The meat industry in Central and Eastern Europe: changes, trends and challenges

Josef Kameník

Faculty of Veterinary Hygiene and Ecology
University of Veterinary and Pharmaceutical Sciences Brno
Brno, Czech Republic

Abstract

Regardless of the level of meat production in individual countries, a gradual decrease in the consumption of meat, especially beef and, to a lesser extent, pork, can be seen in Central and Eastern Europe, while consumption of poultry meat has increased over the last 25 years. Average consumption of poultry per capita in 2015 in the Czech Republic was more than 200% of average consumption in 1991. The corresponding figure for Germany was 162%. Methods of fresh meat packaging that extend product shelf life and enhance consumer safety by preventing the release of meat juice have become established in recent years. Packaging in a modified atmosphere and vacuum skin packaging (i.e. Darfresh® or MultiFresh®) are currently the most widely used methods for the retail packaging of fresh meat. The modern trends that are becoming established include "clean label" and "convenience" products, while vegetarian and vegan substitutes for meat products are currently the fastest growing segment, particularly on the German market.

Castration of boars, clean label, meat consumption, meat production, meat packaging, vegetarian products

Introduction

In the wider sense, the term "the meat industry" is used in the specialist literature to mean the entire field of meat processing. Although large-scale industrial production (i.e. the "meat industry" itself) must be differentiated from the artisan processing of meat, the two areas are often combined during the assessment and analysis of the field and referred to together by the expression given in the title of this paper.

There are four basic components of the meat industry. Meat processing begins, *de facto*, with the production of animals for slaughter, even though this tends rather to be the business of farmers and agriculture. In the more specific sense, the meat industry takes in the slaughter industry, meat processing itself (i.e. meat cutting, the preparation of meat products and meat preparations), and finally the trade in meat and meat products, and the retail trade in particular.

The production of animals for slaughter and meat production

The production of animals for slaughter is closely linked historically with subsequent carcass processing. Although automobile transport and other forms of long-distance transport make it possible to transport live animals over long distances, slaughtering and carcass processing in the near vicinity of productive farms continue to play a large role. The emphasis is returning to the advantages of short transport of animals for slaughter, not merely from the viewpoint of meat quality, but first and foremost with a view to animal welfare and protection and the associated limitation of economic losses. The company Vion Food, e.g., publish data on their webpages showing the area from which pigs are transported to their slaughterhouses and present it as a great plus. Four of total nine pig slaughterhouses in Germany are shown in the image. Most of the animals come from no more than 100 km away (www.vion-transparenz.de) (Plate VI, Fig. 1).

There is still a relationship in Europe between the volume of production of animals for slaughter in a given area (country) and the output of slaughterhouses. Carcass weight in

Address for correspondence:
MVDr. Josef Kameník, CSc., MBA
Faculty of Veterinary Hygiene and Ecology
University of Veterinary and Pharmaceutical Sciences Brno
Palackého tř. 1946/1, 612 42 Brno, Czech Republic
Phone: +420 541 562 008
Email: kamenikj@vfu.cz
www.maso-international.cz

tons for a given period of time (generally a year, though sometimes a shorter period) is an important indicator of meat production. World production of meat is set to reach a figure of 320 million tons (Fleischwirtschaft 2016a). The principal types of meat produced have been pork, poultry and beef (including veal) for decades. Annual production of these kinds of meat amounts to around 45 million tons (data for 2015) in the EU-28, which represents around 15% of global production.

Differences in the development in meat production have been seen in recent years in the countries of Central and Eastern Europe (Germany, Austria, the Czech Republic, Slovakia, Poland and Hungary), as they have in the majority of the other countries around the world. Professor Windhorst has analysed production of pork meat in Europe between 1990 and 2009 (Windhorst 2011). His study indicates that the states of the former Socialist Bloc suffered a pronounced loss of production (a fall of 46.3%) in the cited period. On the other hand, the countries of Southern Europe produced almost 40% more pork. The countries of Southern, Western and Northern Europe have been able to increase production thanks to the decline in domestic production in the states of Eastern Europe, including the Czech Republic. Consumption of pork meat has changed little in the countries of Eastern Europe, and the fall in domestic production has been compensated for by increased imports onto the markets in these countries.

A general increase in numbers of poultry is evident in the EU, accompanied by an increase in the volume of production, although there is again an imbalance in the situation in individual countries. The Central and Eastern European region is dominated by Poland, which has become the largest producer of poultry meat in the entire EU in recent years (Table 1). Germany has, however, also invested intensively in poultry farming, with an increase in production of poultry meat of more than 50% over the last ten years. In contrast, production fell by almost 20% in the countries of the former Czechoslovakia over the same period.

