ASSESMENT OF EFFICIENCY OF CHICK-PEA USE FOR SELENIUM ENRICHMENT OF STEER BEEF AND POULTRY MEAT

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Background

Interest of researchers to selenium – microelement essential for normal activity of an organism – has increased lately. Activity spectrum of selenium inside the organism is rather wide. It fulfils catalytic, structural and regulatory functions; interacts with vitamins, enzymes and biological membranes; is involved in reduction-oxidation processes; fat, protein and carbohydrate metabolism.

To enrich feeds with selenium, various selenium-containing additives, primarily organic selenium compounds, are being used widely in animal husbandry. Moreover, plants with a high content of selenium are known, such as coconuts (8100.0 μg/kg), pistachio nuts (4500.0 μg/kg), soybeans (600.0 μg/kg), wheat bran (1100.0 μg/kg), edible boletuses (1000.0 μg/kg), daily selenium requirement for man being 70 μg. Chick-pea (*Cicer arietinum L.*) has a selenium content of ~700 μg/kg (Table 1).

The main form of digestible selenium in vegetable food is selenium-methionine. It is assimilated 5-10 times better than other forms of selenium. For this reason, plants are considered the priority sources of selenium.

Objectives

The objective of these investigations was to compare the capacity of cattle and poultry tissues as well as organs to accumulate selenium of both vegetable and chemical origin.

Materials and methods

Broiler chicken and young bulls kept on feeds (42 and 90 days, respectively), containing DAFS-25TM (diacetophenonilselenide) preparation and chick peas as selenium-enriching additive, served as the object of investigations.

Samples were analyzed using the following methods:
- selenium content – by fluorimetric method;
- iron content – according to GOST (State Standard) 26928-86;
- total amino acid composition – by Mure and Shtein on LC 3000 automatic amino acid analyzer ("Eppendorf-Biotronic", Germany);
- fatty acid composition – by Folch method on HP 6890 gas chromatograph ("Hwelett Packard");
- color (a-redness) – with "Spectroton" spectrocolorimeter;
- protein, fat, moisture content, and pH – by generally accepted methods.

Results and discussion

Investigation of physical-chemical indices of poultry and beef meat did not show significant difference between test and control groups in terms of moisture, protein and ash content. However, the fat content was significantly lower in broiler chicken meat compared to beef.

As far as selenium content in muscular tissue is concerned, the groups differed from each other (Table 2). Increase in selenium content of poultry meat of the test group was found, the maximum amount being determined for meat and skin samples – by 46.7% higher, compared to the control sample, and by 14.5% higher, compared to the skinless sample. It is obvious, that selenium from chick-pea was assimilated by broiler chicken organism, and accumulated in tissues. Connective tissue, in this case, had higher accumulative capacity, in comparison with the muscular tissue.

Identical data were obtained for red meat. Fattening of Aberden Angus steers on 10 % chick peas diet also resulted in a certain increase of selenium content in muscular tissue. In three months of fattening the amount of selenium in meat of the test group became 33.8% higher than that of the control group.

For comparative study on efficiency of use of diverse-origin biologically active substances, degree of synthetic (DAFS-25, 1st test group) and natural (chick peas, 2nd test group) selenium accumulation was investigated. In the process of fattening it was established, that up to the 15-months' age steers of the 2nd test group outweighed (in live weight) animals of the control group by 19.6 kg (P>0.99), and those of the 1st test group, by 12.8 kg (P>0.95). The average daily gain in live weight of steers by groups was 926.0 ± 10.75, 967.0 ± 11.62, and 1 057.5 ± 10.24 g for the control, 1st and 2nd test groups, respectively. Yield of main carcass tissues is given in Table 3. Steers of the 2nd test group, exceeding analogues of the control and the 1st test group by 13.1 kg, or by 7.3% (P>0.99), and by 8.9 kg, or 4.8% (P>0.95), were characterized by the highest content of muscular tissue in carcasses. However, at the same time, the content of interior fat increased by 4.1 kg, or 39.8%, and by 1.8 kg, or 14.3%, respectively.

