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MEAT FATS IN NUTRITION

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Abstract

This article reviews the fat content and fatty acid composition of meats in the human diet and discusses nutritional facts related to meat, meat products and other meat-containing foods as sources of dietary fats. Meat is an increasingly important source of high-value animal protein worldwide. Meat fat comprises mostly monounsaturated and saturated fatty acids, with oleic (C18:1), palmitic (C16:0), and stearic acid (C18:0) being the most ubiquitous. Meat and meat products are considerable sources of cholesterol in the diet. In most industrialized countries, a high meat intake contributes to a higher than recommended total and saturated fat and cholesterol intake. Another concern is that meat may replace sources of other important nutrients in the diet. Therefore, the advice to consumers is to prefer lean meats and low-fat meat products and use meat in moderation only.

Keywords: meat, meat products, fatty acid consumption patterns, food sources of fatty acids, cholesterol, dietary intake

Rising global meat consumption

Meat is an important source of high-value animal protein in many regions of the world. Around the globe, the diets of relatively more urbanised populations are characterised by a higher content of meat, poultry and other animal products than the less diversified diets of rural communities (WHO, 2003). In South Asia and in Sub-Saharan Africa (excluding South Africa) meat consumption was still very low in the late 1990s, at under 10 kg annually per person. However, meat consumption has increased by, on average, more than 10% worldwide since the beginning of 1960s. Average annual consumption per person has increased by more than 20 kg during that period in Latin America and the Caribbean, East Asia and the industrialised countries. The consumption of meat is highest, on average close to 90 kg per year, in North America and most other industrialised countries (Bruinsma, 2003). Meat per se comprises roughly 10-20% of energy intake in most meat consuming countries (FAO, 2002; WHO, 2003). The combined share of energy of meats, meat products and of composite foods containing meats is larger, because of other energy-rich ingredients used in the preparation of these foods. The purpose of this article is to review the fat content and fatty acid composition of meats in the human diet and discuss nutritional facts related to meat, meat products and other meat-containing foods as sources of dietary fats.

Fat and fatty acid content of meats

Meat and meat products vary greatly in their fat content according to the animal species, age of the animal and part of the carcass used ([Swedish] Livsmedelverket, 2004; [English] Ministry of Agriculture, Fisheries and Food, 1998; Ovaskainen, Reinivuo & Korhonen, 2001). The fat content and fat composition is also affected by animal feeding, a fact that is exploited for modification of the meat fatty acid composition, with the relatively best results in single-stomached pigs and poultry (Wood & Enser 1997; Wood, Enser, Fisher, Nute, Richardson, & Sheard, 1999; Bolte, Hess, Means, Moss, & Rule, 2002). Data on the average fat content and fatty acid composition of meats and meat products are published as part of food composition tables throughout the world (e.g. Livsmedelverket, 2004; Ministry of Agriculture, Fisheries and Food, 1998; Ovaskainen *et al*, 2001).



The average fat content and fatty acid contents of selected meat fats and meats are shown in Figure 1 (modified from Livsmedelverket 2004, Ovaskainen *et al*, 2001). Total fat content of meats and meat products varies around 3-25 g/100 g. Chicken skin has an even higher fat content, about 48 g fat/100g (Fig 1). While cured beef and other cold-cuts may have a fat content of below 5%, the fat content in reduced fat sausages is usually around 10%, in common sausages around 15-25%, and twice as high in salami (~40%) and pepperoni (50%) type of sausages (Ministry of Agriculture, Fisheries and Food, 1998, Livsmedelverket, 2004, Ovaskainen *et al*, 2001).

Meat fat comprises mostly monounsaturated fatty acids (MUFAs) and saturated fatty acids (SFAs). The most ubiquitous fatty acids are oleic (C18:1), palmitic (C16:0), and stearic (C18:0) acids. Poultry and pork contain somewhat more unsaturated fatty acids (~10-15% of total fatty acids) than beef and lamb, and also a notable amount of polyunsaturated fatty acids (PUFAs). Linoleic acid (C18:2) is the predominant PUFA (~0.5-7%) , followed by alpha-linolenic acid (up to 0.5%) (Livsmedelsverket, 2004, Ministry of Agriculture, Fisheries and Food, 1998, Ovaskainen *et al*, 2001, National Public Health Institute, 2001). Trans-fatty acids comprise about 1-2 % of total fatty acids across all types of meat; in ruminant meats they represent ~2-4 %. Conjugated linoleic acid (CLA), a group of polyunsaturated fatty acids that appear in dairy products and are thought to have beneficial effects on health, are also found at low mg-levels in meats, especially in beef and lamb (Belury, 2002).

