days), g | | 112,38±0,43 | 112,13±0,48 |
| Backfat thickness, mm | | 166,15±0,99 | 166,56±0,81 |
| Evaluation exterior points | | 743,59±4,47 | 742,96±4,22 |
| - Development of the longest back muscle | | 3,12 | 2,99 |
| - The development of the front and rear hams | | 10,69±0,26** | 9,81±0,14 |
| Age achieve a live weight of 100 kg, days | | | |
| Average daily. increase (60-180 days), g | | 4,46±0,12 | 5,00 |
| Backfat thickness, mm | | 4,46±0,12 | 5,00 |
| Примітка: ** P≥0,99 (достовірність різниці розраховувалась до бажаного генотипу GG) | | | |

**Fattening and meat quality of young pigs Peitrain depending on genotype polymorphism at genes RYR1 and MC4R**

| Показник | $\overline{X} \pm s_{\overline{x}}$ |
|---|---|
| Genotype GG nn (n=5) | |
| Age achieve a live weight of 100 kg, days | 167,80±0,86 |
| Average daily. increase (60-180 days), g | 731,67±4,85 |
| Backfat thickness, mm | 8,40±0,40 |
| Evaluation exterior points | |
| - Development of the longest back muscle | 5,00 |
| - The development of the front and rear hams | 5,00 |
| Genotype GG Nn (n=11) | |
| Age achieve a live weight of 100 kg, days | 166,00±0,65 |
| Average daily. increase (60-180 days), g | 748,11±3,14* |
| Backfat thickness, mm | 9,00±0,13 |
| Evaluation exterior points | |
| - Development of the longest back muscle | 5,00 |
| - The development of the front and rear hams | 5,00 |
| Genotype AG nn (n=4) | |
| Age achieve a live weight of 100 kg, days | 167,00±0,81 |
| Average daily. increase (60-180 days), g | 744,91±3,98 |
| Backfat thickness, mm | 11,00±0,41** |
| Evaluation exterior points | |
| - Development of the longest back muscle | 4,62±0,24 |
| - The development of the front and rear hams | 4,62±0,24 |
| Genotype AG Nn (n=9) | |

| | |
|---|---|
| Age achieve a live weight of 100 kg, days | 165,78±0,63 |
| Average daily. increase (60-180 days), g | 752,67±3,02** |
| Backfat thickness, mm | 10,56±0,34* |
| Evaluation exterior points | |
| - Development of the longest back muscle | 4,38±0,14 |
| - The development of the front and rear hams | 4,38±0,14 |

## Conclusions

When breeding pigs Peitrain at improving reproductive, fattening and meat qualities recommended to use DNA for diagnosis of swine genes RYR1, MC4R as additional selection criteria and selection of animals.

To form a special line in the herd breeds Peitrain to produce breeding animals with homozygous genotypes AA, GG for gene MC4R (for 100% of the desired allele inheritance).

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## HYGIENIC ASSESSMENT OF HEAVY METALS ON MORPHOLOGICAL STRUCTURE OF SOWS END PIGLETS

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**Abstract:** The research background levels of heavy metals (cadmium, cuprum, Plumbum, zinc, mercury ) in organs and tissues of sows, newborn piglets and their negative impact on the morphological structure of organs and tissues of pigs are given.

**State of issue:** The issue of chemical pollution of the biosphere by heavy metals are "red thread" in many areas of modern research (Israel JA, 1987, Klimenko, M., 2008). Many scientists have studied the problem of the negative impact of high concentrations of heavy metals in the body of animals (Zasyekin DA, 2004, Donnyk IM, 2008). Example, according to experts in the waters of the seas and oceans each year receive about 10 million tons of oil, domestic and industrial wastewater containing hazardous contaminants such as: Lead, mercury - that exhibit toxic effects on living organisms. Background concentrations of these substances in many places already exceeds ten times the MCL.