Table 1. Comparison of production of beef, pork and poultry meat in selected countries of Central and Eastern Europe in the years 2015 and 2006 in 1 000 tons of carcass (Avec 2017 and Eurostat 2017)

Area	Beef			Pork			Poultry		
Country	2015	2006	[%] 15/06	2015	2006	[%] 15/06	2015	2006	[%] 15/06
EU	7 583	8 191	92.6	22 917	22 085	103.8	14 410	11 115	129.6
Germany	1 124	1 193	94.2	5 562	4 662	119.3	1 796	1 185	151.6
Austria	229	215	106.5	528	505	104.6	126	109	115.6
Poland	471	355	132.7	1 906	2 071	92.0	2 430	1 132	214.7
Czech Republic	68	80	85.0	228	359	63.5	174	213	81.7
Slovakia	8	21	38.1	45	122	36.9	78	95	82.1
Hungary	26	34	76.5	409	489	83.6	567	386	146.9

Consumption of meat

Until around the middle of the nineteenth century, consumption of meat in a given area or country was more or less the same as local production of animals for slaughter. The development of the railways and shipping, along with industrial methods of meat processing (and canning in particular) in subsequent years made it possible to transport animals and meat over greater distances. The international meat trade was born and, although the proportion of total production-consumption of meat it accounts for is not presently particularly large (around 10%), it is extremely important to certain countries. These states today include, unfortunately, the Czech Republic and Slovakia. Certain EU member states,

in contrast, have surplus meat and export a proportion of unconsumed production either on the internal market or to third countries. A typical example is neighbouring Germany, which has elevated meat production to the historic level of almost 9 million tons over the last 20 years (Fig. 2), while consumption is, however, slowly falling. This entirely logically leads to pressure on exports of meat and the Czech Republic is one of the largest purchasers of German pork.

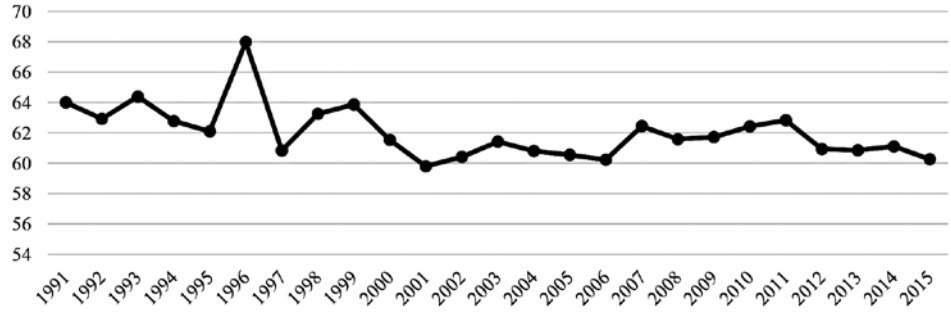

Fig. 2. Production and consumption of meat in Germany 1991 – 2015 (BLE 2017)

The proportions of overall consumption in the EU accounted for by the main types of meat have changed over the last twenty years. Consumption of beef has declined, a slight reduction has been seen in consumption of pork, while interest in poultry meat has increased (Table 2).

Table 2. Consumption of meat in the Czech Republic and Germany in 2015 and 1991 in the value of meat "carcass weight equivalent" in kg per capita per year (BLE 2017 and CSO 2017)

Type of meat	2015	1991	2015 to 1991
Czech Republic [%]			
Beef	8.1	22.4	36.2
Pork	42.9	47.8	89.7
Poultry	26.0	12.8	203.1
Meat – total	79.3	88.4	89.7
Germany [%]			
Beef	13.50	20.57	65.6
Pork	52.06	54.82	95.0
Poultry	19.77	12.20	162.0
Meat – total	88.22	95.31	92.6

Fresh meat or meat products?

The European legislation, specifically Regulation (EC) No. 853/2004 of the European Parliament and of the Council, differentiates a number of categories of "raw" meat. Specifically, European food law defines the terms "fresh meat", "minced meat" and "meat products". The given categories differ in terms of their character, the legislative requirements

of the raw material for their preparation, conditions of storage and microbiological requirements for quality (Table 3).