In addition to fatty acids, cholesterol is a nutritionally important component of meats. The cholesterol content of meats varies between about 30 and 120 mg/100 g of food, being even higher in offals (Ministry of Agriculture, Fisheries and Food, 1998; Ovaskainen *et al*, 2001; [Finnish] National Public Health Institute, 2001).

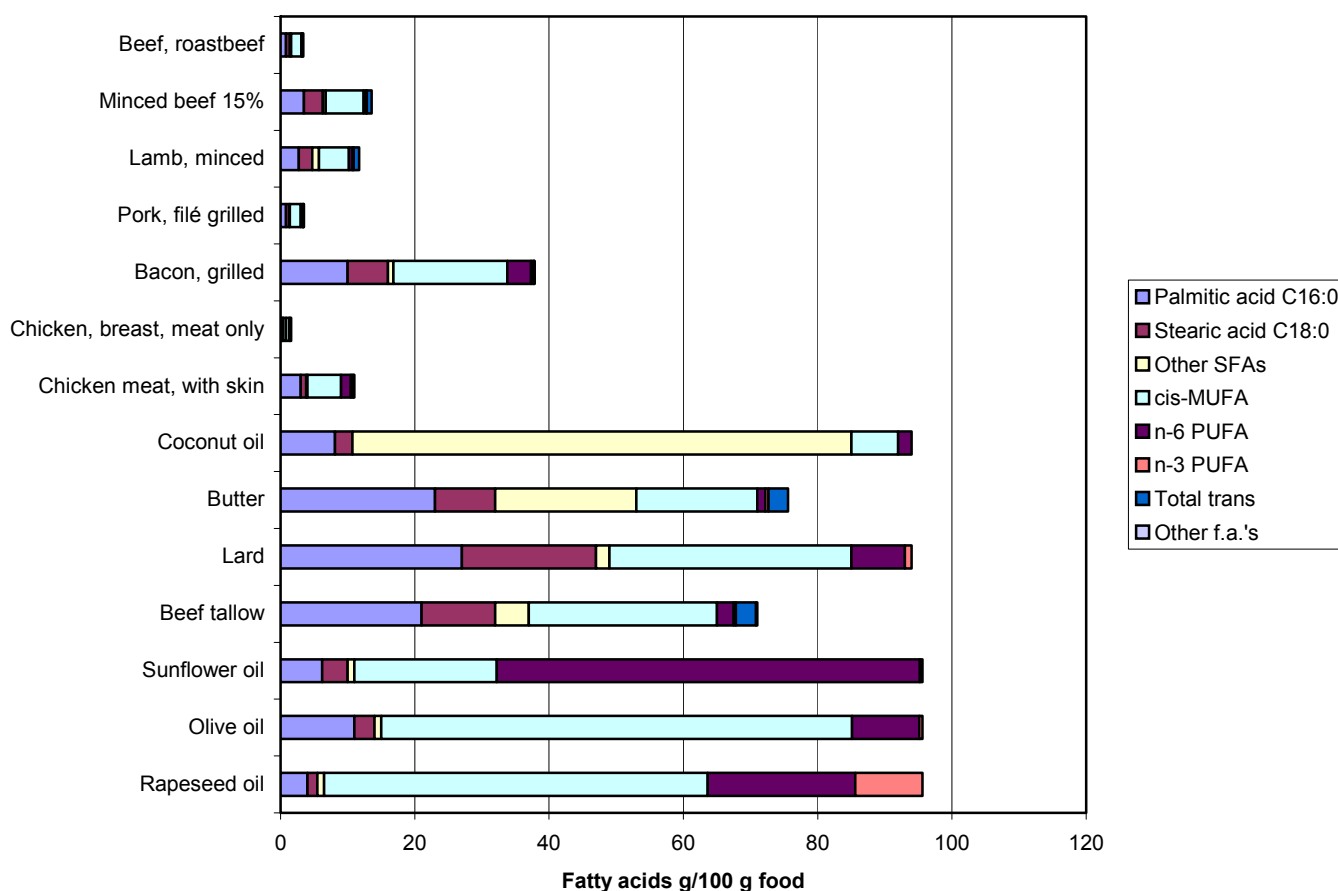


Figure 1. Common fat content and fatty acid composition of selected meats and fats (modified from Livsmedelsverket, 2004, and Ovaskainen *et al*, 2001).



