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# ASSESSMENT OF THE CHEMICAL AND MICROBIOLOGICAL QUALITY OF THE GAME MEAT FOR FAMILY CONSUMPTION

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## Abstract

*Wild game meat consumption is usually consumed in the families of hunters, without any professional postmortem inspection performed by an official veterinarian. Because of that, the hygienic quality of this type of meat is unknown and the consumers choose to prepare at home these product by application of boiling for couples of hours, in order to be sure that the meals are safe. Sometime, wild game meat is processed in meat products, like salami, sausages or pastrami, and not all the time heat treatment is used. Hence, the hygienic quality, and especially microbiological quality is very important, in order to protect the health status of consumers. The aim of this study was to assess the chemical and microbiological quality of wild game meat intended for family consumption. During November 2017 – May 2018, 20 samples were collected from different species: deer, roe deer, wild boar and bear. The samples were collected three different hunting areas, located in Maramureş and Bistriţa County. All the samples were analyzed for chemical composition using FoodScan equipment: moisture, protein, fat, and collagen. Aerobic plate count, Enterobacteriaceae, and E. coli were analyzed using standardized methods. Chemical composition of game meat is characterized by a lower fat and moisture content, and a higher protein value when compared with farm animals. The highest protein content was recorded in the case of bear and the lowest in case of roe deer meat. The lowest values of the fat was found for deer and the highest in case of bear meat. The presence of germs belonging to the Enterobacteriaceae family and E. coli demonstrates non-compliance with hygiene rules during the skinning, evisceration process. Although microbial load has been much higher in comparison with farm animals, we consider these values to be acceptable given the conditions of processing wild game meat (lack of hygiene conditions during processing and abuse transport temperature to the consumer's home in warm seasons). Game meat is considered to be a high-quality product, which can represent an increase food source alternative, because of its high nutritional value and the consumer's interest in healthier products in terms of the absence of chemical residues.*

**Keywords:** meat products, chemical composition, microbial contamination, specie identification

## Introduction

Wild game meat has a much higher dietetic value compared to farm animals, with more proteins and low fat. Wild animals moves a lot in nature, so it does not accumulate fat. Chemical residues are very low, often the tests confirm that their presence is non-existent in the wild game meat. The chemical composition of meat from wild animals (Table 1) differs from that from slaughter animals. Proteins are well represented (21-23%) and the fats are only present in the proportion of 1.2%. Mineral salts of game meat are higher than other types of meat, with more phosphorus content than fish meat, potassium is higher than in beef, pork or even lamb and iron (Fe) is higher more than spinach (Laslo *et al.*, 2008; Sălăgean and Țibulcă, 2010; Mihaiu *et al.*, 2011). Wild game meat consumption is usually consumed in the families of hunters, without any professional postmortem inspection performed by an official veterinarian. Because of that, the hygienic quality of this type of meat is unknown and the consumers choose to prepare at home these product by application of boiling for couples of hours, in order to be sure that the meals are safe. Sometime, wild game meat is processed in meat products, like salami, sausages or pastrami, and not all the time heat treatment is used. Wild game meat intended for family consumption poses

a risk to the consumer because without a post-mortem inspection there is no certainty that this meat is provided from animals with an adequate health status Mihaiu *et al.*, 2011; Paulsen, 2012; Mihaiu *et al.*, 2014). Hence, the hygienic quality, and especially microbiological quality is very important, in order to protect the health status of consumers. The aim of this study was to assess the chemical and microbiological quality of wild game meat intended for family consumption.

