Nutritional value of pork - prejudice and reality

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Scientific review

SUMMARY

A stereotypical opinion that pork is fatty, rich in cholesterol and harmful to the human body is prevalent. However, lean (lower fat content) pork is rich in protein, essential amino acids, essential fatty acids and vitamin B complex. In comparison to other types of meat, lard has the optimum balance of saturated, unsaturated and polyunsaturated fatty acids. Unsaturated fatty acids have a protective effect on the heart and blood vessels. The content of cholesterol in lean pork is lower than in certain other types of meat. For example, lean lamb and beef are thus more often associated with a risk of developing coronary thrombosis and myocardial infarction than lean pork. The abundance of vitamin B complex (B1, B2, B6, B12, niacin, folic acid) found in pork protects the human body from nervous system diseases and mental disorders.

Key words: *pork, nutritional value*

INTRODUCTION

Since humans are omnivores, in addition to plant-based foods, their diet also requires animal-based products - meat, milk and eggs. Meat represents a source of essential (indispensable) amino acids and essential fatty acids for the human body because humans cannot synthesize them themselves. Pork occupies the first place in the structure of overall meat consumption in the Republic of Croatia. Such trend reflects Croatian eating habits (tradition) and favourable production conditions for pig breeding. A stereotypical opinion that pork is harmful to the human body because of its high fat and cholesterol content, as well because it increases the risk of developing cardiovascular diseases is prevalent nonetheless. In this paper we will answer whether such opinion is actually true.

Basic chemical composition

The comparison of basic chemical composition of pork and other types of meat is shown in Table 1. Pork contains a lower mass fraction of water and a higher mass fraction of fat that make pork, alongside duck and goose meat, a meat with the highest energy value. Pork is rich in protein and essential amino acids. It has a particularly good ratio between amino acid tryptophan (T), which builds muscle tissue protein, and amino acid oxoproline (O), which occurs only in connective tissue protein, that amounts to T/O = 7.2. The ratio T/O amounts to 6.4 in beef, 5.2 in mutton and 6.7 in poultry meat. It is well known that muscle tissue proteins have a more favourable amino acid composition (i.e. higher content

Table 1. Basic chemical composition and energy value of different types of meat (Senčić, 1994).

Type of meat	Nutrients (%)				Energy (kJ/kg)
	Water	Protein	Fat	Ash	
Pork	49,0-71,0	16,0-21,0	7,0-34,0	0,8-1,1	631-1597
Veal	69,0-74,0	19,0-22,0	3,1-11,0	1,0-1,1	493-752
Beef	55,0-74,0	19,0-21,0	4,0-25,0	0,9-1,1	514-1296
Mutton	54,0-66,0	15,2-16,5	15,5-30,0	0,8-1,0	899-1404
Older chicken meat	65,5-70,9	19,8-21,4	6,8-13,7	0,9-1,0	631-874
Chicken	67,5-72,1	19,8-22,8	4,0-11,5	1,1-1,2	548-786
Turkey	60,1-66,8	19,9-24,0	8,0-19,1	1,0-1,2	719-1083
Duck	49,4-58,4	13,0-17,5	22,9-37,0	0,6-0,9	1194-1659
Goose	48,9-59,4	12,2-16,9	28,8-38,1	0,8-0,9	1174-1638

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Table 2. Nutritional value of 100 g of lean pork, somewhat fatty veal, lean lamb and a whole chicken (Šimundić et al., 1994).

Sastojci	Mršava svinjetina	Malo masna junetina	Mršava janjetina	Cijelo pile
Voda (g)	72,00	72,00	56,00	66,00
Energija (kJ)	615	582	1298	892
Bjelančevine (g)	20,20	21,00	15,40	18,30
Lipidi (g)	6,80	5,50	27,10	14,80
Zasićene masne kiseline (g)	2,34	2,14	15,18	4,24
Mononezasićene masne kiseline (g)	3,06	2,41	7,76	6,08
Polinezasićene masne kiseline (g)	0,71	0,23	0,81	3,19
Kolesterol (mg)	65,00	60,00	71,00	90,00
Kalcij (mg)	7,00	6,00	9,00	11,00
Željezo (mg)	1,00	2,30	1,10	1,3,
Magnezij (mg)	23,00	23,00	17,00	20,00
Fosfor (mg)	224	201	135	149
Kalij (mg)	358	358	246	189
Natrij (mg)	64,00	63,00	54,00	70,00
Cink (mg)	2,45	4,34	3,40	1,48
Bakar (mg)	0,08	0,08	0,12	0,06
Mangan (mg)	0,01	0,01	0,01	0,03
Tiamin (B1-mg)	0,90	0,11	0,14	0,06
Riboflavin (B2-mg)	0,28	0,19	0,19	0,19
Pantotenska kiselina (B3-mg)	0,80	0,37	0,59	1,07
Piridoksin (B6-mg)	0,47	0,44	0,10	0,34
B12 (mg)	0,80	3,30	-	1,10
Niacin (PP-mg)	5,10	3,60	4,50	6,60
Folna kiselina (mg)	6,00	8,00	1,00	30,00
Vitamin A (mg)	2,00	-	-	0,20

