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SHORT COMMUNICATION

**Barbara Jankowska · Tomasz Żmijewski · Aleksandra Kwiatkowska · Wladyslaw Korzeniowski**

# The composition and properties of beaver (*Castor fiber*) meat

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**Abstract** We analyzed the meat composition of ten females and seven males of sexually mature European beavers (*Castor fiber* L.). Cutting yield, percentage of particular elements, and chemical composition of the meat were determined. On average, a beaver carcass constitutes 48.6% of beaver body mass and contains 62.8% of meat, 14.5% of fat and 22.4% of bones. The thigh was found to be the largest and most valuable element constituting 33.4% of carcass weight and containing 66.7% of meat. Beaver meat has a high concentration of protein (20.9–21.8% wet wt.) and minerals (1.27–1.31%). The fat was characterized by a high proportion of polyunsaturated fatty acids (48.0–53.1%).

**Keywords** Beaver · Carcass composition · Meat composition · Collagen · Fatty acids · Iron

## Introduction

Meat from hunting animals has always been attractive to consumers and, due to its special flavor, has been recognized as a perfect culinary raw material—free from growth stimulators, antibiotics, hormones and other additives. Wild animals feed on natural food rich in herbs, minerals and other components that have a favorable effect on the meat's flavor, and its dietetic and nutritional value (Strmisková and Strmiska 1992; Uherová et al. 1992; Mojto et al. 1993; Berrisch-Hempen 1995; Bandick and Ring 1996; Dzierzynska-Cybulko and Fruzinski 1997). Besides using meat of common game species, which is very popular and consumed in larger quantities, in some regions of the world there is a tradition of consuming beaver meat (Appavoo 1991; Dziecioowski 1996; Fischer et al. 1997). Detailed information on the use of beaver meat has, however, so far been obtained only for beavers bred in captivity (Korzeniowski et al. 1999, 2001).

The population size of beavers in Poland is over 12000 animals. Especially high numbers (over 7000 individuals) are reported from the North-East of Poland (Korzeniowski et al. 2001). In Poland, wild beavers are culled in larger numbers, which enables the collection of material for carcass evaluation and meat composition.

B. Jankowska (✉) · T. Żmijewski · A. Kwiatkowska
Chair of Meat Technology and Chemistry,
University of Warmia and Mazury in Olsztyn, plac Cieszynski 1,
10-726 Olsztyn, Poland
E-mail: barbara.jankowska@uwm.edu.pl
Tel.: +48-89-5233295

W. Korzeniowski
Higher School of Suwalki and Mazury,
ul. Sklodowskiej 5, 16-400 Suwalki, Poland

## Materials and methods

Ten females and seven males, sexually mature European beavers (>1.5-year old) were analyzed. The culled animals were weighed, skinned and eviscerated. The head was removed at the atlas joint, the paws (at the wrist and tarsal joints) and the tail fin were also removed. Carcasses were cooled to 4°C and longitudinally divided into halves. Right semi-carcasses were further analyzed and divided into five elements, namely, thigh, flank, loin, shoulder, and tail. The thigh was cut off between the last lumbar and the first sacral vertebra and along the muscles to maintain anatomic integrity. The shoulder included the system of muscles and bones of the front limb. The loin was cut out from the rear along the thigh cut and 1 cm below the edge of the *m. longissimus dorsi* from the lower center. The tail was cut after the last sacral vertebra. Each element was further separated into meat, bones, and fat. The percentages of particular elements in the beaver body post mortem and the carcass mass were determined as well as the percentage of meat, bones and fat in each element. The contents of basic chemical components and collagen, fatty acids, and iron were determined in the meat obtained from the selected elements. Energy content of meat was calculated based on the concentration of protein and fat.