Fat contribution of meat in relation to recommended fat and cholesterol intake

The most recent nutrient intake goals published as a result of a joint WHO/FAO expert consultation (WHO, 2003) are based on the widespread consensus that a “balanced diet” has preventive effects on chronic non-deficiency diseases, e.g. obesity, type 2 diabetes, cancer and cardiovascular diseases. These guidelines include the following targets for fat intake: total dietary fat, 15-30% of energy (En%); saturated fatty acids (SFA), <10 En%; n-6 polyunsaturated fatty acids (n-6 PUFA), 5-8 En%; n-3 polyunsaturated fatty acids (n-3 PUFA), 1-2 En%; trans fatty acids, < 1 En%. The target for monounsaturated fatty acids (MUFA) is calculated as follows: MUFA = total fat – (SFA+PUFA+trans fatty acids). Saturated fatty acids are well known to raise total and low-density lipoprotein (LDL) cholesterol. The main causes of this effect are myristic and palmitic acids; stearic acid is converted to oleic acid in vivo and has not been shown to elevate blood cholesterol. Myristic and palmitic acids are common fatty acids in dairy products and meat.

When European patterns of food and nutrient intake were recently evaluated, it was shown that despite gastronomic diversity, in most EU countries where the available data allowed for analysis, a higher intake of total fat was associated with a higher intake of energy as well as, in most cases, of all main classes of fatty acids (De Henauw & De Becker, 1999; Haraldsdottir, 1999; Valsta, 1999; Hermann-Kunz & Thamm, 1999; Moschandreas & Kafatos, 1999; Löwik, Hulshof & Brussaard, 1999; Serra-Majem, Ribas & Ramon, 1999). Higher intake of saturated fat was mainly associated with higher intake of energy and MUFA (De Henauw & De Becker, 1999; Serra-Majem *et al.*, 1999; Hermann-Kunz & Thamm 1999; Löwik *et al.*, 1999; Valsta 1999). The intake of cholesterol was shown to be higher in the high-fat as well as high-SFA intake groups in both Eastern and Western Germany (Hermann-Kunz & Thamm, 1999) and in the Netherlands (Löwik *et al.*, 1999), but only in the high-SFA group in Greece (Moschandreas & Kafatos, 1999).

When in this European analysis the food intake in the high-fat quartile was evaluated, the higher intake of fat and/or saturated fatty acids was broadly associated with higher consumption of meat and/or meat products. In Belgium, the consumption of both fresh meat and processed meats was higher in the highest fat intake quartile of the adult population (De Henauw & De Becker, 1999). In a Danish analysis, it was shown that the high-fat diet consumers, defined as the top quartile of fat intake (% of energy), had a higher intake of fats (especially butter), meat and whole milk (Haraldsdottir, 1999). In an analysis of Finnish dietary intake data, the highest fat intake and highest SFA intake quartiles were both found to have a larger mean consumption of meats and to contain more consumers of pork meat and sausages. A similar pattern was seen in Spain for processed meat (Serra-Majem, Ribas & Ramon, 1999) and in Sweden for sausages (Becker, 1999). Interestingly enough, in the Finnish diet, the proportion of beef consumers was larger in the lowest fat intake quartile. Additionally, in the highest SFA intake quartile a larger mean consumption of poultry was found. By contrast, in Finland the lowest SFA intake quartile contained more poultry consumers than the high SFA intake quartile (Valsta, 1999). In Germany and the Netherlands the proportion of consumers of meat products in the overall population was close to 100 %, and the high-fat and high-SFA consumers ate more sausages and meat products compared to the low-fat or low-SFA consumers, respectively (Hermann-Kunz & Thamm, 1999; Löwik, Hulshof & Brussaard, 1999). In Greece, on the other hand, only the proportion of the population consuming pure meat was larger in the high-SFA quartile compared to the low-SFA quartile (Moschandreas & Kafatos, 1999). In the Irish population, those consumers with the fattier diets ate more red meat and sausages than those with a low-fat diet. The Irish pattern was based on a somewhat larger proportion of consumers of red meat and sausages in the high fat intake quartile and, in addition, a larger average portion size for red meat (Flynn & Kearney 1999). In Italy the association between high fat intake and meat consumption was less clear (Turrini, Leclercq & D’Amicis, 1999). These results indicate that like the consumption of dairy products, meat consumption is tied to higher saturated fat and total fat intake in most European countries.

