EXAMINATION OF THE CERTAIN CHEMICAL CHARACTERISTICS OF DIFFERENT TYPES OF BOILED SAUSAGES PRODUCED IN SERBIA

ISPITIVANJA ODREĐENIH HEMIJSKIH POKAZATELJA KVALITETA RAZLIČITIH VRSTA BARENIH KOBASICA PROIZVEDENIH U SRBIJI

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Abstract

The objectives of our study were to examine certain chemical quality parameters in samples of various subgroups of boiled sausages and compare obtained values with reference values (Rule book on the quality of minced meat, semi-finished meat and meat products, Official Gazette of RS, no. 31/2012). We used two reference chemical methods: determination of nitrogen and phosphorus content (SRPS ISO 937:1992, SRPS ISO 13730:1999). For determination of hydroxyproline we used M 050 "in house" modified method. We concluded that the total number of tested samples of Fine grounded boiled sausages (n=170), 47 (27.65%) does not match the requirements for the quality provided the above mentioned Rule book, of which 21 samples because lower total protein content (TP) and 33 samples because higher relative protein content of connective tissue (RPC). The most common chemical quality failure of examined Coarsely grounded boiled sausages (n=94) is a higher percent of RPC than allowed (18 - 25 %). We consider in samples of same subgroup lower content of TP in 8 samples (11.11 %). From a total of 8 samples tested Boiled sausages with meat peaces (Šunkarica), all tested samples revealed lower content of TP than allowed (100 %) and 2 samples (25 %) higher relative protein content of connective tissue (RPC). The most common deficiency that reduces the chemical quality of the boiled sausages is higher level of RPC, demonstrated in 53 (19.48 %) of the total (n=272) samples tested. Something minor drawback is the lower percent of TP determined in 37 samples (13.60 %). Total P_2O_5 content was compatibile with the values permitted by the Rule book in all of 272 examined samples, indicating a strict adherence to regulations when using phosphate as one of the technologically most important additives in the production of boiled sausages.

Key words : Boiled sausages, relative protein content of connective tissue, total phosphorus content, total protein content

Rezime

Cilj našeg istraţivanja je bio da ispitamo odreĊene hemijske pokazatelje kvaliteta u uzorcima iz različitih podgrupa barenih kobasica i uporedimo dobijene vrednosti sa referentnim vrednostima po Pravilniku o kvalitetu usitnjenog mesa, poluproizvoda od mesa i proizvoda od mesa, Sl. Glasnik RS br. 31/2012. Koristili smo dve referentne metode za odreĊivanje sadrţaja azota i ukupnog fosfora (SRPS ISO 937:1992, SRPS ISO 13730:1999) i M 050 "in house" metodu za odreĊivanje hidroksiprolina. Moţemo zaključiti da je od ukupnog broja ispitanih uzoraka fino usitnjenih barenih kobasica (n=170), 47 (27.65%) ne ispunjava zahteve kvaliteta predviĊene gore navedenim Pravilnikom, i to 21 uzorak zbog niţeg sadrţaja ukupnih proteina i 33 uzorka zbog višeg relativnog sadrţaja proteina vezivnog tkiva. Najčešći nedostatak ispitanih grubo usitnjenih barenih kobasica (n=94) je viši relativni sadrţaj proteina vezivnog tkiva od dozvoljenog, ustanovljen u 18 ispitivanih uzoraka (25 %). U uzorcima iste podgrupe utvrdili smo niţi sadrţaj ukupnih proteina od dozvoljenog u 8 uzoraka (11.11 %). Niţi sadrţaj ukupnih proteina od dozvoljenog je utvrĊen u svih 8 ispitanih uzoraka barenih kobasica sa komadima mesa (Šunkarica), a u 2 uzorka (25 %) je relativan sadrţaj proteina vezivnog tkiva bio viši od dozvoljenog. Najčešći nedostatak koji je umanjivao hemijski kvalitet ispitivanih barenih kobasica je bio viši relativni sadrţaj proteina vezivnog tkiva od dozvoljenog, utvrĊen u 53 od ukupno 272 ispitana uzorka (25 %). Nešto manji nedostatak hemijskog kvaliteta je niţi procenat ukupnih proteina utvrĊen u 37 uzoraka (13.60 %). Sadrţaj ukupnih fosfata je bio kompatibilan vrednostima dozvoljenim Pravilnikom u svih 272 ispitivana uzorka, ukazujući da se proizvoĊači striktno pridrţavaju propisa kada je u pitanju upotreba fosfata kao jednog od tehnološki najznačajnijih aditiva u proizvodnji barenih kobasica.