Table 3. Legislative requirements of categories of meat, including processed meat (Regulation EC No. 853/2004)

	Raw material	Additives	Maximum storage temperature
Fresh meat	Skeletal muscle, offal	None	7 °C red 4 °C poultry 3 °C offal
Minced meat	Skeletal muscle	< 1% kitchen salt	2 °C
Meat preparations	Skeletal muscle (including MSM*)	As per Regulation No. 1333/2008	4 °C; Frozen – 18 °C
Meat products	Meat (including MSM*)	As per Regulation No. 1333/2008	No legislative limit (determined by the producer)

*MSM (mechanically separated meat) obtained by processes that do not alter the structure of bone tissue and that satisfy the requirements of EU legislation relating to the content of calcium and selected indicator bacteria can be used in meat preparations consumed following prior heat treatment and in meat products without limitation. Other MSM can be used only in heat-treated meat products.

Regardless of whether it is given as a value of "carcass weight equivalent" or "retail weight", the average consumption of meat given in statistical overviews always includes meat eaten as fresh meat or in the form of meat preparations and meat products. The proportions of the two components, i.e. fresh and processed meat, differ in the individual EU states and around the world depending on cultural traditions, the economic situation and perhaps other factors.

In Germany, for example, with an annual consumption of 59.9 kg of meat per capita in 2015, consumption of meat products amounted to 29.5 kg (Kameník 2016), thereby accounting for practically one half of meat consumption. The situation in the Czech Republic is similar, though there is no precise statistical overview. According to GfK, 52% of expenditure by Czech households in the first half of last year went on processed meats, with 48% going on fresh meat (Šebková 2016). Owners of specialised stores selling meats and processed meats state that sales of fresh meat account for around 60% in terms of volume, with meat products making up the remaining 40%. If we take into consideration the fact that sales of smoked meat predominate in self-service stores such as supermarkets, hypermarkets and discount stores, we can suppose an equal 1:1 proportion of sales of meat and meat products/ready-to-eat meat products in the Czech Republic. This corresponds to the situation on the German market. Germany has a more-detailed overview of the range of meat products available than the Czech Republic. The situation in 2015 is summarised in Table 4.

The advantages of meat packaging

The modern system of self-service sales in food stores demands a range of packed goods. According to GfK, Czech households are making increasing use of the network of hypermarkets, discount stores and supermarkets for purchases of meat and meat products (Šebková 2016). Discount stores, in particular, offer only packed meat and meat products. The system of packaging provides consumers with a number of advantages, including saving time spent making purchases. In addition to the opportunities it offers for information and marketing, packaging also has a significant effect on the quality of packaged meat and meat products, including a longer shelf life.

Table 4. Average consumption of groups of meat products in Germany in 2015 (Fleischwirtschaft 2016b)

Group of meat products	Per capita consumption per year in kg
Bologna type sausage	7.0
Fermented sausage	5.2
Hams	4.8
Frankfurters	4.2
Barbecue sausage (*Bratwurst*)	2.7
Brawn and blood sausage	2.6
Sliceable meat products	0.9
Meat jellies	0.8
Bacon	0.7
Pâtés	0.4
Roast meats	0.2
Meat products – total	29.5

Fresh meat is a perishable foodstuff. In terms of the sensory properties of raw meat (and "red meat" in particular), the most important thing for the consumer making a purchase is the colour of the meat (Joo et al. 2013). The second most important property is the ability of the meat to bind water, as this influences the amount of meat juice released. Packaging systems for fresh meat must, therefore, give due consideration to these characteristics. For these reasons, methods of packaging that extend shelf life and increase safety for the consumer by preventing the release of meat juice and its leaking from the packaging, along with the risk of possible contamination of other foods or the surrounding environment, have become established in recent years. Packaging that extends non-preservative shelf life (known in the English literature as preservative packaging) has entirely replaced packaging in the range of packaged fresh meat on supermarket counters and shelves. The term packaging means simple methods of packaging in which the product is owerwrapped by foil without the atmosphere beneath the packaging being altered in any way. Packaging materials without barrier properties are used for this kind of packaging. As the meat (or meat product) is surrounded by the same atmosphere as the surrounding air, a product packed in packaging does not have a shelf life any longer than unpacked goods.

The commonest methods of retail packing for fresh meat are currently packing in a modified atmosphere and vacuum skin packing (i.e. Darfresh® or MultiFresh®). Traditional vacuum packing can also be seen in the wholesale trade for packing large undivided cuts of meat.

Vacuum skin packaging provides the consumer with many advantages over "traditional" packing in a vacuum or a modified atmosphere (Kameník et al., 2014). In comparison with traditional vacuum packing, there is no significant release of meat juice or its accumulation beneath the packaging (Table 5). In Darfresh® or MultiFresh® skin packaging, the upper foil is sealed to the entire area of the lower tray (with the exception of the product itself) which makes this type of packaging less sensitive to any loss of vacuum caused by mechanical damage to the package (which may occur with conventional vacuum packaging).