The following concentrations were determined: water, using the standard method (AOAC 24.0003, 1975); crude protein, Kjeldahl method with a conversion factor of 6.25 (AOAC 24.024, 1975); fat, Soxhlet method with petroleum ether as a solvent (AOAC 24.005, 1975) and minerals (AOAC 24.006, 1975). The collagen content was determined based on the level of hydroxyproline, using a hydroxyproline-collagen conversion factor of 7.25 (Blomfield and Farrar 1964). Fatty acid analysis was carried out by gas chromatography on samples extracted with the method of Folch (1957). Fatty acids were methylated (Peisker 1964) using a chloroform: methanol: sulfuric acid mixture (100:100:1) with margaric acid as an internal standard. For chromatography we used a gas chromatographer PYE Unicam Series 104 with a flame-ionizing detector (FID) and a system of duplex columns. Argon flow rate was 40 ml/min. Iron content of the meat samples was determined after wet mineralization in a nitrogen and peroxychloride acid mixture (3:1) in an aluminum and electric heating block with temperature control (Digestion System 20 by Tecator). The ASA method was used in the atomic absorption spectrometer AT Unicam 939. The solar spectrophotometer was equipped with an ADAX data station, background correction and a proper cathode lamp (Whiteside and Miner 1984). Energy values were calculated with the use of individual energy factors for protein 4.00 kcal (16.78 kJ) and fat 9.00 kcal (37.62 kJ). The values given for carcass composition refer to fresh mass.

Results were compared statistically with the Student–Newman–Keuls test.

## Results and discussion

Mean body weight of the 17 beavers was 18846 ± 3596 g (mean ± standard deviation); there were no differences in the body mass between the males and the females (18998 ± 3501 and 18628 ± 3732 g). Mean carcass mass after skinning, evisceration, and removal of head, paws, and fin tail was 9154 ± 1790 g, which was 48.6% of the post mortem animal body weight (Table 1). Thus, the carcass yield for wild beavers was about 6% lower than for farmed beavers (Korzeniowski et al. 2002). This difference was caused by the lower amount of subcutaneous fat in the wild beavers and the fact that the alimentary tract of the shot animals was filled, which increased the total body mass.

The thigh was the largest carcass element, constituting over one-third of its mass, similar to other hunting animals (Meyer-Ravenstein et al. 1990; Drozd and Gruszczycki 2000; Żmijewski and Korzeniowski 2000). It weighed on average 3062 g (33.44% of carcass mass). Other elements can be arranged in the following order with respect to size: flank, loin, and a shoulder. The tail was the smallest element. It weighed on average 684 g (7.5% of carcass mass). The most valuable elements of wild animal meat, the thigh and the loin, constituted together 53.1% of body mass. The percentage of the above elements in the wild beaver carcasses was greater than in the farm animal carcasses due to the more developed musculature of the former (Korzeniowski et al. 2001).

**Table 1** Mass and percentage of beaver elements in carcass (mean ± standard deviation)

| Specification | Mass (g) | Percentage (%) | |
|---|---|---|---|
| | | In body | In carcass |
| Beaver post mortem | 18846 ± 3596 | 100 | – |
| Carcass | 9154 ± 1790 | 48.57 | 100 |
| Thigh | 3062 ± 800 | 16.26 | 33.44 |
| Flank | 2362 ± 636 | 12.54 | 25.80 |
| Loin | 1798 ± 560 | 9.54 | 19.64 |
| Shoulder | 1242 ± 327 | 6.60 | 13.56 |
| Tail | 684 ± 217 | 3.62 | 7.48 |

Meat yield was highest in the thigh and declined in the order thigh, flank, loin, shoulder, and tail (Table 2). The amount of meat obtained from particular carcass elements was determined by the size of those elements. Loin was found to have the lowest percentage of fat (0.85%). The thigh and shoulder had significantly higher and similar contents of fat—ranging from 9.95% to 12.08%. However, an almost 3-fold higher content of fat was found in the tail (32.08%) and flank (25.29%). In the tail, the fat tissue formed a covering layer, and in the flank this tissue combined with connective tissue membranes to form layers overgrowing muscles, which reduced its culinary quality. The beaver carcass elements had similar content of bones, excluding loin in which the content of bones approximately doubled that of other elements (38%).

The average beaver carcass contains 62.8% meat, 14.5% fat, and 22.4% bone (Table 2). The variation results from individual differences, different age of animals and their different condition, while gender-related variation was not observed. Certain differences between the meat and fat content in carcasses were found between wild and farm beavers. These differences are most likely due to their different environments (Korzeniowski et al. 2001).