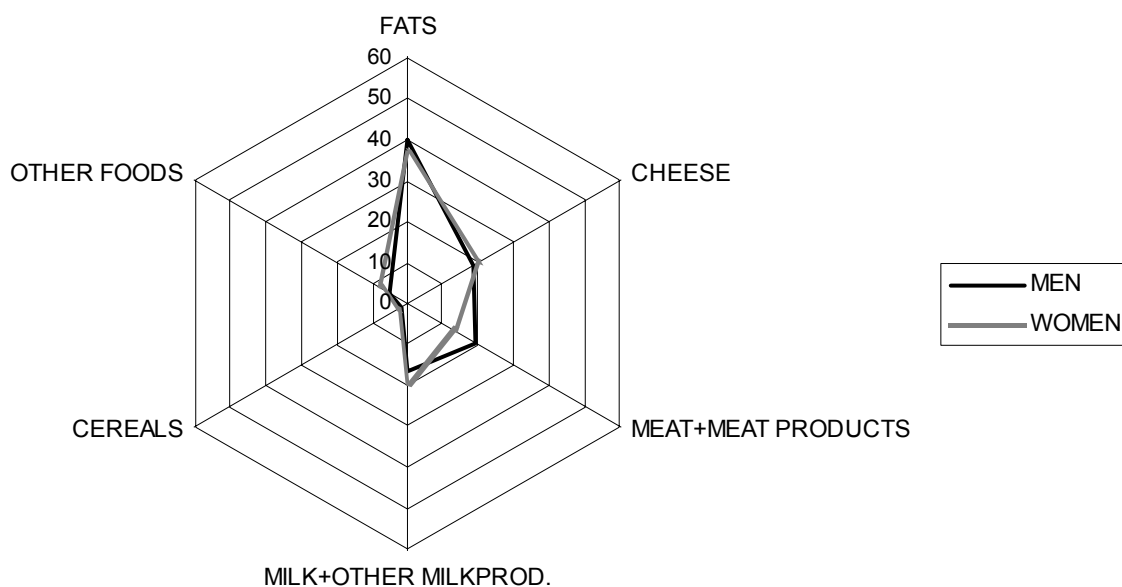


Figure 2a

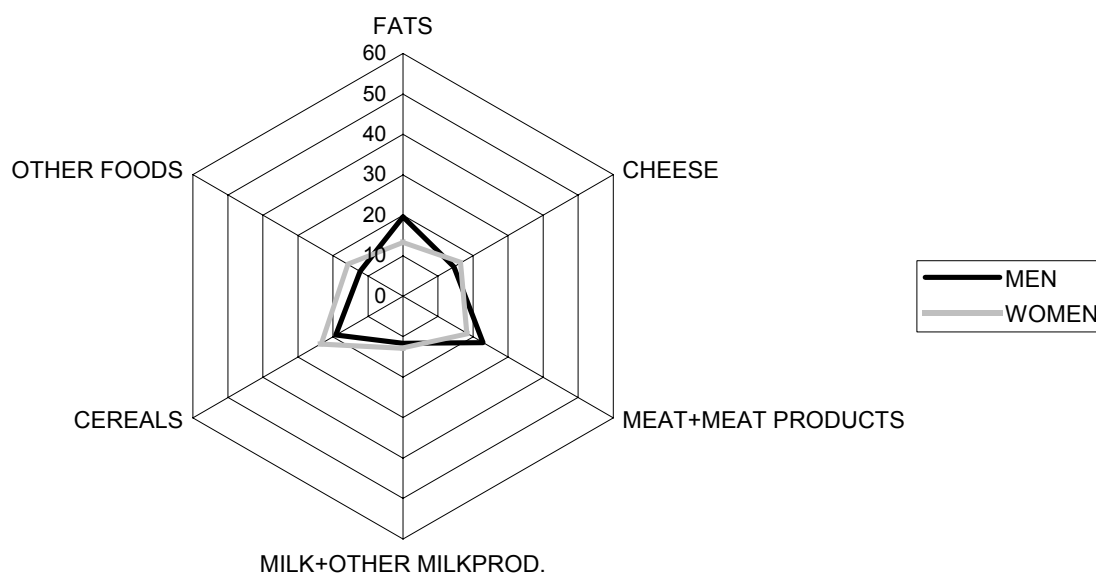


Figure 2 b

Figure 2 a and b. Sources of saturated fatty acids in the Finnish diet, a) at ingredient level, b) in prepared foods, (% of total intake) (Männistö, S., Ovaskainen, M-L. & Valsta, L., 2003).



