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COMPARATIVE EVALUATION OF QUALITY PARAMETERS OF CANNED BEAVER AND NUTRIA

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ABSTRACT

This study evaluated the chemical, physical and sensory properties of canned beaver and nutria. These animals are currently hunted not for their meat, but to reduce their numbers in the wild. The situation is complicated by the fact that both species are on the relevant lists. However, while the beaver is a protected animal, the nutria is an invasive species. This leads to complications in the application of the relevant legislation. Hunters are therefore limited in what they can do with the meat of these species. The chemical composition of the products did not differ ($p > 0.05$). Canned beaver was the darkest ($p < 0.05$) product and canned nutria the softest ($p < 0.05$). Both meat products were sensory acceptable and no off-odour or off-flavour was perceived. Canning meat is something that hunters can easily do at home, and the resulting product meets all the requirements for food safety.

Keywords: meat products, colour, texture, sensory quality, beaver, nutria

INTRODUCTION

The sustainability of food resources is an increasingly important issue today (**Qu *et al.*, 2024**). Demand for ethical and environmentally responsible food is on the rise (**Cembalo *et al.*, 2016**). Deforestation, greenhouse gas emissions and water pollution associated with traditional livestock farming (**Bonnet *et al.*, 2020**). As a result of these influences, there has been an increase in interest in the meat of wild animals, and the game meat is increasingly in demand (**Marescotti *et al.*, 2019**). Animal life in the wild is considered to be natural, and game meat is considered to be a raw material with a low carbon footprint. In terms of environmental impact, wild game hunting is comparable to organic livestock production (**Tomasevic *et al.*, 2018**). Game meat has a very good nutritional composition. Its consumption can be a substitute for meat from farmed animals in the diet (**Enns *et al.*, 2023**). From an ecological point of view, there is also an overabundance of game in many areas. In order to prevent damage to fields and forests, controlling overpopulation is a necessity in many countries (**Matilainen *et al.*, 2023**). Meat from non-traditional wild game species can be an interesting raw material for consumption and culinary processing (**Haščík *el al.*, 2024**).
In the past Eurasian beaver (*Castor fiber*) meat was a common part of the diet in European countries (**Halley *et al.*, 2020**). By the early 20th century, only a few populations remained in Europe (around 1,200 individuals) (**Capobianco *et al.*, 2023**). Since then, beavers have been strictly protected in Europe, and this protection has helped bring the species back from the brink of extinction. Currently, beavers are widespread in most European countries. As conflicts escalate, there are areas where beaver hunting is resuming in a controlled way, offering the opportunity to use beaver game (**Wróbel, 2020**).
In the past, nutria (*Myocastor coypus*) was bred in Europe for their fur and the high quality of their meat (**Martino *et al.*, 2008**). Today, nutria is considered an invasive species in the Czech Republic, and its presence in our natural environment is undesirable. Due to local overpopulation, many areas have resorted to hunting this species. This provides an opportunity to use the meat of the hunted animals (**Mikulka *et al.*, 2023**). The composition of the nutria meat is very similar to that of the rabbit (**Čuboň *et al.*, 2020**). Due to health risks, wild nutria meat may only be processed into heat-treated products (**Niewiadomska *et al.*, 2021**).
Canning meat is simple and easy and can be done in the hunter's home kitchen. This treatment will also significantly extend the shelf life of the game. Canned meat is a common and popular part of the human diet, providing a practical and durable form of high-quality and protein-rich food (**Featherstone, 2016**). Since its origin over 200 years ago, the canning process itself has evolved significantly, both in terms of production technology and the sensory and nutritional properties of the final product (**Watts, 2024**). The main objective of preservation is to ensure commercial sterility, which is understood as the absence of microorganisms with the ability to grow in the food under normal non-refrigerated conditions and the absence of microorganisms that cause alimentary diseases (**Diep *et al.*, 2019**). A common practice involves a sterilization process by heating the food directly in a hermetically sealed container (**Rodrigo *et al.*, 2016**). However, tyndallisation is better suited to preserving meat under home conditions. Tyndallisation is a method in which food undergoes repeated cycles of heating, with intervals of rest between each cycle. The traditional approach involves three rounds of heat treatment with a temperature not exceeding 100°C. To reach these temperatures, you can use a normal cooking pot, which everyone has at their disposal. This method effectively inactivates microorganisms in vegetative form and removes most thermotolerant spores (**Keratimanoch, 2022**). The canned meat can then be stored for long periods of time at normal room temperature without the need for refrigeration, maintaining the original quality (**Featherstone, 2016**). The aim of the study was to evaluate canned beaver and nutria meat that can be produced under home conditions and to provide a suitable meat product with extended shelf-life.