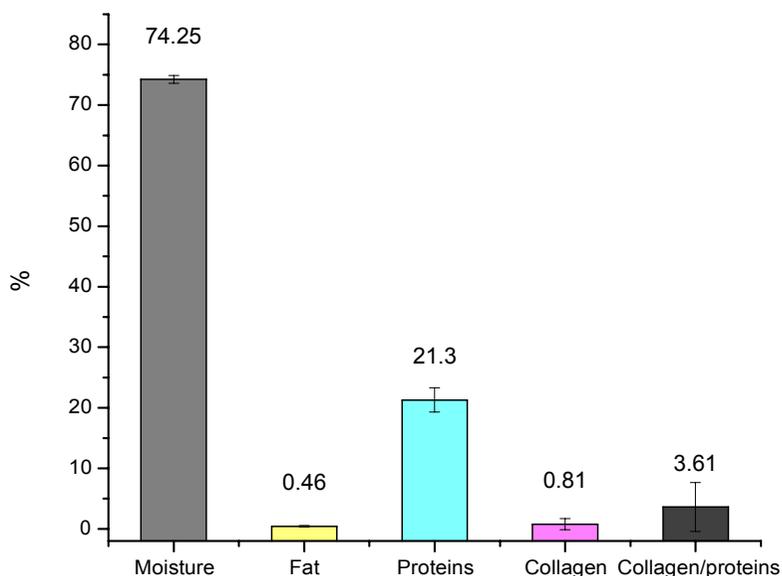
### Material and methods

During November 2017 – May 2018, 20 samples were collected from different species: deer, roe deer, wild boar and bear. The samples were collected three different hunting areas, two located in Maramureş and one in Bistriţa County. All the samples were analyzed for chemical composition using FoodScan equipment: moisture, protein, fat, and collagen. Aerobic plate count, Enterobacteriaceae, and *E. coli* were analyzed using standardized methods. Statistical analysis of the results was realized using Origin 8.5 software program by comparison of means by analysis of variance through ANOVA test. The interpretation of the results was realized according to the probability indicator:  $p \leq 0.05$  (confidence level 95%).

### Results and discussions

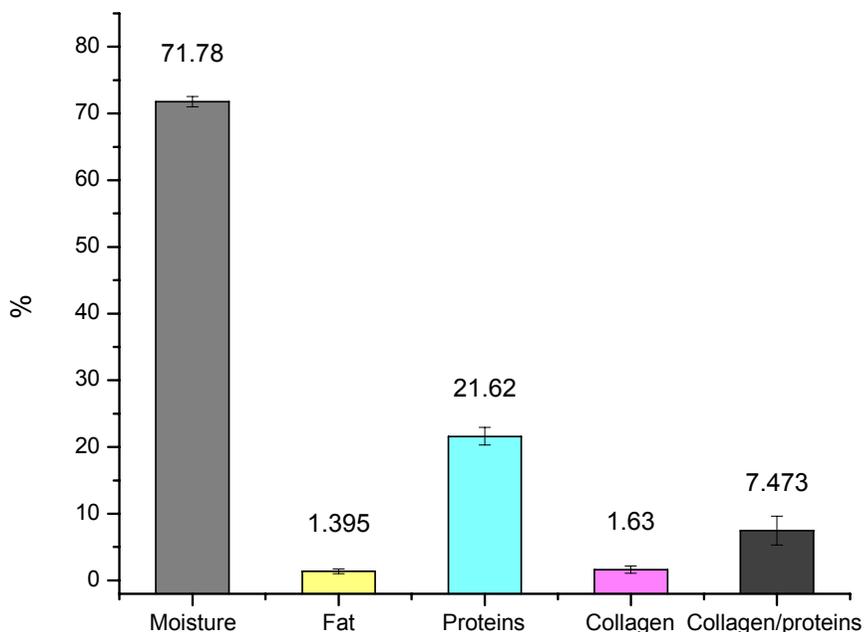
#### *Gross chemical composition of wild game meat*

After analyzing the obtained results, we found that the average moisture content of the roe deer samples was  $74.25 \pm 1.18$  g%, with values ranging from 73.78 to 74.71 g%. The mean fat value was  $0.46 \pm 0.53$  g%, with values ranging from 0.36 to 0.57 g%. Proteins recorded mean values of  $21.3 \pm 0.71$ g%, ranging from 19.88 to 22.73g%, and collagen exhibited values of  $0.81 \pm 0.57$ g%, with values ranging from 0.15 to 1.47g%. The collagen/protein ratio was  $3.61 \pm 3.13$ , with limits between 0.75 and 6.46 (Figure 4.2) (Figure 1).