**Research Objective:** To study the background levels of heavy metals in the organs and tissues of sows and newborn piglets. Compare the results obtained with the maximum allowable concentration . Set action of toxicants on the morphological structure of organs and tissues of piglets.

**Materials and methods.** The material for the conducted studies were samples of tissue samples of sows and newborn piglets Ukrainian Large White breed AF "Dniester" Artsyz district of Odessa region. Content of heavy metals in the organs and tissues of animals was determined by stripping voltammetry on the device ABA-2.

**Results.** Consumption of animal feed contaminated with heavy metals contributed to their cumulation in body of sows (Table 1).

1. Contents of heavy metals in the organs and tissues of sows mg / kg (M ± m, n = 3)

| The element | Liver | Kidneys | Lungs | Heart | Spleen | Muscles | Colon | Thin bowels |
|---|---|---|---|---|---|---|---|---|
| Cd | 0,001± 0,0001 | 0,54± 0,044 | 0,04± 0,006 | 0,001± 0,0001 | 0,16± 0,008 | 0,015± 0,0025 | 0,001± 0,00004 | 0,0009± 0,0001 |
| Cu | 11,5± 0,25 | 9,3± 0,10 | 25,5± 0,42 | 1,92± 0,04 | 13,71± 0,14 | 1,58± 0,06 | 1,97± 0,08 | 1,22± 0,049 |
| Pb | 0,007± | 0,2± | 0,112± | 0,0072± | 0,097± | 0,011± | 0,0008± | 0,00011± |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 0,0006 | 0,03 | 0,008 | 0,00046 | 0,014 | 0,0016 | 0,00005 | 0,00001 |
| Zn | 20,92± 0,25 | 5,6± 0,11 | 9,4± 0,19 | 1,32± 0,06 | 76,9± 0,99 | 2,74± 0,11 | 0,80± 0,044 | 0,64± 0,054 |

The results obtained on the content of heavy metals in the body sows show the excess of cadmium in the kidneys, spleen, respectively, in 10.8 and 3.2 times, copper - the liver, kidneys, lungs and spleen 2.3; 1.8; 5.1; 2.74 times.

The latter is likely to have a negative impact on the detoxification function of the liver, metabolic processes in the body. Excess zinc was observed in the spleen by 9.8% compared to the MAC (70 mg / kg). Significant concentrations of cadmium and copper are reported in the brain, adipose tissue (Table 2).

2. Distribution of heavy metals in the lymph nodes, adipose tissue and brain of sows mg / kg (M ± m, n = 3)

| The element | Cerebrum | Fat | Lymph nodes |
|---|---|---|---|
| Cd | 0,04±0,001 | 0,042±0,0043 | 0,03±0,001 |
| Cu | 1,0±0,47 | 3,86±0,067 | 2,3±0,08 |
| Pb | 0,02±0,003 | 0,09±0,004 | 0,006±0,001 |
| Zn | 0,051±0,0055 | 88,76±0,99 | 0,12±0,0076 |

Lipidotropni properties of heavy metals indicate the possibility of maximum accumulation is particularly important in the structure of the body - the brain. Accumulation of heavy metals in the organs and tissues of newborn piglets are presented in Table. 3.