Ključne reči : Barene kobasice, relativni sadrţaj proteina vezivnog tkiva, sadrţaj ukupnih fosfata, sadrţaj ukupnih proteina

INTRODUCTION

Suitable formulations for production of meat products and the provision of uniform quality, within the unchanged use of this product are one of the tasks with which the meat processing industry faces every day (Sveinsdóttir et al., 2009). Consumers want to buy meat products that will provide them with proper nutrition and ingredients satisfaction with consumption.

According to the used raw materials, production and mode of preservation, sausages are produced and marketed as: fermented sausages, boiled sausages and fresh sausages (Cvijanov et al., 2002). Boiled sausages are meat products that is common to the stuffing containing meat as a base dough, and that preserves heat treatment at a temperature of pasteurization. In the group of boiled sausage has a large number of species that differ in composition and fragmentation of the filling, heat method, type and diameter of the filling layer (Vuković, 2006).

Boiled sausages, produced according to the quantities (not only in Central Europe) the most common meat products. It is known that hundreds of species, which are often characterized by only a local or regional characteristics (Radetić, 2002).

According to the fragmentation of the filling is boiled sausages are divided into three subgroups: Fine grounded boiled sausages, Coarsely grounded boiled sausages and Boiled sausages with meat peaces. Fine grounded boiled sausages are, according to the quality and other requirements for meat products, “products obtained from different types of meat, fat and binding tissue, and they can be added to water, salt, salt substitute, food additives, spices, spice extracts, carbohydrates, protein products, fibers and foods, which stuffing is finely divided, with no visible pieces of meat, fat and binding tissue” (Official Gazette, no. 31/2012). Fine grounded boiled sausages are product of meat of the test (65 to 75%) and chopped fat. Coarsely grounded boiled sausages next to the meat of the test (30 to 50%) contain the stuffing minced cured meat and solid fat. Boiled sausages with meat peaces containing meat dough (20 to 40 %) and large chunks of pickled meat (Vuković, 2006). Spices commonly used in the meat industry are: black pepper, paprika, garlic, onion, coriander, cumin, anise, majoran, cloves, nutmeg, cardamom, laurel, mustard and other (Rahelić et al., 1980). Lack of quality raw materials used in the preparation of meat products significantly reduce the quality of products that are made. Fast and accurate tests to examine indicators of quality raw material and finished product quality of the meat has a techno-economic importance (Valous et al., 2009; Konieczny et al., 2006; Grujić et al., 2009). Quality, composition of meat product in all organized countries is regulated by regulations adjusted to consumer habits, technological capability and development of the country, control possibilities, religious demands (Arihara, 2006). Phosphates and polyphosphates are the most commonly used functional additives in the meat industry. As such, they deserve capability for the water-binding, improving the texture of products and stabilize the product (Belgin et al, 2004).

In Serbia, control of the technological process is carried out in production facilities where meat products are manufactured. Production specifications and declarations are controlled, as well as main chemical investigations, such as protein content, relative content of protein of connective tissue, content of total phosphates, nitrites and nitrates (Matekalo-Sverak et al., 2009).

Due to the fact that the connective tissue protein content significantly affects the quality of meat products, and that the phosphates are the most commonly used additives in the production of boiled sausage, domestic professional literature has very little information about their contents in the sausages. The aim of our investigation was to determine the total protein content (TPC), relative protein content of connective tissue in meat proteins (RPC) and total phosphate content in boiled sausages, and the results compared with the values permitted by the Rule book on the quality of minced meat, semi-finished meat and meat products, Official Gazette of RS, no. 31/2012.

MATERIALS AND METHODS

Samples

In our study, a total of 170 samples of Fine grounded boiled sausages tested, originating from a number of manufacturers registred in the territory of four Serbian districts: Zlatibor, Moravica, Raska and Rasinski. Also, ninety-four (94) samples of Coarsely grounded boiled sausages and 8 samples of Boiled sausages with meat peaces were tested. All examined products (with declared producer name), were shown in table 1.

