Carcass and edible viscera characteristics of nutrias fed the diet supplemented with selenium-enriched yeast

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Thirteen female nutrias were fed the diet, based on farm produced crops, supplemented with the organic form of selenium (0.06 µg Se/1 g DM of the diet) for 60 days, and another eleven animals received not enriched diet. 8-months-old animals were slaughtered and dressed. Carcass and edible viscera characteristics were determined. The dressing percentage was higher in the experimental group, with the strong effect for carcass yield (P=0.06). The weight of liver was significantly lower in the supplemented animals (P=0.008). Similar tendency regarding the weight of kidneys was recorded (P=0.05). Carcass yield and edible viscera weights were correlated significantly. The dietary addition of selenized yeast influenced the carcass yield and the weights of the liver and kidneys of nutria females from an extensive feeding system.

KEY WORDS: nutria / carcass / edible viscera / meat yield

The red meat industry in the United States defines a by-product as everything, except the carcass, that comes from farm animals (cattle, sheep, swine, and goat). Animal by-products can be classified as edible or inedible [17].

Nutrias, as being traditionally used for meat production in many countries, offer a set of edible slaughter by-products that include liver, heart and kidneys [2, 8]. The weight of edible viscera (EV) can be included in carcass yield (CY) calculations [9], as being compared on the basis of age, sex, slaughter time or even the color variety [2, 18].

Effect of the supplementation of small mammals' diet with organic forms of selenium (Se) has been until to-day reported only for rabbits [4]. Dietary addition of Se improved the quality and antioxidant capacity of meat but showed no significant effect on growth parameters of beef [20]. However, broiler growth and meat yield were affected with increased dietary Se content [5]. High doses of selenium enriched yeasts significantly increased the Se content in skeletal muscles, liver, heart and kidneys of lambs [11].

In rats, fed the diet with simultaneous supplementation of Se and conjugated linoleic acid (CLA) mixture, the liver weight increased probably due to fatty acid metabolites' accumulation [7, 12].

The share of EV is commonly used as indicator of meat yield [2, 9, 18]. Thus, we aimed at assessing the effect of the dietary addition of organic Se on carcass and EV characteristics in nutrias.

Material and methods

24 nutria females at 6 months of age, were chosen from the weaned population on the farm (eastern Poland) and assigned to control (C; n=11) and experimental (E; n=13) groups. Animals were kept together indoor in pens without water pool, with drinking water constantly supplied.

The experiment was carried out during autumn/winter slaughter period [2]. After an adaptation period of 10 days, the experimental diet trial was offered constantly for 60 days. The (basal) diet contained approximately (0.06 μg Se/1 g DM) of the diet.

Nutrias were fed twice per day, that is, in the morning and in the evening, exclusively with farm-produced feeds (Table 1). The organic form of selenium was supplied for experimental group as selenium-enriched yeast (SeY) (Sel-Plex, Alltech USA) in the morning. It was mixed with a steamed triticale meal (1 mg/kg of meal) and served in the amount of 80 g/animal. Additionally, grass hay was offered *ad libitum*. In the evening nutrias were fed *ad libitum* with chopped beetroots.

Table 1
Chemical composition and average daily consumption of the diet

Specification	Triticale meal	Meadow hay	Beetroots
Dry matter (%)	87.4	91.0	17.4
Crude protein (%)	17.1	16.3	1.5
Nitrogen-free extractives (%)	76.0	41.0	9.6
Crude fibre (%)	3.1	23.3	0.9
Crude fat (%)	1.7	2.3	0.1
Ash (%)	2.1	6.5	0.8
Metabolizable energy (MJ/kg)	10.2	4.4	2.4
Feed intake (g/animal/day)	80	60	80
DM intake (g/animal/day)	69.9	54.6	13.9

For slaughter, the animals were stunned using a strong electrical impulse (230 V) and bled. The slaughter was performed by the breeder in an abattoir on the farm. Liver, heart and kidneys were removed and immediately weighed. Carcasses were left overnight in +4°C and weighed.

Statistical analyses of the edible viscera weights and carcass yield of nutrias were conducted using the nonparametric Kruskal-Wallis test for comparing independent groups. PASW Statistic software ver. 18 was used. The results are presented as means ± SD. Differences were considered significant at $P<0.05$.

Results and discussion

Compared to previously reported data from extensively [1] and intensively fed nutrias [3], both experimental and control groups showed lower LW and CW values (Table 2). This tendency may indicate that the addition of organic selenium leads to decreased fat deposition in carcasses.

The different nutritive values of feed probably explain the discrepancy between female LW presented by Beutling et al. [1] and those in the present study. The level of nutrients in extensive diets, based on crop by-products, regionally varies, mainly due to the organic matter content in the soil.

Głogowski and Panas [9] described meat yield of extensively reared male and female nutrias in various age categories. They reported main higher carcass characteristics and edible viscera weights of 9 months old females than those obtained in current study, which were more similar to those from 6 months old animals. It seems reasonable to claim that recent significant decrease of the demand for pelts and meat influenced nutria diets, resulting in poorer nutritional quality of feeds, thus in slower growth of nutrias.