Vacuum packing is generally less demanding on the amount of space required in comparison with packing in a modified atmosphere. When a mixture of gases is used (70 – 80% O_2 and 30 – 20% CO_2 in the case of red meat), the packed product must be surrounded by an adequate protective atmosphere. This "headspace" volume should be around two or three times that of the packed goods in the case of red meat, thereby guaranteeing a sufficient amount of oxygen in the first few days after packing. This leads to a higher proportion of oxymyoglobin in the meat which gives its surface a red-pink colour. The large volume of modified atmosphere also prevents the surface of the meat coming into contact with the upper foil which would pose the risk of formation of greyish stains in places at which the meat is not sufficiently saturated with oxygen. On the other hand, of course, in addition to having a positive effect on meat colour during the first few days after packing, oxygen also causes earlier oxidation (Table 5) and, although the

presence of carbon dioxide prevents the intense growth of aerobic bacteria (agents of meat spoilage), their reproduction does occur to a certain extent (Höll et al. 2016). The shelf life of meat packed in a modified atmosphere is, therefore, shorter than when a vacuum is used, particularly Darfresh® or MultiFresh® skin packaging. The disadvantage of the last of these types of packing are higher operating costs, for which reason Darfresh® and MultiFresh® vacuum skin packaging are used for packing more expensive types of meat such as beef steak or duck meat. Its use can, however, also be seen in certain ready-to-eat meat products (Plate VI, Fig. 3).

Table 5. The course of meat oxidation in terms of the content of malondialdehyde (TBARS) in mg.kg^{-1} and losses resulting from the release of meat juice in slices of beef and pork meat (m. longissimus lumborum) during storage at 2±0.5 °C in various types of packaging (Kameník et al. 2014)

Analysis	Day of sampling	Beef			Pork		
		MAP*	VP**	***SVP	*MAP	**VP	***SVP
TBARS	0		2.13 ± 0.56			2.14 ± 0.57	
[mg·kg^{-1}]	7	9.40 ± 4.10	0.26 ± 0.14	0.55 ± 0.52	1.26 ± 0.43	0.36 ± 0.30	0.43 ± 0.25
	14	25.32 ± 10.09	1.72± 2.18	0.45 ± 0.31	4.76 ± 1.57	0.34 ± 0.16	0.24 ± 0.12
	21	29.25 ± 13.01	0.37 ± 0.19	0.51 ± 0.42	1.75 ± 1.02	0.22 ± 0.10	0.26 ± 0.19
	35	34.16 ± 10.31	0.28 ± 0.14	0.44 ± 0.44			
Purge	7	1.8 ± 0.5	2.0 ± 0.6	1.2 ± 0.9	5.2 ± 2.8	7.9 ± 1.2	2.3 ± 0.5
loss	14	1.9 ± 2.8	2.1 ± 1.2	1.0 ± 0.7	4.4 ± 1.3	8.8 ± 0.6	2.8 ± 0.7
[%]	21	3.6 ± 3.3	2.7 ± 1.3	0.7 ± 0.4	4.8 ± 1.0	9.2 ± 1.1	2.6 ± 0.6
	35	2.3 ± 1.3	3.9 ± 2.5	1.0 ± 0.2			

*MAP: modified atmosphere packaging, **VP: vacuum packing, ***SVP: Darfresh® packaging

Current trends

A number of current trends can be seen on the market in meat and meat products in the Central and Eastern European region, including growing interest in “clean label” products, convenience products, homemade products and vegetarian/vegan food.

The potential ban on the castration of barrows is an absolutely fundamental issue in relation to pork meat. The member states of the EU are currently facing the requirements of the “European declaration on alternatives to surgical castration of pigs” with the deadline 1st January 2018. Although the given document is not legally binding, individual countries have either already taken up positions on the issue of the surgical castration of pigs or are biding their time, as is the case with the Czech Republic. Germany, currently the second largest producer of pork in the EU and an important business partner of the Czech Republic for this commodity, has enacted the termination of castration without anaesthetic as of 1st January 2019. As the editorial in the January edition of the journal Fleischwirtschaft states, however, the domestic retail trade is taking its own stand on deadlines – the chains Aldi Süd, Rewe and Aldi Nord are removing pork meat from castrated animals from the range of goods they offer. There is a growing trend in Western Europe for pigs not to be castrated and to be fattened not as barrows but as true boars. Processors and consumers will have to get used to the occasional occurrence of boar taint. In an interview for the Czech journal Náš Chov (2/2017), Ing. Miroslav Rozkot, CSc. (The Research Institute of Animal Science) noted that, “Unfortunately, I get the feeling that the activity of various groups of animal rights activists that has provoked the prohibition of the castration of pigs without anaesthetic is aimed rather at pigs not being bred at all. They have been applying a similar principle in recent times in relation to the breeding of animals for fur… Unfortunately, the general public, which has little idea of how animals are reared, is falling for their plan. It is easy to influence uninformed public opinion.” (Jedlička 2017).