Analytical Methods

Boiled sausages were examined by two standard and one modified methods:

1) SRPS ISO 937:1992: Meat and meat products - Determination of nytrogen content (reference method).
2) Determination of the relative protein content of connective tissue in meat protein (RPC) - „inhouse“ validated method M 050.
3) SRPS ISO 13730:1999: Meat and meat products - Determination of total phosphorus content - Spectrometry method.

Statistical Methods

Descriptive statistics and determination of significance levels by the T-test was done using the Statistica statistical software for Windows Release 5.0.

RESULTS AND DISCUSSION

The results of our investigations presented in tables 1 to 5. Compatibility assessment examined quality parameters of boiled sausages with limits prescribed by the Rule book on the quality of minced meat, semi-finished meat and meat products, Official Gazette of RS, no. 31/2012) are shown in Table 1. From a total of 272 tested samples of boiled sausages found that 74 samples (27.20 %) not fulfill the conditions provided by Rule book. The presented data indicate that the most common reason why the boiled sausage not eglible was higher RPC (33 of 47 samples of Boiled Fine grounded sausage proclaimed incompatible -12.13 % of total samples tested). Lower TP than the Rule book allowed was found in 21 of 47 samples (7.72 % total samples tested). At Coarsely grounded boiled sausages, the reason for the discrepancy in 18 of 22 samples was higher RPC values than allowed (6.61 %), and in 3 sample a higher total phosphorus (expressed as P_2O_5, g/kg) content. In the subgroup Boiled sausages with meat peaces all 8 samples were not eglible due to the TP was below, and in 2 samples (0.73 %) were found higher RPC than the limits permitted by the Rule book. In the Finely grounded boiled sausages subgroup, Viršla (Hrenovka) must have TP not less than 11 % and 20 % RPC. In the same products produced from poultry meat RPC not to exceed 10 %. In Parizer (Paris sausage) TP must not be less than 10 % and RPC must not be greater than 20 %, but in he product where used poultry meat RPC limit is 10 %. The poultry products RPC not to exceed 10 %. In the subgroup Coarsely grounded boiled sausages, Kranjska sausage TP shall not be less than 14 % and RPC not to exceed 15 %. In Tirolska (Tyrol sausage)TP shall not be less than 12 % and RPC not to exceed 20 %. In Mortadella TPC that is not less than 12 % and RPC not exceed by more than 30 %. TP in Other similar products from same subgroup must not be less than 12 % and RPC not exceed by more than 30 %, but if we used poultry meat RPC not exceed than 15 %. In the subgroup Boiled sausages with meat peaces, which is representative of Šunkarica (Ham), the TP in the product must not be less than 14 % and the RPC in meat protein must not exceed 15 %. Other similar types of products are obtained TP must not be less than 14 % and RPC not exceed by more than 20 %. The poultry product RPC not exceed 10 %.

Table 1: Compatibility of the selected boiled sausage quality parameters according the limits prescribed by Rule book on the quality of minced meat, semi-finished meat and meat products (Official Gazette, no 31/2012)

Tabela 1:Usaglašenost odabranih parametara kvaliteta barenih kobasica prema graniĉnim vrednostima propisanim Pravilnikom o kvalitetu usitnjenog mesa, poluproizvoda od mesa i proizvoda od mesa (Sl. Glasnik RS br. 31/2012)

