THE MAIN CHEMICAL COMPOSITION PARAMETERS OF PORK (review)

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ABSTRACT
The main aim of the study was to gather information on the chemical composition of the meat of pig, the pork. Data of several authors were summarized. The data of protein, the total fat, the SFA, MUFA and PUFA content were collected and also those minerals which have great importance on human alimentation. The level of total protein content of pig meat seems very stabile (19-24%) and hardly depend on the genetical background and the environment of the animals. The total fat content was between 1-15%. The results in fatty acid composition showed the following: among the saturated fatty acids the palmitic acid had the highest rate (21-25%) and the ratio of eicosanoic acid was less than 1%. Among monounsaturated fatty acids the palmitoleic acid level was remarkable high. The rate of linolic acid was outstanding in polyunsaturated fatty acids. Among the studied elements (Ca, P, Mg, Fe, I, Se, Mn, Cu, Zn) the iron can have a special role, because it is an important trait of the iron in the meat, that greater amount of it (15-35%) is utilized during the absorption, while only 1-5% of the iron content of the foods is made up of plants.

Keywords: chemical composition, pork, meat, protein, fat, minerals

INTRODUCTION

In Hungary, the annual, per capita domestic meat consumption significantly decreased in the last decade. The EU-27 consumption in average was 37 kg/capita/year (ANONYM, 2012). According to the data of the FAO, the meat consumption of Hungarian people was 74.7 kg per capita, per year. A notable domination was reported by POLGÁR's essay published in 2007. At that time, the per capita meat consumption was 63 kg, the other types of meat (sheep, goat, fish, rabbit, venison) were only 1.1 kg. The consumers of the developed countries pay more attention to the preservation of their health, gather more information about the healthy lifestyle, and they are consciously search for the foods, they presume healthy (ENSER, 2001; INCZE et al., 1998).

The nutrients of meat are indispensable for our vital functions, they are very important protein, fat, vitamin and mineral sources and thereby they are rich in flavouring materials (RODLER, 2009). The composition and the quality of meat are greatly influenced by breeding conditions (ALONSO et al., 2010). The meat quality of domestic animals, which were bred in natural conditions, is higher, and it means greater food safety for the consumer. The fat content of the meat changes on a wide scale (1-45 g/100 g), it depends on the breed, the feed, the age, the sex and the condition of the animal. The consumer behaviour is greatly influenced by these attributions.

In the recent paper, data from different authors were compared about the chemical composition of commercial pork.

DISCUSSION

Protein content

On the basis of the comparison of the data of the meat-examination in different sources, we can claim that there is no difference between the protein content of the meat (*Table 1.*).

ŠEGULA et al. (2007) examined the meat quality of the free-kept Large white, Landrace and Pietrain pigs. The animals ate only the vegetation of the pasture, and pumpkin at the end of the breeding period. KLIMIENĖ et al. (2010) got similar data, who examined the meat of cross-bred offspring (Lithuanian large white X wild boar). There was no significant difference in the protein and fat content between the results of the large white and the F1 generation. In respect of the protein content higher, in respect of the fat content lower values were measured in their samples. Japanese researchers (NISHIMORI et al., 2002) published similar results about the examination of the meat of cross-bred animals (domestic pig X wild boar). MARSICO et al. (2004) carried out feeding experiments on domestic pigs and wild boars, in which they verified that the fed fodder does not influence the chemical features of the meat. The meat of the wild boar always contained more protein and less fat, than the meat of the domestic pig. REN GUANG-ZHI et al. (2008) made the examination of the meat of five domestic pig breeds, of which we publish the results of the Duroc species. LOPEZ-BOTE (1998) analysed the fat content of the meat of the free-kept Iberian pigs. The fodders of the animals were acorn and the grass of the pasture. PEREZ SERRANO (2008) also made experiments with Iberian pigs and cross-bred animals (Iberian X Duroc). The result of PEINADO et al. (2008) was 4.6% total fat content in the meat of Large white X Landrace pigs, and this value is fit to fat content of the meat of wild boars which consume feed only from natural resources. Very low fat content (2.24%) was found by JAKIČ DIMIČ at al. (2007) who examined Large white, German landrace, Belgian landrace and New Hampshire pigs fed with silage and protein (plant and animal protein sources). NILZÉN et al. (2001) analyzed the pork of Hampshire X Yorkshire and Hampshire X (Swedish landrace X Yorkshire) kept free range and in stable also. The protein content of these animals corresponds with the results of several authors (*Table 1.*). It seems that the protein content of pork is more and less stabile in pig and less dependent from different factors.