In addition to the direct contribution of meat and meat products to dietary fatty acid composition, it is also nutritionally important to assess what components of diet are being replaced by growing meat consumption. In a large Swedish study, increasing total meat intake (expressed in quintiles and adjusted for energy, n=11648) was associated with decreasing intakes of poultry, fish, fruit, bread and cereals as well as cheese (Elmstahl, Holmqvist, Gullberg, Johansson and Berglund, 1999). Poultry and fish, bread and cereals are foods that decrease SFA intake when replacing red meat, while fruit decreases mainly the fat content and energy density of the diet when replacing meat.

Fresh meat, meat products and meat dishes as sources of fat and fatty acids

Approximately 60% of the SFAs in the U.S. diet are obtained from meat, poultry, fish and dairy products (Dupont, White & Feldman, 1991). In a more detailed analysis from the late 1980s of the fatty acid consumption pattern of Americans, it was shown that palmitic acid was the predominant SFA in the U.S. diet then, contributing 52-57% of SFA intake (Jonnalagadda, Egan, Himbach, Harris & Kris-Etherton, 1995). Of the SFAs, short chain fatty acids and lauric acid and myristic acid are obtained from dairy products, while the predominant sources of palmitic acid and stearic acid are meat, poultry, fish and blended foods. These same food categories were also the major source of monounsaturated fatty acids, especially oleic acid; among them, beef, pork and chicken meat were the main contributors (Jonnalagadda *et al*, 1995).

Another way of analysing the effect of meat and meat products on fat and fatty acid intake in diet is to compare their share of fatty acid intake at an ingredient level (fresh meat, plain meat products) with their share of fatty acid intake as prepared dishes. In Finland meat and meat products, as consumed, contributed to about one-fourth of the total fat recorded in the National FINDIET 2002 Survey (Männistö, Ovaskainen & Valsta, 2003). This study was carried out using the 48-h dietary recall method and the Finnish National Food Composition Database Fineli® (Ovaskainen, Reinivuo, and Korhonen, 2001) among 25-64-year-old men and women (n=2007). Accordingly, figures 2-4 show that in Finland the food group of fresh meat and meat products as consumed, contributes more saturated, monounsaturated and polyunsaturated fatty acids than do plain meat and meat products. This points to the fact that Finnish meat dishes are frequently prepared with fat-containing ingredients (cream, fat spreads, oils, etc.), which increase the often modest intrinsic fat content of meats.

Ways to modify the contribution of meats to fat intake and quality

Culinary traditions and recipes of meat dishes are an obvious focus if the share of fats from meat dishes and meat products is to be modified or reduced (Papadopoulos, Nowak, Miller, Cross, Savell, Brauchi & Scott, 1992). Fatty ingredients in meat dishes can be reduced in order to increase the nutritional quality of these foods. Methods of supplementation as well have been applied to this purpose in meat product development; for instance, it is possible to increase the proportion of unsaturated fats by processing vegetable oils into the meat product (Hammer, 1991). Manipulation of the fatty acid composition of animal feeds has successfully been used to improve the fatty acid profile of carcass fat in pigs (Morgan, Noble, Cocchi & McCartney, 1992, Vanoeckel & Boucque, 1992). Similarly, dietary fatty acid modification is considered a viable method of adding value to poultry products for the health conscious consumer (Hargis & Vanelswyk, 1993). In addition to both simple and more sophisticated techniques of this kind to modify the fat quality of meat products and meat-containing mixed dishes in order to follow nutritional recommendations, a commonly recommended approach is for consumers to moderate their intake of meat and meat dishes as well as other foods clearly contributing to dietary SFA content. (Dupont, White and Feldman, 1991; Smith-Schneider, Sigman-Grant & Kris-Etherton, 1992).