No.	Name of product	Compatibility				
		Eligible	Not eligible	< TP	> RPC	> P_2O_5
	Fine grounded boiled sausages					
1	Posebna (n= 27)	20	7	3	4	-
2	Pileća posebna (n= 13)	10	3	1	2	-
3	Pileća ekstra (n= 5)	4	1	-	1	-
4	Ekstra posebna (n= 2)	1	1	-	1	-
5	Mini posebna (n= 3)	3	0	-	-	-
6	Ćureća posebna (n= 7)	6	1	-	1	-
7	GoveČa posebna (n= 2)	1	1	1	-	-
8	Francuska (n= 16)	15	1	-	1	-
9	Francuska mini (n= 5)	3	2	-	2	-
10	Pariska (n= 6)	3	3	2	2	-
11	Pileća pariska (n= 12)	6	6	1	5	-
12	Parizer sa povrćem (n= 2)	1	1	1	1	-
13	Juneća pariska (n= 7)	5	2	-	2	-
14	Viršla (n= 40)	31	9	6	6	-
15	Pileća viršla (n= 20)	11	9	6	5	-
16	Safalada (n= 3)	3	0	-	-	-
	Σ = 170 samples	123 (72.35 %)	47 (27.65 %)	21	33	-
	Coarsely grounded boiled sausages					
1	Roštiljska (n= 16)	11	5	-	5	-
2	Tirolska (n= 6)	4	2	1	2	-
3	Mini tirolska (n= 4)	2	2	2	1	-
4	Kranjska (n= 12)	8	4	-	3	-
5	Slaninska (n= 5)	2	3	3	3	-
6	Alpska (n= 10)	9	1	1	-	-
7	Mini alpska (n= 2)	2	0	-	-	-
8	Srpska (n= 14)	12	2	-	2	-
9	Novosadska (n= 4)	4	0	-	-	-
10	Slovenaĉka (n= 2)	2	0	-	-	-
11	Juneća (n= 6)	5	1	-	1	-
12	GoveČa (n= 3)	1	2	1	1	-
13	Tost narezak (n= 7)	7	0	-	-	-
14	Mortadela (n= 3)	3	0	-	-	-
	Σ = 94 samples	72 (76.60 %)	22 (23.40 %)	8	18	-
	Boiled sausages with meat peaces					
1	Šunkarica (n= 5)	0	5	5	1	-
2	Mini šunkarica (n= 3)	0	3	3	1	-
	Σ = 8 samples	0 (00.00 %)	8 (100.0 %)	8	2	-
	Σ = 272 samples	198 (72.80 %)	74 (27.20 %)	37	53	-

Saiĉić et al. (2006) examined a total of 312 sausages on content protein and hydroxyproline, of which 85 belong to Fine grounded boiled sausages subgroup, sixty-seven Coarsely grounded boiled sausages and fourteen Boiled sausages with meat peaces from different producers in the Republic of Serbia. On the basis of test results, it can be concluded which will make it out of the total number of respondents sausage (312), 14 (9.92 %) Fine grounded boiled sausages, 11 (13.92 %) of Coarsely grounded boiled sausages, 7 (35 %) of Boiled sausages with meat peaces does not meet the quality requirements prescribed Rule book. A higher RPC shown in 28 samples (8.97 %)

and lower content protein in 23 samples (7.37%). These results confirm our previously presented claims. Radović et al. (1981) observed large differences in the RPC in sausages. According to these studies, the meat proteins in boiled sausages containing 12-31 % proteins of connective tissue. In our work, mean values from RPC in meat proteins varied between products from 13.20 to 23.85 % (Fine grounded boiled sausages) and from 10.75 to 20.57 % in subgroup Coarsely grounded boiled sausages.

Total P_2O_5 content (g/kg) was compatibile with the values permitted by the Rule book (Official Gazette RS, no. 31/2012) in all of 272 examined samples, indicating a strict adherence to regulations when using phosphate as one of the technologically most important additives in the production of boiled sausages. Allowed total P_2O_5 content (added phosphate content expressed as a maximum of 5 g/kg plus natural phosphorus content) permitted by the newest Rule book (Official Gazette RS, no. 31/2012) is 8 g/kg (0.8 %). Directive 89/107/EEC as well as Croatian Regulation (NN 81/08) on additives that may be present in food specify the authorized use, so that the additives may be used when there is a technological justification, when added to quantities allowed (regulated) and the Regulations by adding when the consumer does not misleading with respect to the true nature, ingredients or nutritional values of food (Serdar and Katalenić, 2006). Croatian Rule book on food additives that may be present in food allowed the use of phosphate in meat products at most 5000 mg/kg P_2O_5. According to the Rule book on the quality and conditions of use of additives in food and other requirements for additives and their mixtures (Official Gazette SCG, no. 56/2003, 5/2004, and 16/ 2005), the maximum amount of phosphate that is added to meat products (diphosphate - E 450, triphosphate E 451 and polyphosphate E 452), alone or in combination, can be at most 5 g/kg.