**Figure 1.** Average chemical composition ( $\pm$ SEM) of deer meat (n=5)

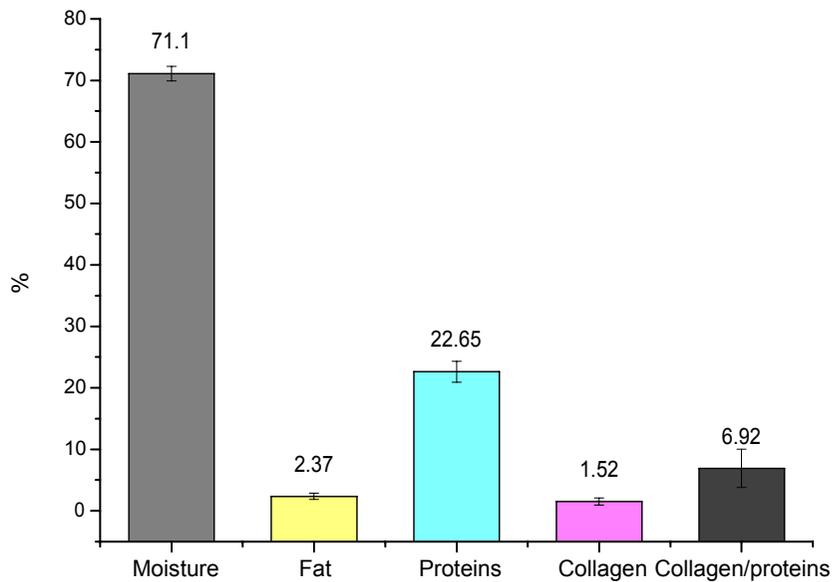
Similar results have been obtained in the survey conducted on deer herds in Poland and Hungary by Daszkiewicz *et al.* (2013), with a protein content of 21.7 g% for deer in Poland and 22.01% in Hungary. The fat content in deer in Poland was 1.06 g%, and 0.69 g% in Hungary.



**Figure 2.** Average chemical composition ( $\pm$ SEM) of roe deer meat (n=5)

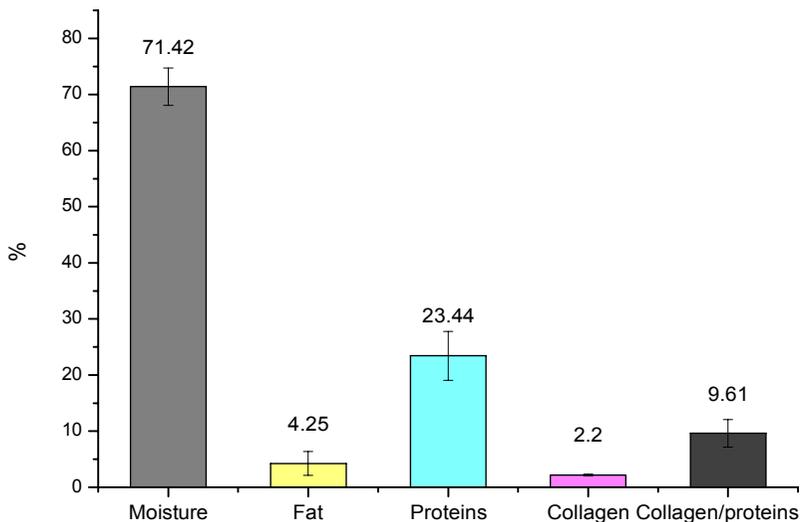
In case of roe deer meat the mean moisture content was  $74.24 \pm 1.18$  g%, with values ranging from 73.78g% to 74.71. The mean value of the fat was  $0.46 \pm 0.53$ g%, with values ranging between 0.36 and 0.57 g%. Proteins recorded mean values of  $21.30 \pm 0.71$ g%, ranging from 19.88 to 22.73g%, and collagen exhibited values of  $1.63 \pm 0.57$ g%, with values ranging from 0.96 to 2.21g%. The collagen / protein ratio was  $7.43 \pm 2.15$ , ranging from 5.28 to 9.58 (Figure 2). Daszkiewicz *et al.* (2008), in a study carried out in Poland, analyzed the chemical composition of roe deer meat. Thus, average values of the protein were found to be:  $22.7 \pm 0.7$  g%, close to those obtained by us, but the mean value of the fat was ( $4.0 \pm 0.6$  g%), was much higher than the amount of fat found in our study.

Based on the results obtained, we found that the average moisture content of wild boar samples was  $71.10 \pm 1.18$  g%, with values ranging from 71.03 to 72.59 g%. The mean fat value was  $2.38 \pm 0.53$  g%, with values ranging from 2.47 to 2.91 g%. Proteins recorded mean values of  $22.65 \pm 0.71$ g%, ranging from 23.17 to 24.1g%, and collagen exhibited values of  $1.53 \pm 0.57$ g%, with values between 1.47 and 2.21g%. The collagen / protein ratio was  $6.90 \pm 3.13$ , with limits between 6.34 and 10.96 (Figure 3). A similar results published by Skobrák *et al.* (2011), shows protein mean values of  $21.83 \pm 0.57$  g%, mean fat value of  $4.27 \pm 1.78$  g%. When compared with our results, higher fat content may occur because our samples were harvested in January, it is known that in the winter season the weight of wild boar drops due to low food and frost.



