Meat product normalizes serum lipid profile in the hyperlipidemia rat model

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Abstract –Meat product with *Sus scrofa* aorta and heart tissues was tested as a supporting nutrition against human cardiovascular diseases. It was shown that meat product in animal diet led to cholesterol and triglycerides decrease in hyperlipidemic rats. Moreover, on 42th day of consumption final atherogenic index reduction was 41.3% as the result of blood serum atherogenic lipoprotein fraction decrease.

Key words – pig aorta, pig heart, hyperlipidemia, lipids.

I. INTRODUCTION

Meat proteome is rich with structural (actin, myosin, troponin, etc.) and antioxidant proteins (superoxide dismutase, catalase, glutathione), glycolytic pathway enzymes (aldolase, dehydrogenase, etc.), DNA-binding (myogenic factors, DNA-lyase, etc.) and metal-binding (metallothionein, myoglobin, etc.) proteins. It is also known that gene expressed according to tissue specificity [6], which allows to consider animal proteins not only as a source of plastic material, but also as the encoded amino acid sequence including polypeptide fragments with regulatory and signaling activity [1,2,9,10,13-15]. Therefore meat by-products are a good source of tissue-specific protein and peptides with biological activity. Immune, gastrointestinal and cardiovascular organs are characterized by numerous tissue-specific proteins [3,5,7,9,11], and their biological activity has been proven *in vivo* and *in vitro* studies [3,4,8,12].

Cardiovascular diseases are still a quite sharp problem; therefore special attention is paid to the development of CVD prevention interventions, such as traditional medical treatment, smoking cessation, increased physical activity and nutrition. Previously, it was shown that *Sus scrofa* hearts and aortas tissues consumption by animals with hyperlipidemia led to a significant decrease of total cholesterol, triglycerides and atherogenic fractions of lipoproteins [3]. The greatest effect was observed in protein-peptide fraction isolated from *Sus scrofa* aortas tissues with a molecular mass less than 30 kDa, which also stimulated the endothelial layer restoration [4]. Proteomic studies revealed the presence of apolipoprotein A-1 involved in the formation of high-density lipoproteins, peroxiredoxin-1 involved in the suppression of oxidative stress, galectin-1 inducing apoptosis of T-lymphocytes in *Sus scrofa* aorta tissues and fatty acid-binding protein in *Sus scrofa* heart tissues [5].

The aim of the study was to investigate the hypolipidemic effect of meat product processed on the base of *Sus scrofa* heart and aorta tissues.

II. MATERIALS AND METHODS

Meat product for specialized nutrition was produced on ZAO "Yoshkar-Olinskiy Myasokombinat". *Sus scrofa* hearts were chopped with a particle size of 2-3 mm and salted for 12 h. *Sus scrofa* aortas were chopped with a particle size of 2-3 mm and homogenized in cutter at 3000rpm for 2-3 min. Minced hearts with the juice were quantitatively transferred in the cutter and homogenized at 3000rpm for 6-8 min (ratio of aorta to hearts 1:3). Obtained mince was packed in cans of lamister and sterilized at 115 °C, a pressure of 0.23 MPa for 40 min.

Thirty male *Wistar* rats (380±20 g) aged approximately 1 year were kept in conventional standard conditions; water and feed were available *ad libitum*. Animals were randomly divided in 3 groups: group 1 – negative control (n=10); group 2 – positive control (n=10) and group 3 – experimental animals (n=10). Animals in group 1 (negative control) got a standard chow (Labkorm, Russia) *ad libitum* during the experiment. Rat model of alimentary hyperlipidemia was developed by adding cholesterol (2.0-10.0%) and fat (10.0 - 25.5%) to the standard diet and vitamin D2 injection *per os* (35,000 IU/kg b.w.). After modeling, rats in group 2 (positive control) were fed with standard chow, in group 3 – meat product (8g/kg b.w.) with standard chow.

On the 42d day rats were euthanized in VETtech camera according to the rules of the animal welfare, blood samples biochemical investigations were taken. Biochemical investigations were carried out on automatic analyzer BioChem FC-360 (HTI, USA) according to instructions applied to measurement kits (HTI, USA). Total cholesterol, triglyceride, cholesterol low-density lipoproteins (LDL) and cholesterol high-density lipoproteins (HDL) levels were measured in rat serum. Cholesterol non-LDL and non-HDL was calculated as the difference between total cholesterol

and cholesterol LDL and HDL. Atherogenic index = (total cholesterol- cholesterol HDL)/ cholesterol HDL. STATISTICA 10.0 software was used in this study for the statistical analyses. Significant differences were tested by using two-way analysis of variance (ANOVA), followed by Newman-Keul's test. Differences with P-values less than 0.05 were considered as statistically significant.

