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MEAT INTAKE - IMPORTANCE AND RECOMMENDATIONS

UNOS MESA - VAŽNOST I PREPORUKE

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ABSTRACT

The aim of the paper is to provide an overview on the role of meat in human nutrition. The focus is on the adaptation of humans to an omnivorous diet and the nutritional value of meat and its contribution in satisfying the nutrient requirements. The influence of meat intake on the incidence of some chronic diseases is described and the fact that re-examination of epidemiological data shows that a higher risk for cancer was wrongly ascribed to high meat intake, being far more associated with low fruit and vegetables intake and to other life-style risk factors. At the end a review of current recommendations concerning meat intake is given. Because of its high nutritional value, meat retains important role in prudent human nutrition.

Key words: meat intake, evolution, nutrient requirements, health, recommendations

INTRODUCTION

The role of meat intake in human nutrition at the present time is very often discussed. On one hand meat without doubt has a very high nutritional value; on the other some investigations showed a positive association between meat intake and the incidence of some chronic diseases. Among the public and in the media we are very often confronted with the statement that meat intake is not important and is not necessary for healthy nutrition, and even statements about the vegetarian nature of man. In these circumstances not only the consumers but also farmers and others involved in the meat production and/or processing are confused.

The aims of the article are to give some answers and explanations about the role of meat in modern nutrition and to present some practical recommendations. Both aims are based on the evolutionary adaptation of man to an omnivorous diet, the nutritional value of meat and the importance of meat in meeting nutritive requirements, and on the association between meat intake and the incidence of some chronic diseases.

EVOLUTIONARY ASPECTS OF MEAT CONSUMPTION

The history of meat consumption started some 7.5 to 4.5 millions year ago when our human ancestors gave up vegetarianism (mainly fruit-arianism) and started to consume more and more meat. Since then meat has obtained a special place throughout the history of human evolution. It is believed that about 2 million years ago *Homo habilis*

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started to produce stone tools and that his follower *Homo erectus*, about 1.8 to 1.6 million years ago, consumed much more meat. However, *Homo erectus and Homo sapiens* (about 400.000 years ago) consumed a diet with more than half of the food of plant origin. After reconstruction of early nutrition on the basis of paleontological findings and comparison of the sources of food of that time with contemporary human tribes who today still live by hunting and collecting food (hunter-gatherers), this palaeolithic man of the modern human species (*Homo sapiens sapiens*), 400.000 years ago consumed daily about 913 g of meat and 1697 g of food of plant origin (Eaton, 1992., Eaton and Konner, 1985., Eaton et al. 1998., Cordain et al., 2002). This means that our ancestors obtained at least half of their daily requirements from food of animal origin.

Cordain (2002) concludes on the basis of his own and other investigations of the nutritional habits of 229 contemporary hunter-gatherer societies that the majority (73%) of these societies consume more than one half of their energy from animal foods and that only 14% of them consume more than one half of their energy from plant foods. On average these societies consume 66-75% of their energy from animal foods. At present Europeans obtain only 7-14% of their energy requirements from meat (Linseisen et al., 2002).

In this at least 4.5 million year long period of meat consumption, man has become omnivorous. This means that he has developed a suitable structure and constitution of digestion and metabolism.

Human digestive adaptations to omnivorous diet include the following:

- Human dentition is adapted for an omnivorous diet composed of plant and animal food. The formation of detention was partially also influenced by food preparation (the last 2 million years) and the use of fire (last 400.000 years) (Konarzewski, 2002).

- The human stomach is histologically more similar to that of carnivorous animals than to the stomach of omnivorous or herbivorous animals. Figure 1 presents the histological regions of the stomach. It is evident that the area of the proper gastric regions that secrete acid and enzymes (fundic and pyloric regions) in the human is more like a dog than a pig or horse (figure 1).

- The human digestive tract is relatively short and has a small volume. Additionally also, the large intestine (designed for the fermentative digestion of non-starch polysaccharides) represents a relatively small part of the digestive tract (Table 1). Both these characteristics are also signs of carnivorous and omnivorous species that digest food with secreta of their own digestive tract and obtain nutrients directly from food. In contrast, the herbivorous animals obtain a substantial part of their energy and some nutrients by microbial fermentation. Hence, also in this respect man is clearly an omnivorous species.