**Figure 3.** Average chemical composition ( $\pm$ SEM) of wild boar meat (n=8)

In case of bear meat, the average moisture content was  $71.42 \pm 1.18$  g%, with values between 69.07 and 73.78 g%. The mean fat value was  $4.25 \pm 0.53$ g%, with values ranging from 2.76 to 5.74g%. Proteins recorded mean values of  $23.44 \pm 0.71$ g%, ranging from 20.36 to 26.52 g%, and collagen exhibited values of  $2.2 \pm 0.57$ g%, with values ranging from 2.09 to 2.31g%. The collagen / protein ratio was  $9.61 \pm 3.13$ , ranging from 7.88 to 11.35 (Figure 4).



**Figure 4.** Average chemical composition ( $\pm$ SEM) of bear meat (n=2)

The Nutritional info of Black bear meat presented lower protein values (20.1 g%), higher fat values (8.3 g%), and similar moisture content (71.42 g%). Similar results were published by Schwartz *et al.*, (2014), in a study regarding black and grizzly bear.

#### *Microbiological analyses of wild game meat*

Aerobic plate count (APC) of wild boar meat presented values ranging between 5.50 and 5.72 log cfu/g, with an average of  $5.44 \pm 0.32$  log cfu/g. The Enterobacteriaceae load was between 4.011 and 4.69 log cfu/g, with an average of  $4.11 \pm 0.42$  log cfu/g, and *E. coli* showed values between 1.77 and 3.07 log cfu/g, with an average of  $2.43 \pm 0.57$  log cfu/g. Considering that there are no limits in the case of wild game meat (Regulation 2073 (EC)/2005), we can compare these values with those for pig carcasses, in which APC should not exceed 5.0 log cfu/g and Enterobacteriaceae must not exceed 3.5 log cfu/cm. Thus, it can be concluded that the values for APC and Enterobacteriaceae are increased by about 0.44 or 0.61 log cfu/g, but given the conditions of processing carcasses of wild game, we can consider those values are acceptable (Figure 5).

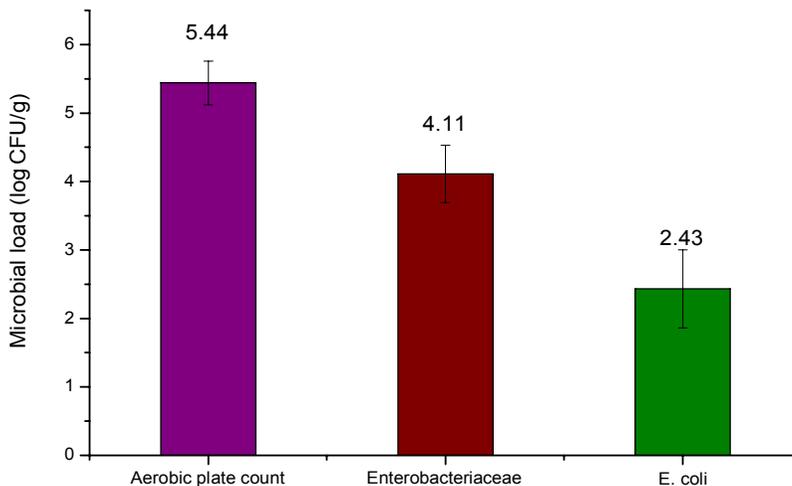


Figure 5. Average microbial load ( $\pm$ SEM) of APC, Enterobacteriaceae and *E. coli* of wild boar meat (n=8)

Microbial load of deer meat is presented in Figure 6. Aerobic plate count ranged between 3.17 and 3.65 log cfu/g, with an average of  $3.41 \pm 0.32$  log cfu/g. The Enterobacteriaceae load was between 3.17 and 3.65 log cfu/g, with an average of  $3.41 \pm 0.42$  log cfu/g, and *E. coli* showed values between 1.69 and 2.25 log ug / g, with an average of  $1.97 \pm 0.57$  log cfu/g. In case of roe deer meat microbial contamination during carcass dressing was lower. Thus, APC ranged between 4.56 and 5.17 log cfu/g, Enterobacteriaceae load was between 2.32 and 3.26 log cfu/g, with an average of  $2.79 \pm 0.42$  log cfu/g, and *E. coli* showed values between 1.39 and 1.9 log cfu/g with an average of  $1.64 \pm 0.57$  log cfu/g.

