Quality of meat products from the Serbian market in terms of protein content

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Abstract. The quality of meat products on the market constantly comes into question. In Serbia, there remains some level of persistent distrust and suspicion regarding meat processors and meat quality. Protein quality, meaning protein content and percentage of collagen in total protein, is a chemical quality parameter stipulated by regulation. Forty meat products from the Serbian retail market, of which 19 were declared, by Serbian regulation, as canned meat in pieces and 21 were declared as finely ground cooked sausages (emulsion-type, pasteurised hotdogs), were investigated. All hotdogs (100%) fulfilled the required protein quality criteria, while 36% of canned meat in pieces were not in accordance with the regulation regarding protein quality. The main reason for products not meeting the regulation was their high collagen levels. In total, 15% of the meat products studied did not meet legal protein requirements.

1. Introduction
Meat and meat products are important protein sources in the human diet. Meat consumption depends on economic factors, religion, ethics and tradition. In Serbian cuisine, meat and meat products have a special place, a long tradition of consumption, and are normally an essential part of at least one meal per day [1, 2]. In a household survey from 2017, it was estimated that each household in Serbia spent the most of its food budget on meat and meat products, exactly 5952 RSD per month. Also, it was noted that average household consumption of meat products for 2017 was 38.9 kg, i.e. 3.24 kg per month [3]. Because of the high meat consumption level in Serbia, consumers demand high quality meat and meat products.

Hotdogs are declared by the “Regulation of the quality of ground meat, meat preparations, semi prepared meat products and meat products” to be finely ground cooked sausages, and are one of the most commonly consumed meat products, because of their low salt content and soft texture. Canned meat in pieces are another subgroup defined by the regulation. Most pizza hams and chicken breast in casings are declared as canned meat in pieces. They are very popular among consumers with special diet regimes because of their low-fat content [4, 5].

In Serbia, as in other countries, the quality of meat and meat products on the market is a constantly debated theme. Hence, the objective of this study was to investigate the protein content and percentage...
of collagen, as chemical quality parameters defined by regulation, in hotdogs and canned meat in pieces, to see if meat processors meet the regulation and if consumers are protected from food fraud.

2. Materials and methods

2.1. Meat products sampled
Commercially available hotdogs (HD) and canned meat in pieces (CM), both made of chicken meat or pork, were collected from the Serbian retail market during 2018. Hotdogs (n=21), of which 11 were made of chicken meat and 10 of pork, and canned meat in pieces (n=19), of which 11 were made of chicken meat and 8 of pork, were collected. The meat products were produced by the most common meat processors in the Serbian retail market. After collection, meats were homogenized and stored at -18°C until analysis. All analyses were conducted in triplicate.

2.2. Total protein content analysis
Total protein content was determined according to the Kjeldahl method recommended by International Organization for Standardization [6].

2.3. Collagen share
Collagen content was calculated by multiplication of hydroxyproline content by a factor of 8, while hydroxyproline content was determined by method SRPS 2002, ISO 3496 [7]. Collagen was expressed as the percent of collagen in the total protein content.

2.4. Statistical analysis
The experimental data were analysed using the two-way T-test for single samples (test of means against a reference constant) with significance level of 95% (p<0.05). The tests were performed by Statistica version 13 [8].

3. Results and discussion
The mean total protein content and percent of collagen (in the total protein content) in the analysed HD and CM, as well as protein content and percent of collagen required by Serbian law are presented in figure 1. The current regulation requires minimum 10% protein and maximum 25% collagen in pork HD and 15% collagen in chicken HD. For CM, the legal limits are minimum of 12% protein and maximum 10% collagen [5].
The mean total protein content (PC) and collagen share (CS) of analysed meat products and values required by regulation: a) the PC in hotdogs; b) the PC in canned meat in pieces; c) the CS in hotdogs; d) the CS in canned meat in pieces

The protein content in HDs ranged from 10.31 (HD14) to 15.70 (HD17) g/100g. The collagen in HDs ranged from 3.22 (HD2) to 11.33 (HD21) g/100g of protein. In CMs, the lowest protein content detected was 11.48 (CM17) g/100g, while CM7 contained the highest protein level, 17.40 g/100g. The collagen in CMs ranged from 1.05 (CM5) to 20.45 (CM13) g/100g of protein. However, figure 1d shows some CMs did not fulfil regulatory requirements for collagen content. Furthermore, the range of collagen contents in the CMs was very wide. The first part of the CM group were labelled as chicken breast (pileća prsa), and second part, which had high collagen contents, were labelled as pizza ham (pizza šunka). Hence, the chicken breast CMs met the regulatory requirements for collagen. It is possible that since pizza ham does not usually command a high price, more connective tissue than is recommended was used in these products.

Figure 2 shows the percentages of HDs and CMs that contained different levels of protein and collagen. Protein and collagen levels were calculated as the percentage of the levels required by regulation (100%). All means of measured values (protein content and % collagen) were significantly different (lower or higher) to their regulated criteria (p<0.05). All HDs (n=21; 100%) met the regulatory requirements, and had higher protein content than the minimum required by law, and lower % collagen than the maximum % collagen stipulated by law. Furthermore, a large group of HDs, 48% in fact, contained 120-140% of the protein stipulated by law. Collagen contents in all HDs were in accordance with regulation. Moreover, all HDs contained less than 70% of the maximum allowed % collagen. In 2006, Saicic et al. examined 85 finely ground cooked sausages. Among these 85 cooked sausages, 14 (16.47%) did not satisfy legal criteria [9]. Furthermore, Kurcubic et al. reported that of 123 finely ground cooked sausages, 47 (27.65%) did not meet the regulation, of which 21 (17.07%) sausages had lower protein content and 33 (26.83%) had higher % collagen [10]. From the results presented in this paper, it seems likely that current production of finely ground boiled sausages (hotdogs) has prospered and that meat processing industries have stopped using excessive amounts of connective tissue.

However, analysis of CMs showed these products did not always comply with the regulation. The protein content in one CM (5%) was too low and did not accord with the regulation. Furthermore, 6 CMs (32%) contained unsuitably high % collagen, i.e. over the maximum allowed level. However, 74% of CMs had protein contents in the range of 100-120% of the legal minimum, and 58% of CMs had % collagen less than 50% of the maximum allowed level. The data show collagen content was the most common reason the meat products were not in accordance with regulation.
4. Conclusion
In conclusion, meat processors followed the regulatory requirements for protein and collagen when producing HDs. All the HDs (100%) had protein and collagen contents in accordance with stipulated Serbian law. In the case of CMs, six samples (32%) were not in accordance with regulation. However, among all 40 meat products examined (HD and CM) only six (15%) did not satisfy the regulatory criteria, mostly because of abundant usage of connective tissue. From previously published results of protein quality in meat products on the Serbian market and the results presented in this work, it seems the quality of hotdogs and canned meat in pieces on the Serbian market is improving.

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