**Table 2** Tissue composition of beaver elements and carcass (mean ± standard deviation)

| Element | Meat | | Fat | | Bones | |
|---|---|---|---|---|---|---|
| | (g) | (%) | (g) | (%) | (g) | (%) |
| Thigh | 2044 ± 554 | 66.74[a] | 370 ± 106 | 12.08[a] | 644 ± 255 | 21.00[a] |
| Flank | 1404 ± 379 | 59.46[a] | 598 ± 351 | 25.29[b] | 354 ± 80 | 15.02[a] |
| Loin | 1096 ± 336 | 60.90[a] | 16 ± 25 | 0.85[c] | 684 ± 281 | 37.99[b] |
| Shoulder | 880 ± 280 | 70.89[a] | 124 ± 97 | 9.95[a] | 234 ± 55 | 18.90[a] |
| Tail | 320 ± 104 | 46.96[b] | 220 ± 101 | 32.08[b] | 130 ± 42 | 18.99[a] |
| Carcass | 5744 ± 1655 | 62.75[a] | 1328 ± 680 | 14.51[a] | 2046 ± 714 | 22.35[a] |

Values in *columns* denoted with *different letters* are significantly different at $p \leq 0.01$

**Table 3** Chemical composition and energy of beaver meat (mean ± standard deviation)

| Component | Element | | |
|---|---|---|---|
| | Thigh | Loin | Tail |
| Water (%) | 72.44[a] ± 1.58 | 72.34[a] ± 1.06 | 70.84[a] ± 1.63 |
| Protein (%) | 21.70[a] ± 0.61 | 21.84[a] ± 0.46 | 20.90[a] ± 0.71 |
| collagen (mg%) | 485.13[a] ± 118.66 | 786.93[b] ± 137.38 | 803.41[b] ± 122.01 |
| Fat (%) | 3.90[a] ± 1.59 | 4.15[a] ± 10.6 | 6.58[b] ± 1.32 |
| $\sum$ unsaturated fatty acids (%) | 74.26[a] ± 8.37 | 68.32[a] ± 9.85 | 79.15[a] ± 16.19 |
| $\sum$ monounsaturated fatty acids (%) | 21.13[a] ± 4.17 | 20.35[a] ± 4.71 | 26.60[a] ± 6.90 |
| $\sum$ polyunsaturated fatty acids (%) | 53.13[a] ± 10.92 | 47.97[a] ± 11.54 | 52.55[a] ± 14.87 |
| Minerals (%) | 1.29[a] ± 0.04 | 1.31[a] ± 0.06 | 1.27[a] ± 0.05 |
| Iron (mg%) | 4.97[a] ± 0.36 | 5.59[a] ± 0.80 | 5.24[a] ± 0.29 |
| Energy (kJ) | 510.29[a] ± 58.38 | 522.19[a] ± 38.71 | 597.81[a] ± 54.61 |

Values in *rows* denoted with *different letters* are significantly different at $p \leq 0.01$

The chemical composition of beaver meat is given in Table 3. The meat from three of the analyzed elements had a high and uniform protein content (20.90–21.84%), comparable to meat obtained from other wild animals (Uherová et al. 1992; Mojto et al. 1993; Dzierzynska-Cybulko and Fruzinski 1997; Żmijewski and Korzeniowski 2001). In addition, the collagen content in loin and tail meat was very similar, whereas the thigh meat contains significantly lower amounts of this protein. From that it was concluded that the thigh meat has the highest nutritional value. Thigh and loin meat had similar contents of fat, which was lower than in the tail. Characteristic properties of meat fat in all the carcass elements were the high concentration of unsaturated fatty acids, ranging from 68.3% to 79.2% and that polyunsaturated fatty acids were dominant (Table 3). A high level of unsaturated fatty acids is normal in the lipids of all herbivorous and ruminant animals; however, the level of polyunsaturated acids in beaver fat is unusually high (Berrisch-Hempen 1995), increasing its nutrional value. Beaver meat is also characterized by its high concentration of minerals (1.27–1.31%). The dark color of the meat of beavers results from the specific environmental conditions under which they live. Beaver muscles store larger quantities of oxygen, which is reflected by a high concentration of iron, ranging from 4.97 to 5.59 mg%.

