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## MICROBIOLOGICAL QUALITY OF THE *Anas platyrhynchos* AND THE *Fulica atra* MEAT

### MIKROBIOLOGICZNA JAKOŚĆ MIĘSA *Anas platyrhynchos* I *Fulica atra*

**Abstract:** The aim of our experiment was monitoring of the microbiological quality of the *Anas platyrhynchos* and the *Fulica atra* meat after the slaughter and seven days of maturing process. We followed total count of microorganisms, number of coliforms bacteria and number of mesophilic anaerobic sporulating microorganisms. The evaluation of microorganisms was done by Codex Alimentarius SR. We noticed that the count of coliform bacteria was negative after slaughter in both experimental groups. The count of mesophilic anaerobic sporulating bacteria in the meat of the wild ducks ranged from 1.78–2.12 log cfu · g<sup>-1</sup> and in the meat of the fulicas was found from 4.98 to 5.95 log cfu · g<sup>-1</sup>. From the statistical point of view it was a high significant difference ( $p \leq 0.001$ ). The total count of microorganisms in the meat of the wild ducks was zero. In the meat of the fulicas ranged from 5.18 to 6.25 log cfu · g<sup>-1</sup>. The statistical differences between the meat samples from the wild ducks and the fulicas were significant ( $p \leq 0.001$ ). The count of coliforms in the mature meat of wild ducks varied from 1.12–1.73 log cfu · g<sup>-1</sup>. The statistical differences between the meat samples from the wild ducks and the fulicas were not significant ( $p \geq 0.05$ ). The count of mesophilic anaerobic sporulating microorganisms in the wild duck mature meat samples varied from 1.95–2.24 log cfu · g<sup>-1</sup> and in the mature meat of the fulicas ranged from 5.00 to 6.00 log cfu · g<sup>-1</sup>. The significant differences between the meat samples of the wild ducks and the fulicas were determined ( $p \leq 0.001$ ). The total count of microorganisms in the mature meat samples of the wild ducks ranged from 1.18–2.24 log cfu · g<sup>-1</sup>, ie on average 1.99 log cfu · g<sup>-1</sup>. Higher values were detected in the mature meat samples of the fulicas. The values varied from 5.24–6.30 log cfu · g<sup>-1</sup>, ie on average 5.69 log cfu · g<sup>-1</sup>. The comparison of meat samples of both experimental animals showed high significant differences ( $p \leq 0.001$ ).

**Keywords:** microorganisms, *Fulica atra*, *Anas platyrhynchos*, meat, maturing

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Hoofed game is nowadays a basic part in production and consumption of game. The high percentage creates feather game, too [1].

Game is an economically significant product. It plays an eminent role like a complement of menu. Feather game, with production of 257 Mg, creates 10% from market production of game [2, 3].

Although the meat production is one of the main indicator, according to Hascík et al [3, 4] it is necessary to pursue the nutrition quality of the meat, adherence to the sanitary code and the microbiological requirements. They are coupled with eventual contamination and consecutive devaluation of the meat.

The maturing processes are running in the muscles up to point of time after death of game until the supplies of glycogen and energetically valued phosphates are available. The production of enzymes and products of proteins metabolism induce specifically taste of game meat. Game meat „the red meat” must be matured few days (5 or 7) in cold conditions, in order to get required tenderness and rich taste [5]. It is necessary to avoid microbial contamination.

The meat is an ideal nutrient medium for microorganisms. It has a high content of water, nitrogenous and mineral compounds, growing factors and pH which is ideal for microorganisms. The meat as a food of animal origin, is exposed to negative surrounding factors. These factors are responsible for surviving and propagation of microorganisms [6, 7].

Contamination of the meat is subjected to these factors: the illnesses of the animals (microorganisms penetrate into the muscles and apparatus), the delay of the evisceration, inexperienced examination of the carcass and breach of sanitation [8].

Steinhauseroval et al [9] mention, that the spectrum of microorganisms on the surface of the meat is very extensive. The most frequently Gram-negative bacteria are: *Acinetobacter*, *Aeromonas*, *Alcaligenes*, *Enterobacter*, *Citrobacter*, *Moraxella*, *Pseudomonas*, *Escherichia*, *Serratia*, *Psychrobacter*, *Shewanella* and *Yersinia*. From the Gram-positive bacteria are present: *Bacillus*, *Brochotrix*, *Carnobacterium*, *Micrococcus*, *Microbacterium* and *Lactobacillus*.