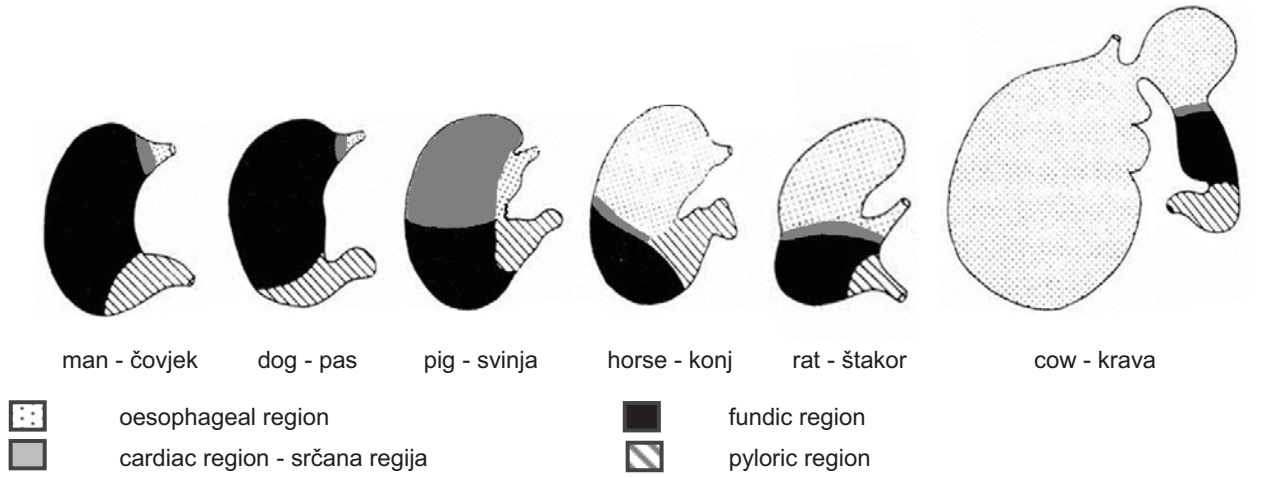

Figure 1. The histological differences in the stomachs of some animal species and man (adapted from Stevens, 1988)
Slika 1. Razlike u histološkoj građi želuca između životinjskih vrsta i čovjeka (prilagođeno prema Stevens, 1988)

Table 1. Some anatomical characteristics of the digestive tract in various animal species and man (according to Kofrány and Wirths, 1987; Bender and Bender, 1997; Loeffler, 2002; Schmidt and Thews, 1983)

Tablica 1. Neke anatomske karakteristike probavnog sustava kod raznih vrsta životinja i čivjeka (prema Kofrány i Wirths, 1987; Bender i Bender, 1997; Loeffler, 2002; Schmidt i Thews, 1983)

	Cow Krava	Horse Konj	Pig Svinja	Man Čovjek	Dog Pas
Body length ÷ alimentary tract length Dužina tijela ÷ dužina probavnog sustava	1÷20	1÷10-16	1÷14	1÷4-7	1÷5
Alimentary tract (m) - Probavni sustav (m)	33-63	25-39	20-27	6-7	2-6
Small intestine (m) - Tanko crijevo (m)	27-49	19-30	16-21	5-5,5	1,8-4,8
(as % of alimentary tract length) (% dužine probavnog sustava)	81-78	76-77	82-78	81-79	86-84
Large intestine (m) - Debelo crijevo (m)	6,5-14	6-9	3,5-6	1,2-1,5	0,3-0,9
(as % of alimentary tract length) (% dužine probavnog sustava)	19-22	24-23	18-22	19-21	14-16

For these reasons humans have to consume food with high digestibility and relatively high concentration of nutrients, in order to provide proper balance of energy and nutrients.

Human metabolic adaptations to an omnivorous diet:

- Like obligatory carnivorous animal species, humans also have insufficient ability to desaturate and elongate C18 fatty acids (FA) into essential long chain (C20 and C22) polyunsaturated fatty acids (LC-PUFAs) (Anderson et al., 1990). Because of the extremely large size of the human brain, our nutritive requirements for LC-PUFAs are also much higher than in animals (also primates). Since plants contain only FA with a maximum of 18 C atoms, the insufficient ability to desaturate and elongate C18 FA is most probably an evolutionary adaptation to foods with high LC-PUFAs content (fish and meat). In carnivorous animals (for instance cats) the ability to desaturate and elongate C18 FA is even lower than in humans (Salem and Pawlosky, 1994).