In our study, mean value for total P_2O_5 content in Fine grounded boiled sausages varied depend of different products from 3.84 to 5.06 g/kg, Coarsely grounded boiled sausages from 4.24 to 5.80 g/kg and for Boiled sausages with meat peaces 4.36 to 4.48 g/kg. Saiĉić et al. (2008) examined 126 samples of finished products with poultry meat and 38 samples with meat of ungulates from export (sub-group Fine grounded boiled sausages), and obtain values from total phosphorus content from 3.27 to 8.77 g/kg, with mean value of 5.08±0.87 g/kg; They also examined 85 samples of finished products with poultry meat and 132 samples with meat of ungulates from local manufacturer (subgroup Fine grounded boiled sausages), and obtain values from total phosphate content from 2.4 to 7.72 g/kg, with mean value of 5.25±0.93 g/kg. The same authors examined 7 samples of imported products with poultry meat and 21 samples with meat of ungulates from export (sub-group Coarsely grounded boiled sausages), and obtain values from total phosphate content from 3.22 to 6.19 g/kg, with mean value of 5.11±1.01 g/kg; They also examined 17 samples of finished products with poultry meat and 162 samples with meat of ungulates from local manufacturer (subgroup Coarsely grounded boiled sausages), and obtain values from total phosphate content from 1.99 to 5.77 g/kg, with mean value of 4.97±0.82 g/kg, similar like in our study and investigation of Prica et al. (2007). Prica et al. (2011) determined average total protein content in hot dogs from Novi Sad market of 11.77±1.08% to 15.41±1.82% and average RPC of 17.34±0.95% to 22.33±2.08%. In tables 2, 3 and 4 presents the results of descriptive statistics for chemical composition of examined Boiled sausages, by subgroups.

For all products tested on chemical quality parameters (TP, RPC and total P_2O_5 content) are shown: Mean value ($\bar{x}$), Mean Standard Error ($S_{\bar{x}}$), Standard Deviation (SD) and interval of variation (min/max).

Table 2. Chemical quality parameters of examined finely grounded boiled sausages

Name of product	Chemical quality parameters	$\bar{x}$	$S_{\bar{x}}$	SD	Interval of variation	
					min	max
Posebna (n= 27)	TP (%)	11.78	0.31	1.62	8.27	15.37
	RPC (%)	18.20	1.53	7.98	7.53	36.83
	P_2O_5 (g/kg)	4.21	0.12	0.64	3.00	5.61
*Pileća posebna (n= 13)	TP (%)	12.12	0.54	1.94	9.11	16.00
	RPC (%)	15.17	1.45	5.24	7.52	24.81
	P_2O_5 (g/kg)	4.86	0.22	0.79	3.68	6.64
*Pileća ekstra (n= 5)	TP (%)	12.19	0.89	2.00	10.13	15.21
	RPC (%)	14.52	1.93	4.33	9.20	19.93
	P_2O_5 (g/kg)	4.52	0.26	5.89	3.71	5.32
Ekstra posebna (n= 2)	TP (%)	12.05	0.18	0.25	11.87	12.23
	RPC (%)	21.73	9.70	13.72	12.03	31.44
	P_2O_5 (g/kg)	4.71	0.68	0.97	4.03	5.40
Mini posebna (n= 3)	TP (%)	13.73	0.95	1.64	12.58	15.61
	RPC (%)	15.20	2.07	3.58	11.40	18.51
	P_2O_5 (g/kg)	5.06	0.63	1.09	4.05	6.21
*Ćureća posebna (n= 7)	TP (%)	11.61	0.51	1.35	10.28	14.07
	RPC (%)	17.11	2.20	5.81	10.20	25.60
	P_2O_5 (g/kg)	5.01	0.28	0.75	3.60	5.99
GoveĆa posebna (n= 2)	TP (%)	10.43	0.48	0.69	9.95	10.92
	RPC (%)	19.85	0.04	0.06	19.81	19.89
	P_2O_5 (g/kg)	3.97	0.18	0.25	3.79	4.15
Francuska (n= 16)	TP (%)	11.92	0.34	1.35	10.18	14.65
	RPC (%)	19.41	1.51	6.06	6.45	30.12
	P_2O_5 (g/kg)	4.15	0.16	0.62	2.63	5.22
Francuska mini (n= 5)	TP (%)	11.15	0.39	0.86	10.31	12.47
	RPC (%)	23.85	3.59	8.03	10.95	32.04
	P_2O_5 (g/kg)	4.11	0.28	0.64	3.10	4.87
Pariska (n= 6)	TP (%)	11.52	0.60	1.46	9.70	13.28
	RPC (%)	16.72	3.002	7.35	10.49	28.30
	P_2O_5 (g/kg)	4.10	0.207	0.51	3.28	4.79
*Pileća pariska (n= 12)	TP (%)	12.59	0.66	2.29	9.83	16.23
	RPC (%)	13.20	1.43	4.95	5.48	20.03
	P_2O_5 (g/kg)	4.13	0.17	0.58	3.32	4.93
Parizer sa povrćem (n= 2)	TP (%)	10.54	0.76	1.08	9.78	11.31
	RPC (%)	18.55	5.91	8.36	12.64	24.46
	P_2O_5 (g/kg)	3.84	0.67	0.95	3.17	4.51
Juneća pariska (n= 7)	TP (%)	13.60	0.28	0.75	12.73	14.51
	RPC (%)	18.22	2.20	5.83	12.50	27.70
	P_2O_5 (g/kg)	4.41	0.33	0.86	3.12	5.63
Viršla (n= 40)	TP (%)	12.45	0.25	1.61	8.37	16.06
	RPC (%)	16.40	0.90	5.67	6.77	36.52
	P_2O_5 (g/kg)	4.49	0.12	0.75	2.95	6.11
*Pileća viršla (n= 20)	TP (%)	10.99	0.33	1.47	8.33	13.60
	RPC (%)	13.73	0.96	4.32	7.26	21.92
	P_2O_5 (g/kg)	4.42	0.17	0.76	3.30	6.24
Safalada (n= 3)	TP (%)	12.74	0.84	1.45	11.07	13.71
	RPC (%)	19.32	2.00	3.47	15.31	21.41
	P_2O_5 (g/kg)	3.88	0.52	0.91	3.15	4.90