## Material and methods

As a biological material were used *Fulica atra* (fulica) and *Anas platyrhynchos* (wild duck) of the both sexes. In the autumn was made the catching of feather game by the nets. Among 30 pieces of fulicas and 30 pieces of wild ducks were chosen randomly 15 pieces of female and 15 pieces of male subjects. They were transported immediately on the Department of Animal Products Evaluation and Processing SPU Nitra, where they were slaughtered. For the quantitative microbial analysis (total count of microorganisms, number of coliform bacteria and count of mesophilic anaerobic sporulating microorganisms) of the meat was taken the thigh and breast muscle, 45 minutes after slaughter, ie before chilling of the meat and after 7 days of maturing process. It was cut (with sterile scalpel) 17 samples of particular muscle. The sections was 5 cm<sup>2</sup> in depth of 5 mm. The samples were preserved at 4 °C. The various pieces from each animal were homogenised on meat-mincer (size of slots was 3 mm). The homogenisate in

amount of 10 g was added into the sterile flask with 90 cm<sup>3</sup> of saline solution. The flasks were shaken for 30 min on the beater. The particular steps of isolation are presented in Table 1.

Table 1

Isolated species of microorganisms of the *Fulica atra* and the *Anas platyrhynchos* meat and their fundamental identification signs

Cultivated microorganisms	Nutritive substrate	Temperature of cultivation [°C]	Time of cultivation [h]	Colour of colony
Coliform bacteria	VRB agar (8)	37	24–48	Reddish purple
MASM	Nutrient agar	25	38–72	Light amber
Total microorganisms count	GTU agar (9)	30	48–72	Yellow

VRB – Violet red bile agar; MASM – mesophilic anaerobic sporulating microorganisms; GTU – Glucose tryptone yeast agar.

The basic statistical characteristic (arithmetical average, standard deviation, min., max and variation index) was evaluated by statistical program SAS. Differences among various groups in the experiment were tested by the t-test and the Scheffe test.

## Results and discussion

At the evisceration and the carcass splitting it is not possible to avoid microbial contamination. A mixture of bacteria, fungi and yeast, which are in contact with game, has various effects on quality of the meat as foodstuff. They can activate positive also negative processes in the meat by Winkelmayr et al [5].

In the meat microorganisms are attendant which are responsible for the alimentary diseases. Microorganisms affect by their metabolism quality of the meat especially sensorial characteristic. Microorganisms participate in metabolism of proteins and lipids and products of metabolism result in unpleasant smell and taste of the meat. Other negative marks are production of visual colonies and mould films on the surface of the meat or changes of the meat pigmentation. The consumption of the bad meat can cause enteric diseases [10].

In our experiment had been monitoring the same groups of microorganisms in the meat of the fulicas and the wild ducks after the slaughter (Table 2) and after the 7 days of maturing process (Table 3).

The count of coliform bacteria was negative after slaughter in the both experimental groups. Kacaniova et al [11, 12] confirmed the suitable quality of the fulica and the wild duck meat on the count of coliforms, that is in accordance with the Codex Alimentarius SR [13]. The standard for the count of coliform bacteria is 5 log cfu · g<sup>-1</sup>.

The count of mesophilic anaerobic sporulating bacteria in the meat of the wild ducks ranged from 1.78–2.12 log cfu · g<sup>-1</sup> and in the meat of the fulicas it was from 4.98 to 5.95 log cfu · g<sup>-1</sup>. From the statistical point of view there was a high significant difference ( $p \leq 0.001$ ). The attained results correspond with assignments of Kacaniova et al

[12]. They observed the increased count of mesophilic anaerobic sporulating bacteria in the meat of the wild ducks, as well. According to the Codex Alimentarius SR [13] we can conclude that the microbial quality of the wild duck meat accommodated to the norm and the microbial quality of the fulica meat was inconvenient. The norm for mesophilic anaerobic sporulating microorganisms is  $2 \log \text{cfu} \cdot \text{g}^{-1}$  according to the Codex Alimentarius SR [13].

Table 2

Representation of individual microorganisms groups of *Anas platyrhynchos* and *Fulica atra* meat in  $\log \text{cfu} \cdot \text{g}^{-1}$

Groups of microorganisms	Basic of statistical characteristics	Animal brand	
		<i>Anas platyrhynchos</i>	<i>Fulica atra</i>
Coliform bacteria	$\bar{x}$	0.00	0.00
	min.	0.00	0.00
	max	0.00	0.00
	$s_x$	0.00	0.00
	v %	0.00	0.00
Mesophilic anaerobic sporulating microorganisms	$\bar{x}$	1.99	5.39
	min.	1.78	4.98
	max	2.14	5.95
	$s_x$	0.12	0.32
	v %	5.97	5.84
Total count of microorganisms	$\bar{x}$	0.00	5.62
	min.	0.00	5.18
	max	0.00	6.25
	$s_x$	0.00	0.42
	v %	0.00	7.53

$\bar{x}$  – average;  $s_x$  – standard deviation; v % – coefficient of variation.