Conclusion

In conclusion, meat, meat products and meat dishes are sources of valuable, but replaceable, animal protein in the diet. From the point of view of fat content, the drawback of this protein source is that it is tied to a considerable level of saturated fatty acids and cholesterol. In several countries with a very low meat intake, a moderate increase in meat consumption could contribute to a nutritionally better diet. By contrast, in most industrialized countries, high meat intake contributes to a higher than recommended total and saturated fat and cholesterol intake and may replace sources of other important nutrients in the diet. Thus, as a part of a balanced diet in these countries, lean meats and low-fat meat products are preferred, and meat is recommended to be used “sparingly” (Willet, 2001) or at most in moderation today (National Nutrition Council, 1998, USDA 2000, Health Canada 2001).

Acknowledgements

The authors wish to thank Christine Bartels, Ph.D. for skilful language editing of the manuscript.

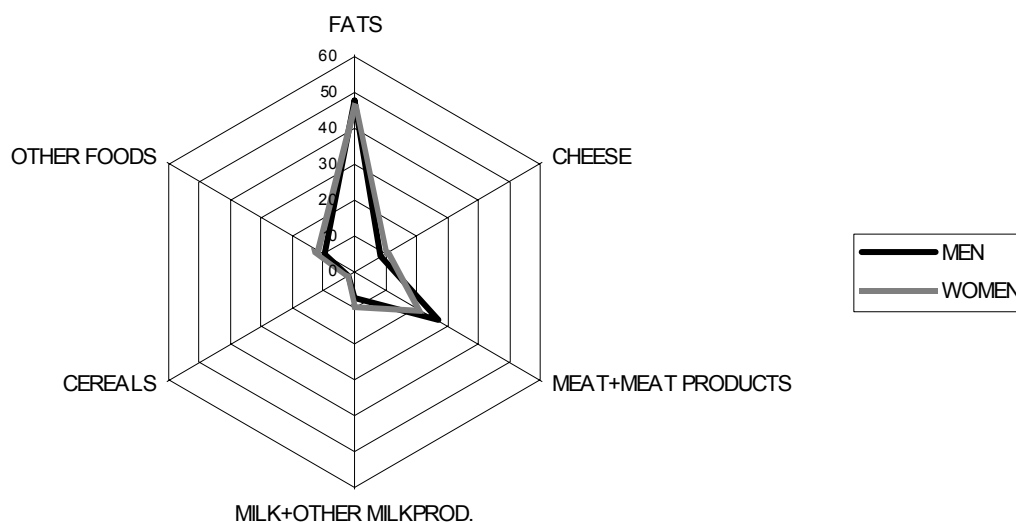


Figure 3 a

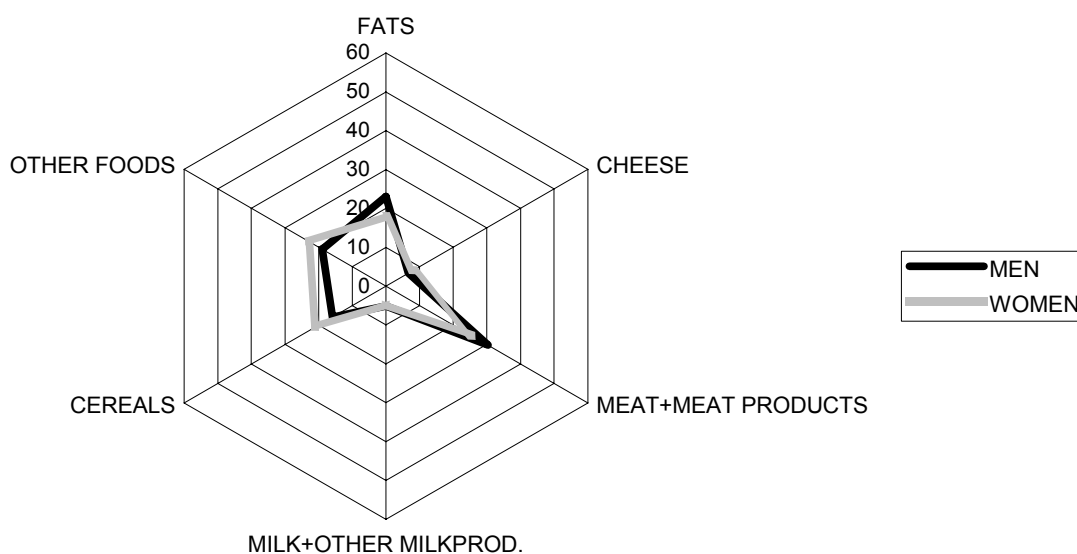


Figure 3 b

Figure 3 a and b. Sources of monounsaturated fatty acids in the Finnish diet, a) at ingredient level, b) in prepared foods, (% of total intake) (Männistö, S., Ovaskainen, M-L. & Valsta, L., 2003).