- Concerning the proportion between n-6 and n-3 PUFAs, humans are adapted to a relatively narrow ratio between these FA groups (Leaf and Weber, 1987; Eaton et al., 1998). Again this desirable ratio is possible and much easier to obtain with a fish- and meat-containing diet.

- Vitamin B_{12} is a vitamin that is not present in plant foods and can be found in natural diets only in food of animal origin. Plant eating animals cover their needs via microbial fermentation in the gut. Of course microbial fermentation also exists in the gut of carnivorous animals, but is insufficient to the extent that, for instance the cat is practically completely dependent on its supply from (animal) food (Konarzewski, 2002; NRC, 2006). A similar situation also occurs in humans. Human microbial fermentation is also insufficient to meet B_{12} requirements. Because of that we depend on the consumption of animal foods and to some extent (in the last few thousand years) also on consumption of fermented food products (yeast, fermented food).

- In contrast to herbivorous animals, humans have a limited ability to synthesize taurine from the precursor sulphur-containing amino acids. Since plants do not contain taurine, vegetarian nutrition reduces the taurine concentration in the blood and urine. Because of their carnivorous nature cats have completely lost the ability to synthesize taurine during evolution. To some extent the same has occurred in humans. Because of consumption of an omnivorous diet the importance of endogenous taurine synthesis has also been reduced and lost to some extent during evolution in humans (Cordain et al., 2002).

- Similarly, loss of the ability to synthesise vitamin C in humans clearly suggests that plants have always constituted a significant part of our diets (Cordain et al., 2002; Konarzewski, 2002).

It is obvious that in this at least 4.5 million year long period of meat consumption, man has become adapted to an omnivorous diet. We have to keep in mind that the period from the hunter-gatherer society (some 40.000 years) is far too short to enable greater genetic adaptation to an other type of diet (Aoki, 1991; Hedges et al., 1992). Consequently, our nutrient requirements and also the type of food that meets our nutrient requirements have not changed.

NUTRIENT COMPOSITION OF MEAT AND THE CONTRIBUTION OF MEAT TO NUTRIENT INTAKE

It is generally known that meat contains high amounts of some nutrients that plant foods do not contain or contain in only limited amounts. But much less known and obvious is the fact that the availability of some crucial nutrients in foods of animal origin is much higher than in plant foods, where they might be practically unavailable.

Meat, especially red meat is a particularly good source of the following nutrients:

- in a continental diet (that contains a low proportion of fish), with the exception of eggs, meat is the only important source of long-chain poly-unsaturated fatty acids (LC-PUFA) (eicosapentaenoic, docosahexaenoic, arachidonic),
- vitamin B_{12}, folate and other B vitamins,
- iron,
- zinc,
- selenium,
- vitamin A,
- vitamin D,
- essential amino acids,
- meat of ruminant animals contains also conjugated linoleic acid that has anticarcinogenic and other effects.

As already mentioned, the availability and/or biological value of many nutrients in meat is much higher than in plant food. Additionally humans are evolutionarily adapted to a type of diet that contains a substantial amount of foods of animal origin. For example, the availability of iron bound in haemoglobin in meat is 20-30%, whereas the availability of iron in plant foods is only 7% (BNF, 1995). The same is true for other macro and micro minerals. Thus meat contributes a significant proportion of total intake of some very often deficient nutrients (Williamson et al., 2005). Because of that meat is a very important food for the nutritionally most vulnerable population groups: e.g., women of childbearing age, pregnant and lactating women, children, the elderly.

The contribution of meat in covering the requirements of some "crude" nutrients in the case of Austria is shown in Figure 2. If we consider that Europeans at present obtain from meat only 7-14% of their energy requirements (Linseisen et al., 2002) and the high availability of nutrients in foods of animal origin, then the importance of meat consumption is even more dramatic. Considering these facts, meat can contribute up to 30-50% of iron requirements. What holds for Austria is true for other countries like Denmark, Great Britain… (Williamson et al., 2005).