* products made from poultry meat

Table 3. Chemical quality parameters of examined coarsely grounded boiled sausages

Name of product	Chemical quality parameters	$\bar{x}$	$S_{\bar{x}}$	SD	Interval of variation	
					Min	max
Roštiljska (n= 16)	TP (%)	16.66	0.41	1.65	13.94	19.16
	RPC (%)	17.24	1.78	7.14	4.25	30.75
	P_2O_5 (g/kg)	4.62	0.37	1.48	1.83	7.26
Tirolska (n= 6)	TP (%)	14.12	0.86	2.11	11.65	16.68
	RPC (%)	15.79	2.25	5.51	6.25	20.24
	P_2O_5 (g/kg)	4.92	0.32	0.77	4.05	5.91
Mini tirolska (n= 4)	TP (%)	12.22	0.43	0.86	11.46	13.44
	RPC (%)	17.18	1.53	3.07	13.30	20.35
	P_2O_5 (g/kg)	4.24	0.40	0.80	3.29	4.98
Kranjska (n= 12)	TP (%)	17.01	1.18	4.09	14.26	29.67
	RPC (%)	15.85	2.35	8.15	4.38	29.25
	P_2O_5 (g/kg)	5.23	0.31	1.06	4.05	7.53
Slaninska (n= 5)	TP (%)	11.88	0.61	1.36	10.46	13.77
	RPC (%)	19.78	2.96	6.62	9.26	26.76
	P_2O_5 (g/kg)	4.90	0.16	0.37	4.47	5.39
Alpska (n= 10)	TP (%)	14.73	0.72	2.29	11.74	18.82
	RPC (%)	11.29	1.47	4.66	5.85	21.84
	P_2O_5 (g/kg)	4.66	0.25	0.80	3.42	6.31
Mini alpska (n= 2)	TP (%)	14.84	0.67	0.95	14.17	15.51
	RPC (%)	10.94	4.99	7.06	5.95	15.93
	P_2O_5 (g/kg)	5.80	0.00	0.00	5.80	5.80
Srpska (n= 14)	TP (%)	14.76	0.43	1.60	12.54	17.12
	RPC (%)	20.57	1.57	5.86	10.38	29.97
	P_2O_5 (g/kg)	4.47	0.18	0.69	3.28	5.81
Novosadska (n= 4)	TP (%)	15.72	0.51	1.02	14.52	16.86
	RPC (%)	10.75	3.91	7.81	3.90	17.63
	P_2O_5 (g/kg)	5.93	0.33	0.66	5.01	6.51
Slovenačka (n= 2)	TP (%)	15.45	1.03	1.46	14.42	16.48
	RPC (%)	17.08	2.61	3.69	14.47	19.69
	P_2O_5 (g/kg)	5.72	0.31	0.44	5.41	6.03
Juneća (n= 6)	TP (%)	16.22	0.45	1.22	14.88	18.41
	RPC (%)	14.53	3.91	9.57	2.36	25.92
	P_2O_5 (g/kg)	4.39	0.69	1.69	0.97	5.35
GoveČa (n= 3)	TP (%)	15.61	2.55	4.41	10.55	18.67
	RPC (%)	19.78	6.91	11.96	10.33	33.23
	P_2O_5 (g/kg)	5.55	0.82	1.42	4.44	7.16
Tost narezak (n= 7)	TP (%)	12.64	0.22	0.59	12.08	13.80
	RPC (%)	18.38	1.57	4.15	9.40	21.26
	P_2O_5 (g/kg)	5.18	0.25	0.68	4.55	6.49
Mortadela (n= 3)	TP (%)	14.63	0.28	0.49	14.24	15.18
	RPC (%)	14.55	1.12	1.94	12.69	16.57
	P_2O_5 (g/kg)	5.70	0.17	0.29	5.37	5.88