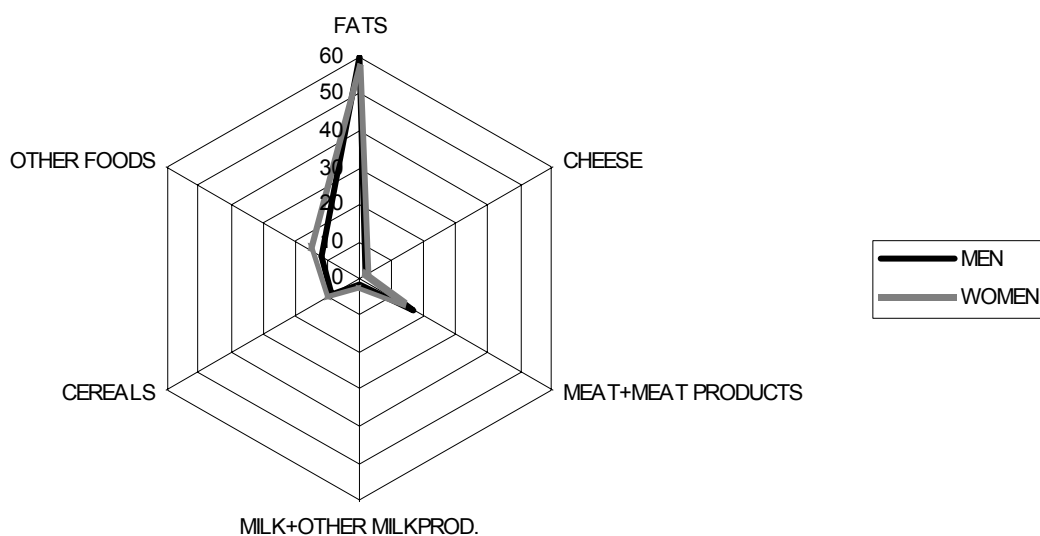


Figure 4 a.

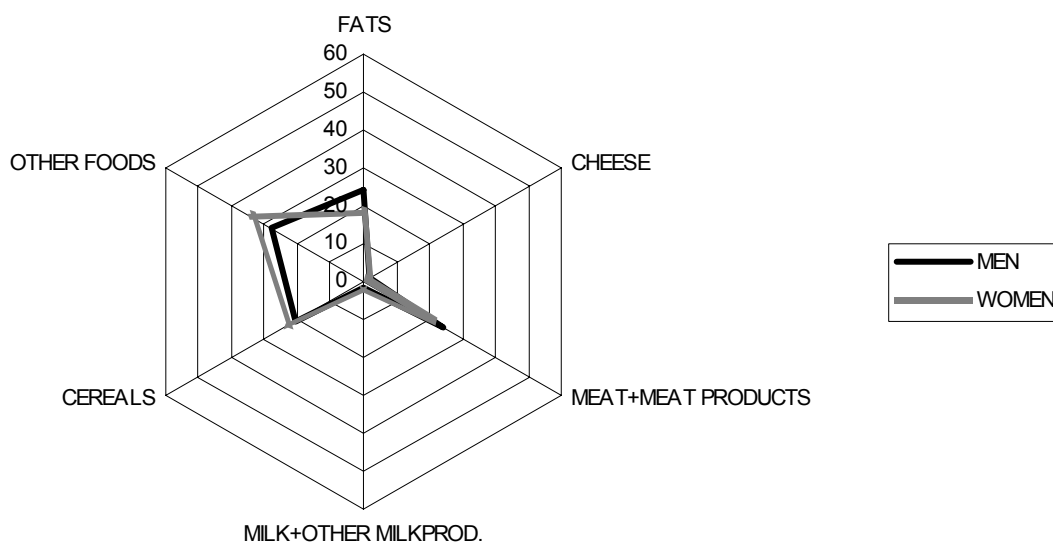


Figure 4 b.

Figure 4 Sources of polyunsaturated fatty acids in the Finnish diet, a) at ingredient level, b) in prepared foods, (% of total intake) (Männistö, S., Ovaskainen, M-L. & Valsta, L., 2003).



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