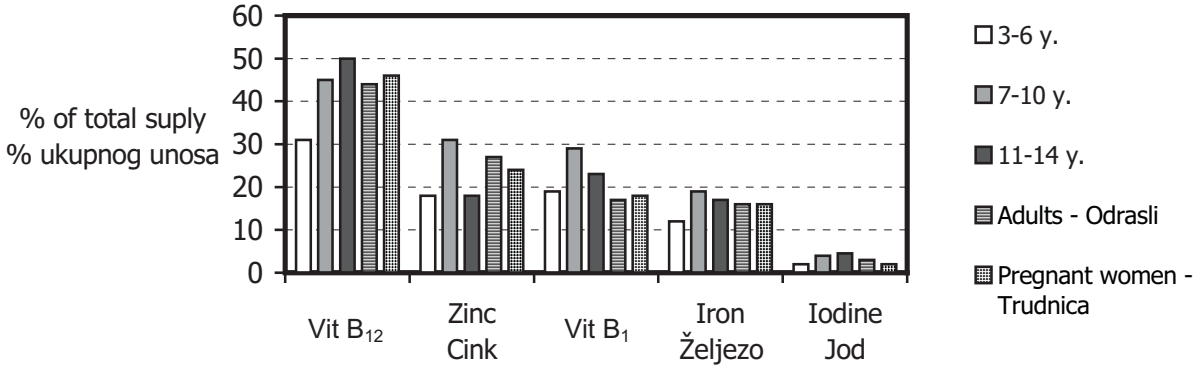

Figure 2. Contribution of meat in covering requirements for some nutrients in Austria (Elmadfa et al., 2003)
Slika 2. Udio mesa u podmirenju potreba za nekim hranjivim tvarima u Austriji (Elmadfa i sur., 2003)

Iron deficiency anaemia is one of the most common nutritional deficiencies in the UK, particularly in young children and women of childbearing age (BNF, 1999a). 25% of women in Great Britain between 19 and 64 years of age and 45% of teenage girls and 42% of women in New Zealand do not reach the lower recommended level of iron intake (Williamson et al., 2005). The position is similar in other developed countries. Gibson and Ashwell (2003) found that in women with a low meat and processed meat intake (less then 90 g per day) the risk of an inadequate iron intake is much higher than in women that consume more than 140 g per day. The risk is connected not only to the higher content and better availability of haem iron in comparison to plant foods, but also to the fact that meat in the diet improves the availability of plant iron (Williamson et al., 2005).

What is true for iron is true also for other nutrients like B_{12}, zinc, selenium (Biesalski, 2002). Because of that eminent nutritionists not only warn that total exclusion of meat in regard to a sufficient Fe supply is critical among certain population groups, e.g. young women (Elmadfa et al., 2003), but also that consumption of red meat, as a part of balanced and varied diet, should be actively encouraged (Hill, 2002; Hallberg, 2002; Biesalski, 2005). Also the British Nutrition Foundation (BNF, 1999b) warns against a general policy of decreasing meat consumption in the population since it may result in iron deficiency becoming a major public health issue.

Meat is very often considered as a fat- and energy-rich food. But there have, however, been substantial reductions in the fat content of carcase meat over the last 20 years. This is a result of successful breeding programmes, modifications of animal feeds, new butchery techniques at retail level and trimming in the home. For instance, the fat content of a pig carcase was reduced by more than 30% in the last one or two decades, and the fat content in some edible parts has been reduced to a level of less than 2%. In respect to a high fat content, only the intake of some carcase parts and especially processed meat (sausages, salami…) that not seldom contains 30% fat, is regarded as questionable and should be reduced.

SOME HEALTH ASPECTS OF MEAT CONSUMPTION

Meat intake is often considered to be related to the incidence of some chronic diseases such as cancer, obesity, cardiovascular disease, and type 2 diabetes. Some associations will shortly be presented. It should be mentioned at the beginning that the scientific literature and also WHO (WHO, 2003) in its report on diet, nutrition and the prevention of chronic diseases, did not find significant associations between meat intake and the incidence of obesity, type 2 diabetes, cardiovascular disease (CVD), cancer, dental disease and osteoporosis. Only the relationship between processed meat intake and the incidence of colorectal cancer is pointed out as probably increasing risk. As will be stressed in the following text, some recent publications indicate that also this association does not exist or does not exist in general.