MATERIAL AND METHODS

This paper evaluates the quality parameters of canned beaver and nutria meat in terms of chemical composition, colour, texture, and sensory analysis. The aim of this article was to present an ideal alternative recipe for the finalisation of the meat of these species and to compare the quality parameters with a recipe containing beef, the traditional ingredient of this meat product.

Canned meat production

Wild animals were shot in the Pohořelice region in February-March 2023. The hunting and subsequent handling of the Eurasian beaver, an especially protected species, was carried out in accordance with all legal regulations. The beaver individuals were hunted in order to regulate the species in an area where it causes significant ecological and economic damage, on the basis of a permit issued by the Regional Authority of the South Moravian Region, Department of the Environment (JMK 107931/2020). Wild nutria may be hunted throughout the year based on Law No 364/2021 Coll.
Animals were hunted and eviscerated as quickly as possible, no later than one hour after killing. Subsequently, in accordance with Regulation (EC) No 853/2004, the carcases and internal organs were inspected by a trained person. The carcasses were then cooled to below 4°C and were transported to the Mendel University in

Brno on the second day at the latest. The carcasses were then refrigerated at 4°C for 4 days. After 4 days the carcasses were skinned and deboned at the Department of Food Technology (Mendel University, CZ22067) and lean meat was obtained from beaver and nutria thighs. The pork and beef used in production came from a local slaughterhouse.
The recipe and production process were chosen so that the canned meat can be made in the hunter's home. The canned meat was prepared in two 3 kg batches at the Meat Pilot Plant CZ22067 of the Mendel University in Brno (approved by the State Veterinary Administration, Czech Republic) according to the recipe (Tab 1). Meat products made according to this recipe may be called canned beaver or canned nutria according to Decree No 69/2016 Coll., as they contain more than 50% meat of the species concerned. Lean beef (contains less than 5% of fat from adipose tissue), lean beaver (contains less than 5% of fat from adipose tissue), or nutria (contains less than 5% of fat from adipose tissue), fatty pork (contains 50% of fat from adipose tissue) and pork rind were cut into smaller pieces by hand, mechanically minced into 8mm pieces (TMP 23-98, Braher, Spain) and mixed with salt and spices (RC-100, MAINCA, Spain). The minced meat was then filled by hand into cleaned 250 ml oval glass jars. All jars were sealed, and heat treated in a steam convection oven at 85°C for 2.5 hours and then rapidly cooled to below 20 °C. After 24 hours, the jars were reheated (85°C for 2 hours) in a convection steam oven and cooled to below 4 °C. After 3 days of storage, samples were taken for analysis.

Table 1 Canned meat recipes (kg.100 kg^{-1})

	Canned Beef	Canned Beaver	Canned Nutria
Lean beef meat	51.0	0.0	0.0
Lean beaver meat	0.0	51.0	0.0
Lean nutria meat	0.0	0.0	51.0
Fatty pork	41.5	41.5	41.5
Pork rind	5.4	5.4	5.4
NaCl	1.8	1.8	1.8
Crushed pepper	0.1	0.1	0.1
Crushed caraway	0.3	0.2	0.2

Chemical analysis

Water content (g.100g^{-1}) (**AOAC, 2005a**), fat content (g.100g^{-1}) (**AOAC, 1996**), protein content (g.100g^{-1}) (**AOAC, 2002**), and salt content (g.100g^{-1}) (**AOAC, 2005b**) were determined after homogenisation of the 250 g sample for each group. All analyses were performed in triplicate to increase the precision and reliability of the results.