of essential amino acids) then connective tissue proteins, as well as a higher biological value.

In the human digestive system, proteases break down muscle tissue proteins more easily than connective tissue proteins. Meats that are high in connective tissue therefore remain more undigested. The composition of pork is affected by the degree of fatness and meatness of pigs.

Table 2 demonstrates the difference in nutritional value between lean pork and other types of lean meats.

Proteins

Lean (lower fat content) pork is rich in protein and amino acids essential for human development. Of the 19 amino acids contained in food that are considered important for human nutrition, eight are considered essential or indispensable (phenylalanine, isoleucine, leucine, lysine, methionine, threonine, tryptophan and valine). Since these essential amino acids cannot be synthesized by the human body, they must be supplied by food. Dispensable (non-essential) amino acids include three amino acids (cysteine, tyrosine and arginine) that are important for children (Živković, 1999; Kaić-Rak et al., 1999) and therefore considered semi-essential (Živković, 1999). We also differ conditionally essential (conditionally indispensable) amino acids (Laidlaw and Dopple, 1987; Garlik and Reeds, 1994) that include serine, tyrosine, arginine, proline, histidine and glycine. Table 3 shows the share (%) of essential and conditionally essential amino acids in certain types of meat. Pork contains all essential and conditionally essential amino acids. Since insufficient amounts of essential amino acids jeopardize the proper functioning of organs and organ systems, and weaken the immune system, they accelerate the incidence and development of disease in elderly. Lean pork is rich in proteins that contain all essential and conditionally essential amino acids. Because it prevents the occurrence of chronic diseases, slows their development and prolongs life span, we can consider lean pork beneficial for the sick and the elderly.

A healthy diet, especially for the elderly, consists of meat that is higher in protein and lower in fat. Such meat aside from rabbit (22 % protein and 4 % fat) and skinless chicken (21.5 % protein and 6.9 % fat) also includes lean pork. Proteins are in human body primarily used as building materials. They build nails, hair, intracellular matrices, enzymes, hormones, nucleic acids and other substances essential for sustaining life. Their importance as a source of energy for the body is secondary. A daily intake of protein in adults should amount to 0.8 g of protein per kg of body weight (Kovačić and Senta, 1999). Children and young persons require even more protein, namely 1.0 - 1.5 g / kg of body weight, because of growth. It is recommended that adults consume even more protein than recommended daily amounts, namely about 80 - 100 g per day, whereas 40 % should be of plant and 60 % of animal origin (Kovačić and Senta, 1999). To fulfil all animal protein requirements by eating meat, a person should eat about 240 g of meat a day.

Table 3. Shares (%) of essential and conditionally essential amino acids in proteins of different types of meat (Sviben, 2001; different authors).

Amino acid	Share (%) in proteins		
	Pork	Beef	Mutton
Arginine	6.4	6.6	6.9
Cysteine	1.3	1.4	1.3
Phenylalanine	4.1	4.0	3.9
Glycine	6.1	7.1	6.7
Histidine	3.2	2.9	2.7
Isoleucine	4.9	5.1	4.8
Leucine	7.5	8.4	7.4
Lysine	7.8	8.4	7.5
Methionine	2.5	2.3	2.3
Tyrosine	3.0	3.2	3.2
Threonine	5.1	4.0	4.9
Tryptophan	1.4	1.1	1.3
Valine	5.0	5.7	5.0

Table 4. Shares (%) of fatty acids in intramuscular fat of different animals (Vuković, 2012).