Meat and obesity

Because studies comparing meat-eaters to vegetarians have shown that vegetarians tend to have a lower BMI than comparable non-vegetarians (Key et al., 1999), it could be concluded that meat intake is one of the reasons for obesity. But the conclusion is wrong. The reason for the difference lies in the fact that vegetarians very often have higher physical activity and eat much more fruit and vegetables that have low energy values (Williamson et al., 2005). It has to be mentioned that there is also some evidence that it can be advantageous to include lean meat in weight loss diets, as high protein intakes have been found to lead to increased satiety (Stubbs 1995).

Meat and cardiovascular disease (CVD)

Red meat contains SFAs, a high intake of which can have adverse effects on CVD risk factors such as blood cholesterol levels and LDL, but it also contains other fatty acids (n-3 PUFAs, MUFAs) and nutrients (e.g. B vitamins and selenium) that offer potential cardio protective benefits (reducing cholesterol levels and increasing HDL). Cohort studies have been unable to distinguish between the effects of different types of meat, but feeding trials have not

demonstrated lean meat to be hypercholesterolemic or blood pressure raising or to have any negative effect on thrombotic risk factors, which suggests that it can be promoted as part of a healthy diet for primary and secondary CVD prevention (Williamson et al., 2005).

As already mentioned, unsaturated fatty acids have cardio-protective effects. Because of an inadequate intake of n-3 PUFAs current dietary guidelines recommend an increase in their intake. Intake of these fatty acids from red meat, mainly in the form of α-linolenic acid (18:3 n-3), is significant for the average consumer, despite being present at low levels (BNF, 1999b).

The content of n-3 PUFAs can be increased by appropriate animal nutrition. Research has shown that fortifying the diets with n-3 PUFA offers the opportunity to increase levels of n-3 PUFA and to decrease the level of saturated FA in meat to the level that can have a positive effect on consumers' health (Table 2).

Table 2. The effect of normal and n-3 FAs enriched (by feeding soy oil) pork meat on the concentration of free FAs and plasma lipids in healthy women (Stewart et al., 2001)

Tablica 2. Učinak normalnog i n-3 obogaćenih masnih kiselina (hranjenjem sa sojinim uljem) obogaćenog mesa svinja na koncentraciju slobodnih masnih kiselina i lipida u plazmi zdravih žena (Stewart i sur., 2001)

	Feed - Hrana		Blood plasma - Krvna plazma	
	Control Kontrola	n-3 enriched n-3 obogaćen	Control Kontrola	n-3 enriched n-3 obogaćen
Saturated FA, % - Saturirane MK, %	39	24	43^a	36^b
PUFA, %	17	42	21^a	33^b
Total cholesterol (mmol/l) - Ukupni kolesterol (mmol/l)			$4,0^a$	$3,4^b$
LDL (mmol/l)			$2,3^a$	$1,8^b$
HDL (mmol/l)			1,3	1,2

[a, b] Means without the same superscripts in the same row differ significantly; $P < 0{\cdot}05$

It is of course clear that a high intake of fatty meat and preserved meat with a high fat content increases risks of CVD and also obesity. The risk is associated not only with the high saturated FA intake and the high energy intake, but also with the fact that a high meat intake is often associated with reduced intake of foodstuffs and substances in the diet (vegetables and non-refined cereal products…) that are cardiprotective.

Meat and type 2 diabetes

People with type 2 diabetes, like the general population, are recommended to follow a healthy balanced diet, low in fat (especially SFAs) and rich in fruit, vegetables and wholegrain cereals, to maintain a healthy bodyweight and to stay physically active (BNF 2004). There is no evidence to suggest that lean red meat cannot be recommended, in moderation, as part of a healthy balanced diet for people with type 2 diabetes (Williamson et al., 1995). In fact, single-meal intervention studies suggest that an energy restricted, high-protein, low-fat diet (that includes lean red meat) may actually help improve overall glucose control in type 2 diabetes (Gannon et al., 2003). Additionally, evolutionary studies suggest that we are not adapted to a high carbohydrate diet and to food sources with very high carbohydrate digestibility (high glycaemic index) and that this can provoke the development of type 2 diabetes (Colagiuri and Miller, 2002). Because of that it is not surprising that an energy restricted, high-protein, low-fat diet (that includes lean red meat) may actually help improve overall glucose control in type 2 diabetes (Gannon et al., 2003; Nuttall and Gannon, 2006).