The chemical composition data reliably confirmed a higher fat content in meat samples of the 2nd test group, compared to analogues of the control and the 1st test group, by 9.9% (P>0.999) and 8.4% (P>0.999), respectively.

Results of investigations of selenium and iron content in steer meat are of interest (see Table 2). It was established that the maximum increase in selenium content (by 34%), compared to the control, was observed when fattening with chick-pea, whereas the fattening with DAFS-25 resulted in a correspondent increase of 15%. Reduction of iron level both in poultry and steer meat of test groups was surprising considering that the iron level was equal in all feeds. Results of investigations of selenium in steer liver, heart and *longissimus dorsi* demonstrated that the level of selenium content in the heart muscle, when fattening both with chick-pea and DAFS-25, was practically the same or slightly higher, in contrast to selenium level in muscular tissue, where it was increased with the increase of its ingress into the organism. Selenium level in liver of the test animals did not exceed that of the control ones. This may be an indication of non-accumulation or obtaining its optimal level even during usual fattening.

Results of investigation of color characteristics of the steer back *longissimus dorsi* after freezing, storage in the frozen state for 24 hours and the consequent defrosting showed, that during the first day the maximum value of the redness index was noted in control, and the minimum, in samples with DAFS fattening, what correlates with the data on iron content. In 3 days the above index decreased to the same level in all samples. In 5 days decrease was in progress. At the same time, the redness index of meat samples of steers obtaining feed with chick-pea was the highest, while in control samples it decreased by 62%, in samples with DAFS-25 fattening – by 54%, and in samples with chick-pea fattening – by 41%, that is, these samples were decolored more slowly, compared to the others. This may be explained by the high selenium content, which perhaps exhibited antioxidant properties.

Conclusions

Comparative evaluation of effect of diets with chick-pea and DAFS-25 selenium-containing preparation on gain in live weight, meat quality and selenium accumulation by organs and tissues of farm animals and poultry demonstrated the following:
- selenium assimilation from chick-pea was more effective, compared to DAFS-25 additive;
- the maximum selenium accumulation took place in muscular tissue;
- the presence of selenium positively affects the stability of meat colour.

In the future, further investigations on selenium influence over iron assimilation by animal organism, as well as study on technological characteristics of meat products manufactured from such meat, are planned to be carried out. In this way, a possibility of meat selenium enrichment in the animal lifetime was shown. Usage of natural selenium-containing plants is preferable in this case.

Acknowledgements

The authors thank collaborators of the North-Caucasian branch of VNIIMP for assistance in carrying out of investigations.

References

Table 1. The chemical composition of Chick-pea

Content	Mean	SD
Protein, %	23,7	0,80
Fat, %	5,0	0,15
Cellular tissue, %	4,0	0,03
Starch, %	46,4	0,39
Sugar, %	5,6	0,99
Ash, %	3,0	0,20
Moisture, %	6,9	0,12
Selenium, µg/kg	660	23,3

Table 2. Selenium content in meat of poultry and steers fed selenium-containing additives

Sample	Iron, mg/kg			Selenium, µg/kg		
	Control	Chick-pea	DAFS-25	Control	Chick-pea	DAFS-25
Chicken meat with skin	8.37 ± 1.2	6.95 ± 0.95	--	129.5 ± 3.5	190.0 ± 5.6	--
Chicken meat skinless	7.39 ± 1.2	6.33 ± 1.3	--	122.0 ± 4.2	166.0 ± 12.7	--
Beef	10.41 ± 4.03	10.15 ± 3.5	9.44 ± 1.4	183.0 ± 21.0	244.8 ± 34.7	211.0 ± 20.8

Table 3. Tissue yield from steer carcasses depending on the type of additive containing selenium

Index	Group					
	control		chick-pea		DAFS-25	
	Mean	SD	Mean	SD	Mean	SD
Slaughter mass, kg	395.8	4.1	403.1	3.95	414.6	4.27
Carcass yield, %	55.7	0.25	55.9	0.19	56.6	0.27
Fat yield, %	2.6	0.02	3.1	0.02	3.5	0.01
Bone yield, %	16.1	0.06	15.9	0.13	15.3	0.08