The results of the present study compare well with literature data for farm-bred and free-living beavers (protein, range: 21.88–22.80%; fat, range: 5.06–6.18%; ash, range: 1.10–1.33%. The content of collagen in the loin and tail falls in the range (742–1036 mg%) reported for beavers bred on farms, as did the content of iron in the meat of the analyzed parts of the body (5.2–7.2 mg%) (Dzierzynska-Cybulko and Fruzinski 1997; Korzeniowski et al. 1999). However, wild beaver fat contains twice as much polyunsaturated fatty acids as the fat of farm beavers (Korzeniowski et al. 1999). This is likely because the main composition of the wild beaver diet is aquatic flora rich in polyunsaturated fatty acids (Dziecioowski 1996).

## Conclusions

The presented results indicate that the carcass of a mature beaver can provide over 5.5 kg of meat. The thigh was found to be the largest carcass element, yielding the greatest amount of meat. Beaver meat has a desirable chemical composition, high percentages of protein and minerals, and a high concentration of polyunsaturated fatty acids.

## References


AOAC (1975) Official methods of analysis of the association of official analytical chemists. Washington, DC

Appavoo DM (1991) Lipid composition of indigenous foods eaten by the Sahtu (Hareskin) Dene-Metis of the Northwest Territories. J Food Comp Anal 4:107–119

Bandick N, Ring C (1996) Wildbret als nahrungsmittel. Fleischwirtsch 76:888–896

Berrisch-Hempen D (1995) Fettsäurenzusammensetzung von Wildfleisch. Vergleich zum Fleisch schlachtbarer Haustiere. Fleischwirtsch 75:809–813

Blomfield LJ, Farrar F (1964) Factors affecting the determination of hydroxyproline. Analyt Chem 20:950–960

Drozd L, Gruszecki T (2000) Content of fatty acids in reserve and tissue fat of red-deer (*Cervus elaphus*) and roe-deer (*Capreolus capreolus*) obtained in central-eastern Poland. Ann Univ M Curie-Skod Sect EE XVIII 39:303–307

Dziecioowski R (1996) Bóbr. Warszawa SGGW, pp 51–56, 104–114

Dzierżyńska-Cybulko B, Fruziński B (1997) Dziczyzna jako źródo Żywności. Poznań PWRiL, pp 100–140

Fischer JB, McArthur LH, Petersen JB (1997) Continuity and change in the food habits of the seventeenth-century English colonists in Plymouth and Massachusetts Bay. Ecol Food Nutr 36:65–93

Folch H (1957) Simple method for the isolation and purification of total lipids from animal tissues. J Biol Chem 226:497–499

Korzeniowski W, Jankowska B, Kwiatkowska A, Żmijewski T (1999) Chemical composition of European beaver (*Castor fiber L.*) meat. Nat Sci 3:291–300

Korzeniowski W, Jankowska B, Kwiatkowska A, Niewegowski H, Żmijewski T (2001) Performance traits of the European beaver (*Castor fiber L.*). Ann Anim Sci 1:187–193

Korzeniowski W, Żmijewski T, Jankowska B, Kwiatkowska A (2002) Ocena wartości użytkowej bobrów z hodowli fermowej. Acta Sci Pol Technol Aliment 1:67–73

Meyer-Ravenstein HJ, Kallweit E, Oldigs B, Scupin E (1990) Körperzusammensetzung und Fleischqualität von Hasen, Wild- und Hauskaninchen in Abhängigkeit von verschiedenen Behandlungen und Lagerungsbedingungen. Fleischwirtsch 60:474–481

Mojto J, Palanská O, Kartusek V, Bezáková E (1993) Kvalita mäsa raticovej zveri (daniel, jeleň, srnec, diviak) z vol'nej prírody. Pol'nohospodárstvo 39:54–60

Peisker K (1964) Rapid semi-micro method for methyl esters from triglicerides using chloroform methanol, sulphuric acid. J Am Oil Chem Soc 11:87–90

Strmisková G, Strmiska F (1992) Contents of mineral substances in venison. Nahrung 36:307–308

Uherová R, Buchtová V, Takácsová M (1992) Nährwertfaktoren im Wildfleisch. Fleischwirtsch 72:1155–1156

Whiteside P, Miner B (1984) Pye unicam atomic absorption data book. Cambridge Pye Unicam Ltd., Cambridge, UK

Żmijewski T, Korzeniowski W (2000) Tissue composition of wild boar carcasses. EJPAU Food Sci Technol 3:2

Żmijewski T, Korzeniowski W (2001) Technological properties of wild boar meat. EJPAU Food Sci Technol 4:2