Meat and cancer

As mentioned, the WHO report on diet, nutrition and the prevention of chronic diseases (WHO, 2003) did not find a significant association between meat

intake and the incidence of cancer. But the relationship between processed meat intake and the incidence of colorectal cancer (CRC) is indicated as probably increasing risk. Therefore in continuation the focus will be on these associations.

The results of meta analyses of meat intake in relation to cancer development, for example of Norat et al., 2002 (14 studies), Williamson et al., 2005 (6 studies) or Marques-Vidal et al., 2006 (42 studies) show that some surveys actually proved an association between the incidence of cancer and meat intake, especially processed meat intake. For example Marques-Vidal et al. (2006) found that most studies did not find any association between colorectal cancer and processed meat intake but some did: for red meat 4 surveys out of 20, for processed meat 4 surveys out of 11 and for white meat 2 surveys out of 11.

Based on these results it could be concluded that especially intake of processed meat is associated with CRC cancer risk. But this has to be examined more critically and taking into account also other nutritional (intake of fruit and vegetable) and life style (smoking, physical activity…) risk factors. After doing this the association between meat and CRC cancer risk disappears or at least is not established in general. For example, in the large prospective study carried out by Hirayama (1990, cit. Williamson et al., 2005) daily meat consumers were found to have a much higher incidence of CRC than those who never consumed meat. But interestingly meat intake was positively associated with CRC only for those individuals who never ate vegetables, whereas, for those who consumed green-yellow vegetables daily, there was an inverse association between meat intake and CRC risk. This may also help explain why many Mediterranean countries, which have a higher meat intake and also a higher vegetable and fibre intake than for instance Denmark and the UK, have lower rates of CRC mortality (see Table 3). Moreover, this could also help explain why meat intake only appears to be a risk factor in the highest intake groups (i.e. more than 140 g per day), as this level of intake could override the effect of protective factors provided by plant foods in the diet (Hill 2002).

Prospective cohort studies provide the best available evidence regarding associations between diet and cancer, but they have their limitations. In particular, the complex nature of the diet makes it very difficult to measure precise levels of food and nutrient intake. Furthermore, it is very difficult to unravel the independent effects of individual dietary factors, as dietary patterns tend to cluster, e.g. individuals with high intakes of processed meat have also been shown to have low intakes of fruit and vegetables (Cosgrove et al. 2005). The ones with high meat and processed meat intake very often also have increased other risk factors linked to diet and to life-style such as, higher incidence of smoking, higher body mass index, lower dietary fibre intake, lower vitamin E, folic acid intake, lower intake of dietary supplements, lower degree of education… (Davey et al., 2003; Cade et al., 2004; Cosgrove et al., 2005; Williamson et al., 2005; O'Hanlon, 2006).

The most recent study that also took into account other nutritional and life-style factors is EPIC (European Prospective Investigation into Cancer and Nutrition) (Norat et al., 2005). The power of this study was increased by using large numbers of subjects (520.000 subjects from 10 EU countries) with great heterogeneity in dietary habits. Therefore, the EPIC study currently provides the strongest available evidence regarding associations between dietary factors and the risk of cancer (Williamson et al., 2005). The results of the study show:

- red and white meat intake are not significantly associated with increased CRC incidence,
- processed meat intake is significantly associated with increased CRC incidence (higher intakes have increased risk)
- high intake of red and processed meat intake (> 160 g per day) is significantly associated with increased risk, but the association is no longer significant if other factors are taken into account (BMI, energy intake, smoking, intake of alcohol, dietary fibre and folate, physical activity)

We also have to keep in mind that no studies so far have shown red or processed meat intake to be protective against CRC. A number of mechanisms for the association between red and processed meat intake and CRC incidence have been suggested. However, none of these potential mechanisms has been definitively established. The most plausible mechanisms identified so far to explain why red meat intake may be a risk factor for colorectal

carcinogenesis involve meat-related mutagens such as heterocyclic amines, polycyclic aromatic hydrocarbons and N-nitroso compounds (Cross & Sinha 2004).

Based on these facts it can be concluded:

- Moderate intake of lean (red) meat has no negative effect on health. There is no scientific justification for eliminating meat from the diet. (Hill, 2002).