Table 1. Protein content of commercial pork

Protein %	Source
19.10±2.70	TÓTH ET AL. (2009)
22.44±1.15	JAKIC DIMIC ET AL. (2007)
22.31±0.85	REN GUANG-ZHI ET AL. (2008)
23.42±0.14	KLIMIENĖ - KLIMAS (2010)
21.00±0.15	NILZÉN ET AL. (2001)
24.20±0.60	ŠEGULA ET AL. (2007)
21.20±0.11	PEINADO ET AL. (2008)
20.10±0.34	PEREZ SERRANO (2008)

Fat content and fatty acid composition

The total fat content of the meats (*Table 2*) shows an interesting result. The fat content in the meat of free range pigs was 2.1% and in stable was 2.4% (NILZÉN ET AL., 2001) lower than the research results of TÓTH et al. (2009) about the meat of Mangalitza pigs from organic production. LUGASI et al. (2006) examined the fat content of the meat of the Mangalitza, and the Large white X Dutch landrace. In case of Mangalitza 10.3%, in case of the cross-bred

animals 5% was the result. The total fat content of pork shows great variability (1-15%) depending on several factors. The fatty acid composition and levels are demonstrated in *Table 3*. The myristic acid (C14:0) and palmitic acid (C16:0) did not showed difference as it was found by different authors in domestic pig. Among the monounsaturated fatty acids the palmitoleic acid (C16:1) and the oleic acid (C18:1) showed bigger difference by the examined studies.

Table 2. Fat content of commercial pork

Fat %	Source
15.07±3.47	TÓTH ET AL. (2009)
2.24±2.73	JAKIC DIMIC ET AL. (2007)
3.16±0.36	REN GUANG-ZHI ET AL. (2008)
1.75±0.07	KLIMIENĖ - KLIMAS (2010)
1.77±0.05	WOOD ET AL. (2007)
2.10±0.13	NILZÉN ET AL. (2001)
10.00–13.00	LOPEZ-BOTE (1998)
1.00±0.37	ŠEGULA ET AL. (2007)
4.6±0.20	PEINADO ET AL. (2008)
10.3±3.8	LUGASI ET AL. (2006)

The fatty acid composition was analysed in different feeding circumstances in different domestic pig populations: Duroc (PEREZ SERRANO, 2008), Slovenian landrace and Slovenian large white (FURMAN ET AL., 2007), Landrace X Large white X Duroc crossbred (MITCHAOTHAI ET AL., 2007), and in all of them the level of palmitoleic acid was high.
ZUMBO et al. (2007) studied the level of linolic acid in a local breed (Nero Siciliano) and found lower level (4.72%) in the group was fed with acorn than in the group which was fed with barley (7.10%). The highest linolenic acid (C18:3 n-3) value was found in the data of MITCHAOTHAI ET AL. (2007).

Level of some important elements

The Ca levels of pork in publications are demonstrated in Table 4, and the alteration of the result is notable. Maybe the reasons of the differences are: the soil quality of the habitats, and the Ca and P content of the concentrates. The iron, the zinc, the copper, the manganese and the selenium are important minerals of the assorted flesh. It is an important trait of the iron in the meat, that greater amount of it (15-35%) is utilized during the absorption, while only 1-5% of the iron content of the foods is made up of plants (RODLER, 2004). The mezo- and microelements play a significant role in the metabolism processes of the body. The iron content was described low level in pork (TÓTH ET AL., 2009; MAIORANO ET AL., 2005; GERBER ET AL., 2008). The utilization of iron is correlated to the copper level. The Ca has also an influence on Cu utilization, so the high Ca level reduces the copper level of the meat. Data about the zinc content of pork shows relatively low values. The selenium content of the meat in the two groups remarkably differed.

Table 3. Saturated and unsaturated fatty acid content of commercial pork
(percentage of the total fatty acid content)