The total count of microorganisms in the meat of the wild ducks was zero. In the meat of fulicas ranged from 5.18 to 6.25  $\log \text{cfu} \cdot \text{g}^{-1}$ . On the base of average results we can conclude that the total count of microorganisms is conformable with the Codex Alimentarius SR [13]. The norm for the total count of microorganisms is 5.69  $\log \text{cfu} \cdot \text{g}^{-1}$ . But we must stress that 30 % samples of the fulica meat had excess values.

The increasing count of microorganisms noticed Kacaniova et al [11] at the samples of the wild duck meat (0.00–6.37  $\log \text{cfu} \cdot \text{g}^{-1}$ ), but in other experiments [12] are the total counts of microorganisms the same as in our experiment, ie zero. The statistical differences between the meat samples from the wild ducks and the fulicas were significant ( $p \leq 0.001$ ).

In the past storage of game meat was usually at 0 to 4 °C. The base of the 7 days maturing process is to supply the mature meat for consumer. Profoundness autolysis occurs right after the 7 days maturing process [14]. Then we had observed microbial contamination of the wild duck and the fulica meat at the end of maturation.

Table 3

Representation of individual microorganisms groups of *Anas platyrhynchos* and *Fulica atra* meat in  $\log \text{cfu} \cdot \text{g}^{-1}$  after 7 days of maturing

Groups of microorganisms	Basic of statistical characteristics	Animal brand	
		<i>Anas platyrhynchos</i>	<i>Fulica atra</i>
Coliform bacteria	$\bar{x}$	1.27	2.03
	min.	1.12	0.00
	max	1.73	3.43
	$s_x$	0.17	1.45
	v %	13.63	71.38
Mesophilic anaerobic microorganisms	$\bar{x}$	2.08	5.43
	min.	1.95	5.00
	max	2.24	6.00
	$s_x$	0.11	0.31
	v %	5.43	5.62
Total count of microorganisms	$\bar{x}$	1.99	5.74
	min.	1.18	5.24
	max	2.24	6.30
	$s_x$	0.30	0.39
	v %	15.19	6.86

$\bar{x}$  – average;  $s_x$  – standard deviation; v % – coefficient of variation.

All samples of the wild duck and the fulica meat were contaminated by the coliform bacteria, it comes to this, that in the term of faecal contamination the muscles of game were not clean. The count of coliforms in the mature meat of the wild ducks was in the rate of 1.12–1.73  $\log \text{cfu} \cdot \text{g}^{-1}$ . In the mature meat of the fulicas was from 0.00 to 3.43  $\log \text{cfu} \cdot \text{g}^{-1}$ . The other attributes were measured by Kacaniova et al [11, 14]. The count of coliforms was zero in the meat of wild ducks as well as in the meat of fulicas. These results had confirmed the suitable microbial quality of feather game according to the Codex Alimentarius SR. The Codex Alimentarius [13] determined 5  $\log \text{cfu} \cdot \text{g}^{-1}$  as the maximum of the count of coliforms. Our results correspond with the norm listed in the Codex Alimentarius SR. The statistical differences between the meat samples from the wild ducks and the fulicas were not significant ( $p \geq 0.05$ ).

The count of mesophilic anaerobic sporulating microorganisms in the wild duck mature meat samples was within range of 1.95–2.24  $\log \text{cfu} \cdot \text{g}^{-1}$  and in the mature meat of fulicas it was from 5.00 to 6.00  $\log \text{cfu} \cdot \text{g}^{-1}$ . The average values were inconvenient according to the Codex Alimentarius SR [13]. The norm for mesophilic anaerobic sporulating bacteria is 2  $\log \text{cfu} \cdot \text{g}^{-1}$ . The significant differences between the meat samples from the wild ducks and the fulicas were significant ( $p \leq 0.001$ ).

The total count of microorganisms in the mature meat samples of the wild ducks was in the rate of 1.18–2.24  $\log \text{cfu} \cdot \text{g}^{-1}$ , ie on the average 1.99  $\log \text{cfu} \cdot \text{g}^{-1}$ . These values are suitable with the norm in the Codex Alimentarius SR [13]. The higher values were detected in the mature meat samples of the fulicas. The values were within rate of

5.24–6.30 log cfu · g<sup>-1</sup>, on average 5.69 log cfu · g<sup>-1</sup>. The comparison of the meat samples of both experimental animals showed high significant differences ( $p \leq 0.001$ ).

The statistical significant differences ( $p \leq 0.001$ ) were found among the count of coliforms and the total count of microorganisms in the meat of the wild ducks immediately after the slaughter and after the 7 days maturing process. In the counts of mesophilic anaerobic sporulating microorganisms after the slaughter and after the 7 days maturing process were not found statistical significant differences ( $p \geq 0.05$ ).