- Lean red meat is unlikely to increase the risk of CRC significantly when consumed in moderation and as a part of healthy, balanced diet that includes plenty of fibre from fruit, vegetables, legumes and wholegrain cereals (Williamson et al., 2005).

- Meat intake may only be a risk factor in those who do not eat sufficient amounts of foods that are considered to be protective (Hill, 2002).

MEAT INTAKE IN EUROPE

To be able to give general nutritional recommendations concerning any food or food group intake it is of course necessary to know the current intake and pattern of intake of the population. Table 3 shows the daily intake of different types of meat for selected European countries from the already mentioned EPIC study, together with CRC incidence for each country.

RECOMMENDATIONS FOR MEAT INTAKE

There is no general agreement on recommendations for meat intake. Recommendations vary between countries and organisations and are also not consistent in the type of meat they are recommending (red meat, total meat, meat products…). In the following some examples of well acknowledged recommendations are given.

United Kingdom recommendations

The British Nutrition Foundation (Williamson et al., 2005) believes that the currently available evidence suggests that the guidelines set by UK Department of Health (1998) in its report on nutritional aspects of the development of cancer are still appropriate, that is that individuals' consumption of red and processed meat should not rise and that higher consumers (>140 g per day or 12–14 portions per week (1022 to 1193g per week)) should consider a reduction in intake. Additionally, advice on improving morbidity and mortality should focus on diet and lifestyle factors for which there is clear evidence of a beneficial effect. For example, people should be encouraged to stop smoking, to take more exercise and to maintain a sensible body weight (BNF, 1999a)

The British Nutrition Foundation (Williamson et al., 2005) further believes that average daily intakes of red and processed meat in most countries are still below the level thought to increase the risk of CRC. For example, average intakes of red meat in Europe (in men) range from 40 g per day in the UK to 74 g per day in Spain, while average intakes of processed meat (in men) range from 10 g per day in Greece to 83 g per day in Germany (see Table 3) and therefore it is only the small proportion of high consumers of meat and meat products that may need to consider a reduction in consumption

German recommendations

German recommendations (Deutsche Gesellschaft für Ernährung, 2004) are very clear and are the only ones that in fact give meat requirements and not only the upper limit. They state: "300-600g meat and meat products per week are sufficient". This means that this are the only recommendations that takes into account also the public health perspective, that meat makes an important contribution to intake of a number of nutrients, in particular micronutrients such as iron and zinc.

USA recommendations

From the USA several recommendation are available:

- The U.S. Department of Health and Human Services and United States Department of Agriculture do not give exact recommendation for meat intake, but only the upper recommended intake of 155g meat and beans (as 2000 kcal per day).

- Widely used among patients with hypertension are the DACH recommendations (USDHHS, 2006). They set un upper limit of 170g meat per day.

Table 3. Mean daily intake (g per day) of total meat, red meat, processed meat and red processed meat and CRC incidence in selected countries participating in the EPIC study (Linseisen et al., 2002; Williamson et al., 2005)

Tablica 3. Prosječni dnevni unos (g/dan) mesa, crvenog mesa, obrađenog mesa, obrađenog crvenog mesa i rasprostranjenost kolonorektalnog karcinoma u odabranim zemljama koje sudjeluju u EPIC studiji (Linseisen i sur.., 2002; Williamson i sur.., 2005)

	Total meat* Ukupno meso*		Red meat Crveno meso		Processed meat Obrađeno meso		Red meat + processed meat Crveno meso + obrađeno meso		CRC incidence** Rasprostranje-nost CRC**
	Man Muško	Woman Žensko	Man Muško	Woman Žensko	Man Muško	Woman Žensko	Man Muško	Woman Žensko	
Greece Grčka	79	47	45	26	10	6	55	31	8,0
	63		36		8		43		
Spain Španjolska	170	99	74	38	53	30	127	67	11,3
	135		56		42		97		
Italy Italija	140	86	58	41	33	20	91	60	10,9
	113		50		27		76		
Germany Njemačka	155	84	52	29	83	41	135	70	15,7
	120		41		62		103		
Netherlands Nizozemska	156	93	64	41	72	38	136	79	14,4
	125		53		55		108		
United Kingdom Ujedinjeno Kraljevstvo	108	72	40	25	38	22	78	47	12,4
	90		33		30		63		
Denmark Danska	141	88	70	44	52	25	121	69	19,2
	115		57		39		95		