Fatty acid	Value (%)	Source
Myristic acid C14:0	1.53±0.05	FURMAN ET AL. (2007)
	1.22±0.17	MITCHAOTHAI ET AL. (2007)
	1.53±0.28	UEMOTO ET AL. (2011)
Palmitic acid C16:0	24.00±0.15	PEREZ SERRANO (2008)
	25.14±0.37	FURMAN ET AL. (2007)
	21.74±2.82	MITCHAOTHAI ET AL. (2007)
	24.60±1.10	LUGASI ET AL. (2006)
	23.86±0.32	GIULIOTTI ET AL. (2007)
	26.56±1.50	UEMOTO ET AL. (2011)
Stearic acid C18:0	13.00±0.29	PEREZ SERRANO (2008)
	14.01±0.57	FURMAN ET AL. (2007)
	14.73±2.52	MITCHAOTHAI ET AL. (2007)
	9.20±1.0	LUGASI ET AL. (2006)
	12.30±0.41	PEREZ SERRANO (2008)
	13.46±1.41	UEMOTO ET AL. (2011)
Eicosanoic acid C20:0	0.23±0.04	MITCHAOTHAI ET AL. (2007)
	0.06±0.01	GIULIOTTI ET AL. (2007)
Palmitoleic acid C16:1	2.50±0.16	FURMAN ET AL. (2007)
	0.91±0.22	MITCHAOTHAI ET AL. (2007)
	4.48±0.87	UEMOTO ET AL. (2011)
Oleic acid C18:1	48.20±0.27	PEREZ SERRANO (2008)
	39.80±0.53	FURMAN ET AL. (2007)
	30.39±1.44	MITCHAOTHAI ET AL. (2007)
	51.30±1.9	LUGASI ET AL. (2006)
	47.58±0.43	GIULIOTTI ET AL. (2007)
	48.38±2.16	UEMOTO ET AL. (2011)
Linolic acid C18:2 (n-6)	8.10±0.18	PEREZ SERRANO (2008)
	12.47±0.57	FURMAN ET AL. (2007)
	25.26±5.27	MITCHAOTHAI ET AL. (2007)
	6.20±2.00	LUGASI ET AL. (2006)
	4.72±0.02	ZUMBO ET AL. (2007)
	10.58±0.32	GIULIOTTI ET AL. (2007)
	5.48±1.25	UEMOTO ET AL. (2011)
Linolenic acid C18:3 (n-3)	0.79±0.10	FURMAN ET AL. (2007)
	1.00±0.23	MITCHAOTHAI ET AL. (2007)
	0.40±0.20	LUGASI ET AL. (2006)
	0.78±0.04	GIULIOTTI ET AL. (2007)
	0.23±0.05	ZUMBO ET AL. (2007)
Arachidonic acid C20:4 (n-6)	0.58±0.03	FURMAN ET AL. (2007)
	0.60±0.20	LUGASI ET AL. (2006)
	0.26±0.05	MITCHAOTHAI ET AL. (2007)
	0.05±0.008	GIULIOTTI ET AL. (2007)
	0.87±0.02	ZUMBO ET AL. (2007)

Table 4. Element content of commercial pork

Trait	Value	Source
Ca (mg/kg)	57.80±2.45	TÓTH ET AL. (2009)
	110.0±0.31	REN GUANG-ZHI ET AL. (2008)
	63.30±0.52	ŠEGULA ET AL. (2007)
P (mg/kg)	1754.00±23.3	TÓTH ET AL. (2009)
	2216.70±28.8	ŠEGULA ET AL. (2007)
Mg (mg/kg)	212.00±3.65	TÓTH ET AL. (2009)
	278.30±0.98	ŠEGULA ET AL. (2007)
Fe (mg/kg)	12.90±0.20	TÓTH ET AL. (2009)
	50.1±0.88	REN GUANG-ZHI ET AL. (2008)
	12.00±0.3	MAIORANO ET AL. (2005)
	30.21±10.51	JI-HUN JUNG ET AL. (1999)
	54.0	BUNCH ET AL. (1963)
	13.00±0.6	GERBER ET AL. (2008)
	64.00±7.80	ŠEGULA ET AL. (2007)
I (mg/kg)	0.025 ± 0.0155	HERZIG ET AL. (2005)
Se (mg/kg)	0.014	MAHAN ET AL. (1975)
	0.16±0.05	GERBER ET AL. (2008)
Mn (mg/kg)	0.504 ±0.01	REN GUANG-ZHI ET AL. (2008)
	0.43	LEIBHOLZ ET AL. (1962)
	0.12±0.06	GERBER ET AL. (2008)
Cu (mg/kg)	1.003±13.9	TÓTH ET AL. (2009)
	1.91±0.45	REN GUANG-ZHI ET AL. (2008)
	1.08±0.23	JI-HUN JUNG ET AL. (1999)
	2.1	KLINE ET AL. (1971)
	0.92±0.36	GERBER ET AL. (2008)
	1.00±0.20	ŠEGULA ET AL. (2007)
Zn (mg/kg)	20.30±0.15	TÓTH ET AL. (2009)
	4.94±0.91	REN GUANG-ZHI ET AL. (2008)
	19.49±6.02	JI-HUN JUNG ET AL. (1999)
	15.3	COUSINS ET AL. (1973)
	3.30±0.30	GERBER ET AL. (2008)
	12.30±0.70	ŠEGULA ET AL. (2007)

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