It should be noted that DP of nutria females from the group fed the diet supplemented with Se was higher than that in control group ($P=0.06$) and was similar to that in 7 months

Table 2
Carcass efficiency and edible viscera weights of young nutria females

Specification	LW (g)	CW (g)	CY (%)	Liver (g)	Heart (g)	Kidneys (g)
E (n=13)	3526 ±668	1950 ±407	55.1 ±2.2	106.6 ±33.5	15.0 ±5.7	14.6 ±2.4
C (n=11)	3256 ±492	1744 ±366	53.2 ±3.1	143.1 ±41.9	14.2 ±4.4	16.4 ±1.9
Statistical effect (P)	0.35	0.13	0.06	0.008	0.68	0.05

E – experimental group
C – control group
LW – live weight
CW – carcass weight
CY – carcass yield

old animals, fed high protein complete feed as reported by Cabrera et al. [3] (55.1 vs 53.2 vs 55.4, respectively). Moreover, LW and CW of the experimental group tended to be higher than those in the control (Table 2). Extensive studies on selenium supplementation of animal diets showed that the addition of the organic form of Se influenced the protein deposition in broiler tissues [5] and water holding capacity in pigs [15]. In rats, selenized feed had dose dependent effect on growth and adipose tissue content [6].

Mertin et al. [18] report for 8 months old females, fed the pelleted mixture with fresh lucerne forage (served in spring-summer) and fodder beet (served in autumn-winter), higher LW than that recorded in the present study, although CW and CY values were lower than those obtained for intensively fed nutrias (1942 vs 2650 g and 55.4 vs 49.4%, respectively), reported by Cabrera et al. [3]. The possible explanation is that not-edible slaughter by-products, such as subcutaneous or perirenal fat depots, had larger share in carcasses of animals fed diet with high energy and protein levels than those in extensive feeding regime [9]. Wang et al. [21] postulated, that Se-Y improves total digestibility of feeds in the dairy cattle by up-modulation of the activity of digestive microorganisms. This effect may be a good explanation of generally better carcass yield in the nutrias, fed selenium yeast.

Table 2 shows also the weights of the most valued EV from Se-supplemented and not-supplemented nutrias. The dietary addition of Se in extensively reared animals resulted in significantly lower ($P=0.008$) liver weight, which is generally consistent with the data presented for rats by Czauderna et al. [7]. Similar tendency regarding kidneys weight was noted ($P=0.05$).

Neville et al. [19] discussed the effects of supranutritional Se level and source in maternal diets on internal organs weights of ewes and lambs. Livers of pregnant ewes were heavier in the supplemented group, however fetal livers were unaffected ($P=0.02$ and $P\geq0.16$, respectively). Liver weight in finishing steers fed either adequate or high Se doses did not differ significantly in the study carried out by Lawler at al. [14] ($P<0.53$). Moreover, the diet based on high Se containing wheat, resulted in numerically heavier liver than those in the supplemented groups. Discrepancies in these and current study are likely explained by differing dietary intake and form, growth, physiological state, and possibly form of Se provided.

The liver metabolism in ruminants is different than that in monogastric animals. The effective processes of coprophagy and caecotrophy enable high metabolic rate in small herbivores (incl. *Caviomorpha* rodents) with rapid extraction of energy and short period of food retain in the gastrointestinal tract [13].

Recently, Lui and Baron [16] presented the concept that liver size may be regulated by function. The decrease in the functional capacity of liver causes bile acids to build up thus induces the proliferation of cells, promoting liver growth [10]. Thus it seems probable, that the poor quality of diets offered in an extensive feeding system of nutria may lead to disrupted lipid metabolism in the liver of control group, additionally increasing deposition of by-products in the organ.

Pearson's correlations, calculated for carcass traits and edible viscera weights showed some significant bounds (Tables 3-4), mostly similar to those, previously reported for young nutrias by Mertin et al. [18]. However, there were interesting differences between E and C groups. Significantly smaller liver weight in E group (discussed above) visibly

Table 3
Pearson's correlations between edible viscera weights and carcass efficiency in experimental group

	Liver	Heart	Kidneys	LW	CW	EVW	CY
Liver	1	0.244	0.773**	0.792**	0.713**	0.982**	–0.001
Heart	0.244	1	0.715**	0.641**	0.707**	0.420	0.706**
Kidneys	0.773**	0.715**	1	0.884**	0.866**	0.867**	0.421
LW	0.792**	0.641**	0.884**	1	0.989**	0.865**	0.516*
CW	0.713**	0.707**	0.866**	0.989**	1	0.803**	0.635**
EVW	0.982**	0.420	0.867**	0.865**	0.803**	1	0.135
CY	–0.001	0.706**	0.421	0.516*	0.635**	0.135	1

** – significant at P<0.01
* – significant at P<0.05
LW – live weight
CW – carcass weight
EVW – edible viscera weight
CY – carcass yield

Table 4
Pearson's correlations between edible viscera weights and carcass efficiency in control group

	Liver	Heart	Kidneys	LW	CW	EVW	CY
Liver	1	0.741**	0.810**	0.876**	0.877**	0.997**	0.752**
Heart	0.741**	1	0.824**	0.776**	0.833**	0.791**	0.804**
Kidneys	0.810**	0.824**	1	0.868**	0.888**	0.843**	0.789**
LW	0.876**	0.776**	0.868**	1	0.982**	0.892**	0.775**
CW	0.877**	0.833**	0.888**	0.982**	1	0.899**	0.880**
EVW	0.997**	0.791**	0.843**	0.892**	0.899**	1	0.780**
CY	0.752**	0.804**	0.789**	0.775**	0.880**	0.780**	1

** – significant at P<0.01
LW – live weight
CW – carcass weight
EVW – edible viscera weight
CY – carcass yield

affected the total EVW weight and resulted in quite negligible, negative correlation with CY. The correlations were generally stronger in C than those in E group, which was the likely effect of increased capacity of metabolic processes in tissues.

In conclusion, it can be stated that dietary organic Se supplementation influenced nutria meat yield. It is likely that feed conversion of supplemented animals tends more into protein than fat deposition, which can be regarded as beneficial from the consumers' point of view. However, biochemical aspects of nutria metabolism need further elucidation.

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