* Total meat includes pork, beef, veal, lamb/mutton, poultry, game, rabbit, horse, goat and offal

* Ukupno meso uljučuje svinjetinu, govedinu, teletinu, janjetinu/ovčetinu, te meso peradi, divljači, kunića, konja, koza i otpadaka od mesa

** CRC Incidence reported as age standardised (world) rate (ASR) per 100 000

** Izvještaj rasprostranjenosti CRC-a prije standardizacije (svijet) procjena (ASR) na 100 000

- Very well known are the joint recommendations of World Cancer Research Fund and American Institute for Cancer Research (WCRF and AICR, 1997) which recommend less than 80g of cooked weight of red meat per day. It is preferable to choose fish, poultry or meat from non-domesticated animals in place of red meat. According to the recommendations, red meat refers to beef, lamb and pork, and products made from these meats. It does not refer to poultry or fish, or to game or meat from undomesticated animals or birds, consumption of any or all of which is preferable to consumption of red meat. There are very serious doubts about this recommendation. For instance the British Nutrition Foundation (1999) states that it is uncertain how this figure has been calculated that this level could not be considered dangerous.

Combined German and UK recommendations – the best advice?

The best recommendation for the public seems to be a combination of the German and UK recommendations, that is a minimum daily intake of 42 g of meat and meat products and a maximum intake of 140g of red meat per day. Such a recommendation would be safe concerning an appropriate intake of critical nutrients and concerning development of cancer. Of course meat should be lean and part of a well balanced diet that includes enough fruit, vegetables, legumes and wholegrain cereals.

CONCLUSIONS

It can be concluded that:

- Evolutionary studies suggest that our digestive system and metabolism are preadapted to an omnivorous diet that also includes meat.

- Meat is rich in essential nutrients that are present in low concentration and poorly available in foods of plant origin. Meat makes a significant contribution to intake of a number of nutrients for most individuals. Meat complements plant foods in the diet and assures a safe way of meeting dietary recommendations.

- Meat is low in fat! In last 20 years there was a substantial reduction in the fat content of carcase meat.

- A moderate intake of lean (red) meat has no negative effect on health. There is no scientific justification for eliminating meat from the diet. On the contrary! Total exclusion of meat in regard to an adequate Fe supply is critical among certain population groups.

- Lean red meat is unlikely to significantly increase the risk of CRC when consumed in moderation and as a part of a healthy, balanced diet that includes plenty of fibre from fruit, vegetables, legumes and wholegrain cereals.

- Although the relation between meat intake and CRC is weak, those with very high red and processed meat consumption should reduce meat intake and increase intake of fruit, vegetables, legumes and wholegrain cereals.

- Average red and processed meat intakes in most countries are still below the level thought to increase the risk of CRC.

- Since the evidence for any role of meat in colon carcinogenesis is so weak, and since such a high proportion of women of child-bearing age are iron deficient, the consumption of red meat, as a part of balanced and varied diet, should be actively encouraged.

In addition, meat can be a versatile food that adds variety to eating occasions and is enjoyed by many. Some people choose not to eat meat, for a variety of reasons, but as there is no evidence that a moderate intake of lean red meat has any negative effects on health, there is currently no real scientific justification for excluding it from the diet. Therefore, as recommended in healthy eating advice around the world, lean red meat, consumed in moderation, can be promoted as part of a healthy balanced diet (Williamson et al., 2005).

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SAŽETAK

Cilj rada je dati pregled uloge mesa u prehrani ljudi. Rad je usmjeren na prilagodbu ljudi na svaku vrst hrane i hranidbenu vrijednost mesa te njegov doprinos zadovoljavanju hranidbenih potreba. Opisan je utjecaj uzimanja mesa na pojavu nekih bolesti te činjenicu da je preispitivanje epidemioloških podataka pokazalo da se veći rizik za rak pogrešno pripisuje visokom unošenju mesa; rizik je daleko više povezan s niskim unošenjem voća i povrća te drugim rizičnim čimbenicima načina života. Na kraju je pregled današnjih preporuka u vezi s uzimanjem mesa. Zbog svoje visoke hranidbene vrijednosti meso zadržava važnu ulogu u razumnoj prehrani ljudi.

Ključne riječi: unos mesa, razvoj, hranidbene potrebe, zdravlje, preporuke