3. Contents of heavy metals in the body of newborn piglets, mg / kg (M ± m, n = 3)

| The element | Концентрація важких металів в органах і тканинах, мг/кг | | | | | | | | | | | MAC |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Liver | Kidneys | Lungs | Heart | Spleen | Cerebrum | Muscles | Colon | Thin bowels | Fat | Lymph nodes | |
| Cd | 0,0011± 0,0001 | 0,65± 0,042 | 0,05± 0,003 | 0,006± 0,007 | 0,24± 0,08 | 0,08± 0,005 | 0,012± 0,003 | 0,009± 0,0002 | 0,006± 0,0001 | 0,039± 0,006 | 0,07± 0,003 | 0,05 |
| Cu | 13,1± 0,18 | 12,1± 0,12 | 15,4± 0,12 | 3,42± 0,06 | 13,42± 0,23 | 4,0± 0,47 | 4,23± 0,12 | 3,24± 0,32 | 2,12± 0,44 | 3,22± 0,21 | 4,15± 0,21 | 5 |
| Pb | 0,04± 0,019 | 0,53± 0,12 | 0,22± 0,01 | 0,052± 0,0012 | 0,23± 0,061 | 0,54± 0,065 | 0,21± 0,042 | 0,005± 0,0008 | 0,0014± 0,0005 | 0,41± 0,031 | 0,08± 0,005 | 0,5 |
| Zn | 22,41± 0,11 | 8,97± 0,21 | 12,36± 0,67 | 10,33± 1,7 | 60,8± 4,56 | 17,4± 6,45 | 7,56± 0,44 | 6,54± 0,98 | 8,33± 0,71 | 54,22± 2,31 | 45,61± 3,61 | 70 |

Excess of cadmium in the liver , kidneys , lungs , heart , spleen of newborn piglets compared with the mother being respectively 1.17 ; 1.20 ; 0.11 ; 5.45 ; 1.5 times. There were also a significant excess of cadmium in the brain and lymph nodes of pigs respectively by 18.2 ; 20.4 times compared with the mother and the kidneys and lymph nodes 1.3 and 1.4 times, respectively MAC.

The studies found excess of copper in the liver , kidneys , lungs , spleen piglets compared with MPC 2.62 respectively ; 2.42 ; 3.08 ; 2.68 times.

Increased content of lead is registered in the kidney and brain of pigs respectively 1.06 and 1.08 times, and zinc content in the range of MAC. The level of cadmium in the kidneys, liver, spleen , lungs , fat pigs exceeded the norm by 16.2 ; 5.4 ; 15.8 ; 9.6 2.7 ; 2.4 times (0.05 mg / kg) of lead in the spleen 1.2 times (0.6 mg / kg).

Thus, the results indicate that the blood-brain and placental barriers is not an obstacle for migration of heavy metals in tissues of the foetus. Heavy metals through the placenta and blood-brain barrier pigs migrate into the body and accumulate in concentrations higher than in the mother and MAC. An important issue is the development of methods for in vivo diagnosis of intoxication of animals. We worked out options for determining intoxication on the content of heavy metals in bristle from different parts of animal skins. Vivo diagnosis by the degree of accumulation of heavy metals in pig bristle suggests that the best predictor is a month old pigs , the content of cadmium in bristle (areas grits ) which exceeded the maximum permitted limit by 6.4 times, of copper - 1.5 times, of lead - by 1,1 times.

It was determined the excess of heavy metals in the bristle of sows of different parts of the body. Thus, the bristle area of the back marked excess of cadmium 1,2 times , limbs copper - 1.4 times , band grits of lead – 2,4 times, in the head section copper exceeding by 1.2 times according to established maximum allowable level. Heavy metals accumulated in the organs and tissues of pigs affect their morphological structure. Thus, we set the focus of granular degeneration of the epithelium of the renal tubules, granular degeneration of hepatocytes of the liver of pigs , hyperplasia of the reticular tissue in the red and white pulp of the spleen of the type " granules " focus of atelectasis in the lung tissue , cellular infiltration of lymphoid elements of the lung tissue.

## Conclusions

1. It was experimentally proved the excess of cadmium in the body sows: kidney, spleen by 10.8 and 3.2 times, copper - the liver, kidneys, lungs and spleen by 2.3; 1.8; 5.1; 2.74 times respectively MAC.
2. Excess of cadmium was found in the body of piglets compared with the mother in the liver, kidney, heart, spleen, brain, lymph nodes in 1.17; 1.20; 5.45; 1.5, 18.2; 20.4 times. It was proved the highly embryotoxic effects of heavy metals.
3. Research has established degenerative changes in the spleen, lung tissue, liver, renal tubules of piglets for the actions of heavy metals.

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