The similar tendency of the statistical significant differences ( $p \leq 0.001$ ) showed values between the counts of coliforms in samples of the fulica meat after the slaughter and maturation. In the counts of mesophilic anaerobic sporulating microorganisms and in the total counts of microorganisms after the slaughter and the maturing process were not found statistical significant differences ( $p \geq 0.05$ ).

## Conclusion

The zero values of the counts of coliform bacteria in the meat of the wild ducks and the fulicas after the slaughter as well as values 1.27 log cfu · g<sup>-1</sup> (the wild duck mature meat) and 2.30 log cfu · g<sup>-1</sup> (the fulica mature meat) give the good premise to consummation of this meat. The count of mesophilic anaerobic sporulating microorganisms in the meat of the wild ducks had allowed values according to the Codex Alimentarius SR. After the 7 days of maturing process the value of mesophilic anaerobic sporulating microorganisms count increased about 0.08 log cfu · g<sup>-1</sup> above the norm. In the fresh and the mature meat of the fulicas were observed the high values of the mesophilic anaerobic sporulating microorganisms counts, where the value of the count of mesophilic anaerobic sporulating microorganisms were about 2.69 higher than it is allowed. After maturation the value of the count of mesophilic anaerobic sporulating microorganisms was about 2.69 higher than is allowed by the Codex Alimentarius SR. The total count of microorganisms in the meat samples of the wild ducks after the slaughter was zero and the values increased after maturation on 1.99 log cfu · g<sup>-1</sup>, which is in accordance with the Codex Alimentarius SR. In the meat samples of fulicas after the slaughter was 5.62 log cfu · g<sup>-1</sup>, ie close to maximum of the allowed norm. The total count of microorganisms in the mature meat samples of the fulicas was about 2.13 % higher than in the fresh meat. This value falls outside the Codex Alimentarius norms.

On the base of our experiments we can conclude that the maturing process of game meat is not relevant problem in term of negative influence of the meat quality, but in many cases the microbial quality is better than in the fresh meat.

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#### MIKROBIOLOGICZNA JAKOŚĆ MIĘSA *Anas platyrhynchos* I *Fulica atra*

**Abstrakt:** Celem badań był monitoring mikrobiologicznej jakości mięsa z *Anas platyrhynchos* i *Fulica atra* bezpośrednio po uboju oraz po 7 dniach dojrzewania. Oznaczono całkowitą liczebność mikroorganizmów, liczebność bakterii Coli oraz liczebność mezofilowych anaerobowych mikroorganizmów sporulujących. Nie stwierdzono obecności bakterii Coli bezpośrednio po uboju. Liczebność mezofilowych anaerobowych mikroorganizmów sporulujących w mięsie *Anas platyrhynchos* wynosiła 1,78–2,12 log cfu · g<sup>-1</sup>. Liczebność tych organizmów w mięsie *Fulica atra* wynosiła 4,98–5,95 log cfu · g<sup>-1</sup>. Różnice między badanym mięsem były statystycznie istotne (p < 0,001). Całkowita liczebność mikroorganizmów w mięsie *Fulica atra* wynosiła 5,18 do 6,25 log cfu · g<sup>-1</sup>. Parametr ten wykazał wartość zerową w mięsie *Anas platyrhynchos*. Różnice między badanym mięsem pod względem całkowitej zawartości mikroorganizmów były statystycznie istotne (p < 0,001). Liczebność bakterii Coli w dojrzałym mięsie *Anas platyrhynchos* wynosiła 1,12–1,73 log cfu · g<sup>-1</sup>. Różnice między mięsem *Anas platyrhynchos* i *Fulica atra* pod względem tego parametru nie były istotne statystycznie (p < 0,05). Liczebność mezofilowych anaerobowych mikroorganizmów sporulujących w dojrzałym mięsie *Anas platyrhynchos* wynosiła 1,95–2,24 log cfu · g<sup>-1</sup>, a w dojrzałym mięsie *Fulica atra* 5,00–6,00 log cfu · g<sup>-1</sup>. Różnice te były statystycznie istotne (p < 0,001). Całkowita liczebność mikroorganizmów w próbkach dojrzałego mięsa *Anas platyrhynchos* wynosiła 1,18–2,24 log cfu · g<sup>-1</sup> (średnio 1,99 log cfu · g<sup>-1</sup>). Większą liczebność mikroorganizmów stwierdzono w dojrzałym mięsie *Fulica atra*, gdzie mieściła się ona w granicach 5,24–6,30 log cfu · g<sup>-1</sup> (średnio 5,69 log cfu · g<sup>-1</sup>). Porównanie dojrzałego mięsa obu gatunków pod względem tego parametru wykazało statystycznie istotne różnice (p < 0,001).

**Słowa kluczowe:** mikroorganizmy, *Fulica atra*, *Anas platyrhynchos*, mięso, dojrzewanie