III. RESULTS AND DISCUSSION

On 42[d] day serum cholesterol and triglyceride levels in group 2 exceeded corresponding levels in the group 1 by 35.8% (P<0.05) and 17.0%, respectively. Redistribution of lipoprotein fractions was also observed: cholesterol LDL increased by 15.5% and cholesterol non-LDL and non-HDL increased by 2.3 times (P<0.05) (figure 1).

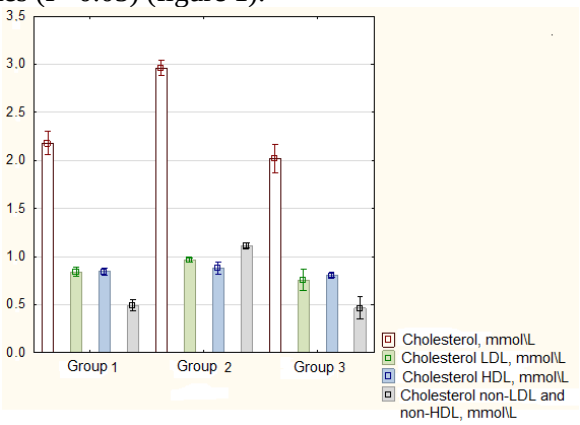

Figure 1. Effect of the diet on serum lipid profile

Incorporation into the animal diet of meat product led to cholesterol and triglycerides decrease in serum by 31.8% (P<0.05) and 28.2% (non-significant) compared to group 2 as well as cholesterol LDL, cholesterol non-LDL and non-HDL reduction by 21.6% (P<0.05) and 2.4 times (P<0.05), respectively (figure 1).

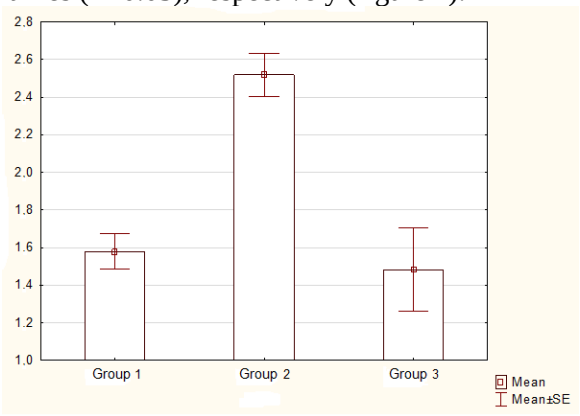

Figure 2. Serum atherogenic index

Cholesterol increase, especially atherogenic lipoproteins fractions, correlated with serum atherogenic index elevation in group 2 by 59.5% (P<0.05) compared with group 1, while in group 3 atherogenic index was by 41.3% (P<0.05) lower than in group 2 (figure 1).

Supporting nutrition is a dynamic strategy against human cardiovascular diseases. In this regard, products that could normalize lipid disorders as a main risk factor of atherosclerosis development represent a wide area for scientific research. In previous study it was shown that *Sus scrofa* hearts and aortas as well as low-molecular fractions (<30kDa) led to a significant decrease of total cholesterol, triglycerides and atherogenic fractions of lipoproteins [3,4], presumably, due to tissue-specific proteins and peptides, which was also identified [5]. In study we confirm that sterilization also led to decrease of hypolipidemic ability of tissue-specific bioactive substances. Thus, low-molecular fractions (<30kDa) were active on 14[th] day, while meat product – only on 42[nd]. Nevertheless, significant reduction was observed in cholesterol level, cholesterol non-LDL and non-HDL and serum atherogenic index. Interestingly, atherogenic index decrease was mostly corresponded to cholesterol non-LDL and non-HDL reduction. The level of cholesterol non-LDL and non-HDL characterized content of atherogenic lipoprotein fractions excluding LDL and described intermediate short-term living lipoproteins, therefore we supposed that such characteristic may be an important for lipid metabolism speed evaluation.

IV. CONCLUSION

Based on the results, the meat product made of *Sus scrofa* aorta and heart tissues demonstrated positive effects in hyperlipidemic rats due to the ability of heart and aortha tissue-specific proteins modify the lipid metabolisms and reduce the rat blood serum atherogenic index.

The developed meat product has a high potential role to low the risk of dyslipidemia and some cardiovascular diseases. Such products are more preferable in contrast to lipid lowering agents because of high cost and possible side effects.

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