Colour measurement

Differences were determined using the CIELAB colour space. The CM 3500d spectrophotometer (Konica Minolta, Japan) was used for the measurement of L*, a* and b*. Samples were measured (D 65, 6500°K) on the fresh cut across the centre of the product SCE (Specular Component Excluded) and an 8 mm slit in triplicate.

Texture measurement

The textural properties of the canned meat were measured using a TIRATEST 27 025 texture analyser (TIRA Maschinenbau GmbH, Germany). Samples were tempered to 20°C. The jars were opened, and 1 cm of the top layer was removed. The surface was then levelled. The analysis was performed using a MORS knife with a crosshead speed of 100 mm.min^{-1} and penetration to 10 mm.

Sensory analysis

The analysis was carried out in the sensory laboratory of the Mendel University in Brno, which complies with ISO 8589 standards. The samples were presented in a closed state on white plates tempered to room temperature (20°C) and labelled with randomly generated three-digit numbers. Each evaluator opened each sample, removed the entire contents of the jar, and continued the evaluation. Bread and tap water were served for neutralization. Samples were assessed by a panel of 10 trained assessors in accordance with ISO 8586-1. For all descriptors, an unstructured line scale of 100 mm was used, with anchor points at the two ends of the line scale. The following attributes were hedonically rated: overall appearance, odour, colour, chewiness, tenderness, juiciness, and flavour (0 points for an unsatisfactory sample, 100 points for an excellent sample). In addition, the intensity of the off-odour and off-flavour was assessed (0 points absent, 100 points very strong).

Statistical analyses

The data were sorted, and normality was tested using the Shapiro-Wilk test. Subsequently, analysis of variance (one-way ANOVA) and Tukey's test were used to compare groups of samples in STATISTICA 14. The differences were considered significant at the 95% confidence level ($p < 0.05$).

RESULTS AND DISCUSSION

The approximate composition of canned meat products is shown in Tab 2. The highest average amount of protein was measured in the product made from beaver meat. Canned beaver contained an average of 0.8% more protein than the beef control and 0.85% more than canned nutria. However, these differences are not statistically significant ($p > 0.05$). The lean meat of the beaver contains the highest amount of protein in its raw state, so this fact is also reflected to a certain extent in the resulting meat products (**Florek *et al*., 2017; Saadoun and Cabrera, 2019; Baik *et al*., 2023**). There are also small differences in fat content between the samples. The least fat was measured in canned beaver. However, even this difference was not statistically significant ($p > 0.05$).

Table 2 Chemical analysis results of canned meat (g.100 g^{-1})

	Canned Beef ($\bar{x} \pm SD$)	Canned Beaver ($\bar{x} \pm SD$)	Canned Nutria ($\bar{x} \pm SD$)
Water	59.54 ± 2.21	58.18 ± 2.81	59.15 ± 2.28
Fat	21.95 ± 2.23	19.38 ± 3.12	22.15 ± 2.21
Protein	16.73 ± 2.32	17.53 ± 1.95	16.68 ± 2.27
NaCl	2.02 ± 0.18	1.98 ± 0.22	2.04 ± 0.16

Legend: Values with different superscripts in the same row indicate significant differences ($p < 0.05$).

In fact, when it comes to influencing the purchasing decisions of consumers, the colour of meat products plays an important role (**Ranucci *et al*., 2019**). According to the colour measurements (Tab 3), there is a variance between the samples. Canned nutria is significantly lighter ($p < 0.05$) than canned beef and beaver. Canned beaver is the darkest of all samples. L* values of canned beaver reached the average value 39.11 ± 0.01. This corresponds to the dark colour of beaver raw meat (**Florek *et al*., 2017**). Statistical analysis revealed no difference in redness (coordinates a*) between samples ($p > 0.05$). Canned nutria had the highest yellowness value (coordinates b*) 14.08 ± 1.03. The sample with the nutria meat was therefore the one with the most pronounced yellow colour and was different from the other two products ($p < 0.05$). These values in turn reflected the colour characteristics of the raw nutria meat used for each sample (**Hernández *et al*., 2016; Florek *et al*., 2017; Saadoun and Cabrera, 2019**). According to the results of the sensory analysis (Tab 4), the colour of the beaver product was rated as the best and the colour of the nutria product as the worst ($p < 0.05$). This means that the darker coloured product was found to be the most acceptable by the sensory evaluators.