Type of fat	Saturated fatty acids	Monounsaturated fatty acids	Polyunsaturated fatty acids
Beef	46	48	6
Pork	39	53	8
Mutton	48	46	6
Poultry	31	39	30

Table 5. Shares (%) of unsaturated fatty acids and essential fatty acids fatty acid content of different types of fat (Karakaš and Tomčov, 1973).

Fat	Unsaturated fatty acids	Essential fatty acids		
		Linoleic	Linolenic	Arachidonic
Lard	59	0.7	10	2.0
Mutton tallow	48	0.5	4	0.3
Beef tallow	40	0.5	2	0.1
Butter	30	1.0	2	0.2

Fat and cholesterol

Depending on the degree of fatness (meatness) of pig carcasses, pig genotype, method of feeding, body size and other factors, pork can contain a significant proportion of fat. Notably, in comparison to other types of meat, lard contains significantly greater amounts of unsaturated essential fatty acids (linoleic, linolenic and arachidonic) and favourable ratio of saturated, unsaturated and polyunsaturated fatty acids (Table 4). Fats that contain a higher percentage of unsaturated fatty acids exert a protective effect on the heart and blood vessels. Most fatty acids in lard are unsaturated. A low ratio (about 0.2) between polyunsaturated and saturated fatty acids (polyunsaturated fatty acid / saturated fatty acid - P/S) is generally associated with the high concentration of cholesterol in the blood and the development of coronary heart diseases such as angina pectoris and myocardial infarction in humans.

Lard contains five times more essential linolenic acid than beef tallow and two and a half times more essential linolenic acid than mutton tallow or butter (Table 5). The share of arachidonic acid in the total fatty acid content in lard is 6.7 times greater than the share of arachidonic acid in mutton tallow, 10 times greater than the share of arachidonic acid in butter and 20 times greater than the share of arachidonic acid in beef tallow.

Fatty acids derived from pig feed are absorbed and deposited almost unchanged. Higher levels of polyunsaturated fatty acids in pig feed therefore increase their content in pig fat. The fatty acid profile of pig body fat can thus be modified and adapted to human nutrition requirements by feeding (functional feeds).

The content of cholesterol in lean pork (Table 2) is lower than the content of cholesterol in chicken (whole chicken) and lean lamb, but slightly higher than the content of cholesterol in somewhat fatty veal. Higher levels of cholesterol in the human blood plasma were determined to be associated with a higher intake of saturated fatty acids, while lower levels of cholesterol were associated with a greater intake of foods high in polyunsaturated fatty acids in organism. A strong correlation ($r = 0.8$) was also established between levels of cholesterol in human blood serum and incidence of heart disease. Higher cholesterol levels in blood plasma were more often associated with death than lower cholesterol levels, in all human populations in the world. Levels of cholesterol in human blood plasma in different populations not only vary considerably, ranging from 2.6 mmol/l (100 mg / 100 ml) in New Guinea to 7.0 mmol/l (270 mg / 100 ml) in eastern Finland, but are without doubt directly affected by nutritional factors. The ratio of polyunsaturated to saturated fatty acids (P/S) in food is a widely used indicator of reducing cholesterol levels in human blood plasma.

An index of atherogenicity - IA) and an index of thrombogenicity - IT demonstrated in Table 6 are also used to indicate the tendency of food to influence the incidence of coronary heart disease.

Based on the value of IA and IT indices, it is evident that lean lamb and beef are more conducive to the development of coronary thrombosis and myocardial infarction than lean pork.

Cardiovascular diseases are the main cause of death in developed countries. A large number of people (> 50 %) also die from atherothrombosis in Croatia. The majority of older people is as a consequence of consuming too much saturated fat, cholesterol and salt diagnosed with hyperli-

Tablica 6. Index of atherogenicity (IA) and index of thrombogenicity (IT) of different foods (Ulbricht and Southgate, 1991).

Food	IA	IT
Sunflower oil	0.07	0.28
Olive oil	0.14	0.32
Margarine with polyunsaturated fatty acids	0.35	0.53
Braised beef liver	0.41	0.82
Roasted chicken	0.50	0.95
Hard margarine (from vegetable oils)	0.56	1.26
Fried pork sausages	0.58	1.35
Pork ham roast	0.60	1.37
Cuts of bacon (meat and fat)	0.69	1.66
Roast beef tenderloin	0.70	0.79
Raw ground beef	0.72	1.27
Fried beef sausages	0.74	1.39
Lamb chops	1.00	1.33
Roast breast of lamb	1.00	1.58
Milk, butter, cheese	2.03	2.07
Coconut oil	6.18	13.63

pidemia. The incidence of hypertension, tachyarrhythmia and bradyarrhythmia is also high (20 - 50 %).