Table 4. Chemical quality parameters of boiled sausages with meat peaces

Name of product	Chemical quality parameters	$\bar{x}$	$S_{\bar{x}}$	SD	Interval of variation	
					min	max
Šunkarica (n= 5)	TP (%)	12.41	0.19	0.43	12.00	13.10
	RPC (%)	11.35	1.93	4.33	6.75	18.20
	P_2O_5 (g/kg)	4.36	0.35	0.79	3.45	5.42
Mini šunkarica (n= 3)	TP (%)	12.98	0.36	0.63	12.41	13.66
	RPC (%)	9.67	0.36	0.62	9.05	10.30
	P_2O_5 (g/kg)	4.48	0.66	1.14	3.75	5.79

Table 5. Results of t-test comparation of Boiled sausages chemical quality parameters made from poultry and other types of meat

Compared products	Chemical composition	p
Posebna (n= 27) and *Pileća posebna (n= 13)	TP (%)	ns
	RPC (%)	ns
	P_2O_5 (g/kg)	**
Francuska (n= 16) and *Pileća pariska (n= 12)	TP (%)	ns
	RPC (%)	**
	P_2O_5 (g/kg)	ns
Viršla (n= 40) *Pileća viršla (n= 20)	TP (%)	**
	RPC (%)	ns
	P_2O_5 (g/kg)	ns

ns - non significant; ** - very significant differences (p<0.001)
* products made from poultry meat

Table 5 shows the results of individual t-test, which we found significant differences between the tested products (made from poultry meat and other meat), from sub-group sausages Fine grounded boiled sausages. Comparative analysis of Posebna (Special Sausages) and Pileća posebna kobasica (Special Chicken Sausages) were found statistically significant differences (**- p<0.01), or on the level of 99 % between total P_2O_5 content, and the differences of TP and RPC values were not statistically significant (ns). Comparison of Francuska and Pariska pileća kobasica (French and Parisian Chicken Sausage) differences were not statistically significant were observed when the TP and total P_2O_5 content, and comparing RPC were found statistically significant differences (p <0.01). Not observed statistically significant differences in RPC and total P_2O_5 content in poultry frankfurter and frankfurter produced with other type of meat, while the TP differences were highly significant (p <0.01).

CONCLUSION

From the results we can conclude that food business operators (Meat-processing industry) are trying to lower the cost of their meat products using the lower categories of meat (less biological and nutritional value), with a higher content of connective tissue. Sausages that contain more connective tissue have a lower biological value and sensory quality. Connective tissue proteins differ significantly in their amino acid composition of proteins of muscle tissue, especially the smaller content of essential amino acids. Boiled and cooked sausages that come mostly from meat the second, third and even fourth category, which is less cleared of connective tissue, as well as from different parts connective tissue, may contain more protein connective tissue (different types of boiled sausages contain 20 or 25 % protein of connective tissue proteins in meat proteins). Since the TPC in most of the products was within the limits prescribed in the Regulations, our opinion is that the processors used protein supplements, approved for use in meat products which preserves heat treatment (boiled sausages). Our investigation should continue and deepen by the determination of the content of soy protein, gluten, milk obtained from supplements and carrageenens in meat products.

Our results revealed greatest compatibility (100 % samples of boiled sausages examined on total phosphorus content) with the permitted values by Rule book.

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