Table 3 Colour and texture analysis results of canned meat

	Canned Beef ($\bar{x} \pm SD$)	Canned Beaver ($\bar{x} \pm SD$)	Canned Nutria ($\bar{x} \pm SD$)
L*	51.78 ± 0.01^{b}	39.11 ± 0.01^{c}	58.93 ± 1.51^{a}
a*	7.60 ± 0.01	6.43 ± 0.01	6.37 ± 0.83
b*	11.81 ± 0.01^{b}	10.08 ± 0.02^{b}	14.08 ± 1.03^{a}
Shear force (N)	5.69 ± 0.82^{a}	5.98 ± 1.52^{a}	4.45 ± 0.81^{b}

Legend: Values with different superscripts in the same row indicate significant differences ($p < 0.05$).

The determination of the textural properties (Tab 3) showed that the product with the 51% of nutria meat was the one with the least resistance to the knife. This product was therefore demonstrably softer ($p < 0.05$) than the other products. However, in the sensory analysis (Tab 4), compared to the other products, this had neither a positive nor a negative effect on the evaluation of this product. On the other hand, the evaluators still found some differences in the textural sensory descriptor (tenderness). According to their evaluation, the canned beaver scored the highest in the descriptor of tenderness ($p < 0.05$).

Table 4 Results of sensory analysis of canned meat

	Canned Beef ($\bar{x}$ ± SD)	Canned Beaver ($\bar{x}$ ± SD)	Canned Nutria ($\bar{x}$ ± SD)
Overall appearance	75.50 ± 2.22[b]	90.50 ± 2.23[a]	66.25 ± 3.30[c]
Odour	69.50 ± 10.08	72.00 ± 9.63	71.50 ± 9.88
Colour	68.25 ± 4.71[b]	79.75 ± 5.22[a]	42.50 ± 3.08[c]
Chewiness	92.00 ± 4.16[a]	73.50 ± 5.29[b]	90.25 ± 4.71[a]
Tenderness	46.75 ± 2.75[b]	51.50 ± 2.39[a]	50.00 ± 2.63[ab]
Juiciness	48.00 ± 2.81	51.50 ± 2.69	49.72 ± 3.26
Flavour	71.25 ± 9.00	73.75 ± 1.96	73.00 ± 8.80
Off-odour	2.50 ± 1.29	3.25 ± 0.96	3.50 ± 1.49
Off-flavour	4.00 ± 0.81	4.00 ± 0.82	2.00 ± 1.41

Legend: Values with different superscripts in the same row indicate significant differences ($p < 0.05$).

In addition to the differences in colour and texture of the products mentioned above, the sensory analysis revealed differences in the overall appearance of the samples. The beaver product was the best rated with an average score of 90.50 ± 2.23 points, while the nutria product had the worst average score of 66.25 ± 3.30 points ($p < 0.05$). Flavour is also one of the most important descriptors evaluated. All products had a hedonic score above 70 points. This means that they were all rated quite positively, and no significant differences were found between them ($p > 0.05$). **Żochowska-Kujawska *et al.* (2016)** published that the addition of 20 to 40% beaver meat has a positive effect on the flavour of meat products. Our results showed that even the addition of 51% beaver meat had a pleasant effect on the sensory characteristics of the canned meat, and no off-odour or off-flavour were perceived. Nutria meat was sensory evaluated as neutral, without strong flavour and odour and it can be compared to pork (**Tůmová *et al.*, 2021**). The nutria meat product was only rated worse for overall appearance and colour ($p < 0.05$). For the other descriptors of interest, there was no difference between the control and the nutria product ($p > 0.05$).

CONCLUSION

Preserving by heat sterilization is still a generally known and applicable method among the public, especially from a food safety point of view. To prevent damage to fields and forests, it is essential to control overpopulation of beavers and especially nutrias. One way of making game meat more accessible to consumers could be to process it into meat products with a longer shelf-life. Canning beaver and nutria proved to be a good way of processing raw meat from both species into meat products. It is also easy for hunters to do at home and the resulting product meets food safety requirements. The sensory evaluation of products containing 51% beaver or nutria meat was good and no off-flavour or off-odour was perceived.

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