Minerals and vitamins

Lean pork is also distinguished by the abundance of phosphorus and potassium, as well as magnesium and sodium. It also contains smaller quantities of other elements (trace elements): copper, cobalt, aluminium, nickel, manganese, molybdenum, lead, fluorine, iodine, barium etc.

Pork is especially rich in water-soluble vitamin B complex. It is particularly rich in thiamine (B1), i.e. aneurin. Namely 100 g of pork contains 15 times more thiamine than the same weight of chicken, about 8 times more thiamine than somewhat fatty veal and about 6.5 times more thiamine than lean lamb. Vitamin B1 is essential for the normal function of nervous system. Considering that daily human requirements for this vitamin range from 0.5-0.7 mg/day (children up to 3 years of age) to 0.9-1.3 mg/day (fifty-year-olds), they can be met by a lean pork cut weighing about 100-135 g. Pork also contains significant quantities of riboflavin (B2), pyridoxine (B6), cobalamin (B12), niacin and folic acid. The absence of these vitamins may result in the development of nervous system diseases and mental disorders. Furthermore, pork also contains smaller quantities of fat-soluble vitamins (A and D).

CONCLUSION

Lean (lower fat content) pork is a valuable source of protein, essential amino acids, essential fatty acids and vitamin B complex. Lard has the optimum balance of saturated, unsaturated and polyunsaturated fatty acids. The content of cholesterol in lean pork is lower than the content of cholesterol in certain other types of meat. The consumption of lean pork therefore contributes to the protection of the human body from cardiovascular and nervous system diseases and mental disorders.

REFERENCES

Garlik, P. J., Reeds, P. J. (1994.): Proteins Human nutrition and dietetics. Churchill Livingstone, Edinburgh, London, Madrid, Melbourne, New York, Tokyo.

Kaić-Rak, Antoinette, Antonić Degač, Katica (1999.): Prehrambene potrebe i bioiskoristivost bjelančevina. Proteini u prehrani i dijetetici, str. 27-31. Akademija medicinskih znanosti Hrvatske, Zagreb.

Karakaš, R., Tomčov Dragica (1973.): Gastronomske mogućnosti i dijetetske odlike svinjskog mesa i njegovih prerađevina. SVIND-Symposium „Kakvoća svinjskog mesa, njegova prerada i korištenje", Zagreb.

Kovačić, L., Senta, Ankica (1999.): Proizvodnja i potrošnja proteina u svijetu i Hrvatskoj. Proteini u prehrani i dijetetici, str. 17-25. Akademija medicinskih znanosti Hrvatske, Zagreb.

Laidlaw, S. A., Dopple, J. D. (1987.): Newer concepts of the indispensable amino acids. American Journal of Clinical Nutrition 46, 593-605.

Senčić, Đ. (1994.): Peradarstvo. Gospodarski list, Zagreb.

Sviben, M. (2001.): Opskrba ljudi mesom za zdravlje. Hrvatsko agronomsko društvo, Zagreb.

Šimundić, B., Jakovlić, Vlasta, Tadejević, V. (1994.): Poznavanje robe i živežne namirnice s osnovama tehnologije i prehrane. Tiskara Rijeka d. d., Rijeka.

Ulbricht, T. L. V., Southgate, D. A. T. (1991.): Coronary heart disease: seven dietary factors. The Lancet 338: 485-992.

Vuković, K. I. (2012.): Osnove tehnologije mesa. IV izdanje. Veterinarska komora Srbije, Beograd.

Živković, R. (1999.): Proteini u prehrani i dijetetici. Akademija medicinskih znanosti Hrvatske, Zagreb.

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Opatija, od 26. do 29. listopada 2016.

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Za organizacijski odbor
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Rad Kongresa odvijat će se putem uvodnih predavanja po pozivu te znantveno-stručnih radova s kratkim usmenim izlaganjem odabranih radova, koji će biti objavljeni u Zborniku.