A study carried out in Austria by Obwegeser *et al.*, (2012), showed a lower microbial load in terms of both Enterobacteriaceae load (2.6 log cfu/g), and a total viable count (4.0 to 4.2 log cfu/g).

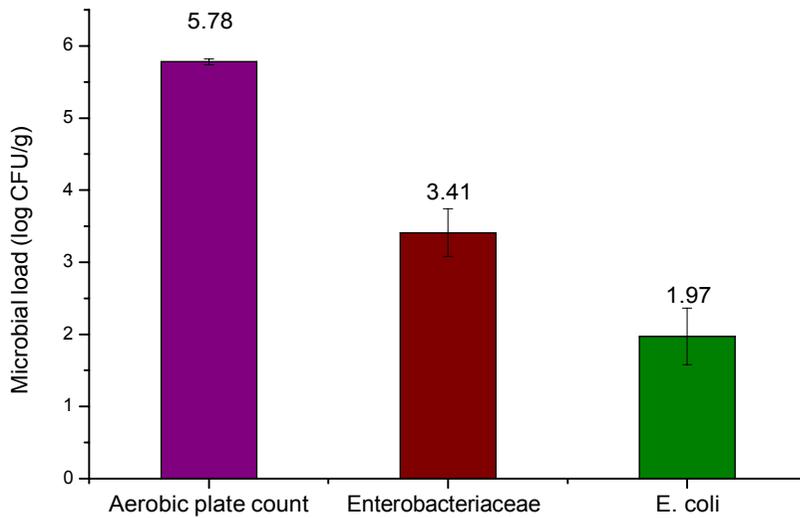


Figure 6. Average microbial load ( $\pm$ SEM) of APC, Enterobacteriaceae and *E. coli* of deer meat (n=5)

Bear meat shown the lowest microbial contamination. Aerobic plate count ranged between 3.17 and 3.68 log cfu/g, with an average of  $3.42 \pm 0.32$  log cfu/g. The Enterobacteriaceae load was between 1 and 2.30 log cfu/g with an average of  $1.65 \pm 0.42$  log cfu/g. *E. coli* was not isolated in bear meat (Figure 7).

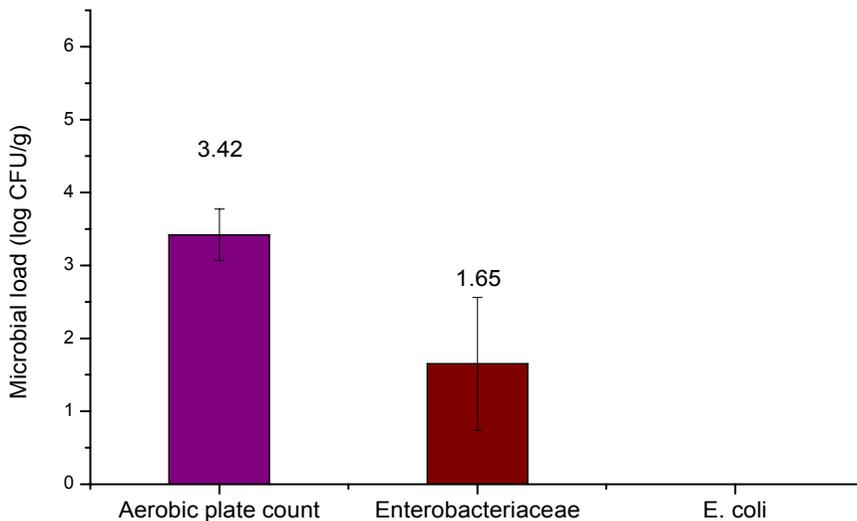


Figure 7. Average microbial load ( $\pm$ SEM) of APC, Enterobacteriaceae and *E. coli* of bear meat (n=2)

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## Conclusions

Chemical composition of game meat is characterized by a lower fat and moisture content, and a higher protein value when compared with farm animals. The highest protein content was recorded in the case of bear and the lowest in case of roe deer meat. The lowest values of the fat was found for deer and the highest in case of bear meat. The presence of germs belonging to the Enterobacteriaceae family and *E. coli* demonstrates non-compliance with hygiene rules during the skinning, evisceration process. Although microbial load has been higher in comparison with farm animals, we consider these values to be acceptable given the conditions of processing wild game meat (lack of hygiene conditions during processing and abuse transport temperature to the consumer's home in warm seasons). Game meat is considered to be a high-quality product, which can represent an increase food source alternative, because of its high nutritional value and the consumer's interest in healthier products in terms of the absence of chemical residues.

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