Clean label

The expression clean label is used to mean the clear and entirely comprehensible labelling of foods for the consumer. The trend in this area is further strengthened by demand for natural food ingredients without "artificial" chemical additives, demand for the sustainability of production and food processing, demand for entirely transparent traceability and an increasing proportion of organic foods (Löhr 2016). Clean label can also be linked with the "transparent labelling" of products. The expression clean label may not be the subject of registration and there is no single uniform interpretation of this expression.

Vacuum skin packaging (Darfresh®, MultiFresh®), which prevents the formation and accumulation of meat juice purge loss beneath the wrapper and thereby extends the shelf life of products, can be given as an example of new forms of product packaging in line with the *clean label* trend. Excluding oxygen from the packaging prevents oxidation and delays rancidity. Other examples include the use of foils with barrier properties against the UV spectrum and the application of "active" forms of packaging.

Convenience

In relation to foods, the term convenience is used to indicate "convenient" products that require minimal treatment before cooking and consumption. Typical examples in the case of fresh meat are pieces of beef or pork meat for making goulash packed in a modified atmosphere or the wide range of meat preparations. The category "convenience" also includes "easy to open" systems that make it easy for consumers to open the packaging using just their fingers without the need for knives, scissors or other suitable aids. (Plate VII, Fig. 4).

Other examples of "convenience" foods include ways of packing meat specifically designed for cooking without the product needing to be unwrapped and placed in a cooking dish. Sealed Air® offers systems known as Ovenease® and Cryovac® Sealappeal® OSF AW (Kameník 2015a). Multivac sells the Mylar® COOK brand (Kameník 2015b).

Vegetarian and vegan substitutes for meat products

Vegetarian and vegan meat substitutes are a rapidly developing segment of the food market, particularly in Germany. According to the journal Fleischwirtschaft, these products are not purchased merely by vegans (99%) and vegetarians (96%), but also by "flexitarians" (82%) and consumers with an ordinary diet (62%). This is only to be expected of vegetarians and vegans, though the relatively large proportion of people with a traditional mixed diet buying these products is surprising. Of 6 000 respondents asked to state their main reason for buying burgers made from tofu or similar substitutes, 42% stated animal protection, 28% stated ethical reasons, and 11% said that health aspects play a role. The attitudes held by the individual groups are interesting. While vegetarians and vegans consider animal protection and ethical motives to be most important, the health aspect is just as important for "flexitarians". For consumers eating a normal diet, the health issue is the principal reason for purchasing substitutes for meat and meat products (Fleischwirtschaft 2016b). (Plate VII, Fig. 5).

Conclusions

Developments in the countries of Central and Eastern Europe over the last twenty-five years have also affected the meat processing industry. Countries such as the Czech Republic and Slovakia, for example, have seen a pronounced reduction in the production of animals for slaughter. If we compare 2015 with 2006, we see falls to levels of production of 85% for beef, 63.5% for pork and 81.7% for poultry in the Czech Republic. In Germany, in

contrast, meat production increased over the same period by 19.3% for pork and 51.6% for poultry. Regardless of meat production in individual countries, a gradual decline in meat consumption, particularly for beef and to a smaller extent for pork, can be seen in Central and Eastern Europe, while consumption of poultry has increased over the last quarter of a century. Average per capita consumption of poultry meat in the Czech Republic in 1995 was 200% of average consumption in 1991; the corresponding figure for Germany was 162%.

Packaged products, and products packed in a modified atmosphere or vacuum skin packaging in particular, are accounting for an increasingly large share of the market in meat and meat products. One of the modern trends of the age are increasing demands for "clean label" and "convenience" products, while particularly on the German market vegetarian and vegan substitutes for meat products are the most rapidly growing segment at the present time.

References

Avec 2017: Annual Report 2015. Available at: http://www.avec-poultry.eu/annual-reports-overview/annual-report-2015

BLE 2017: Versorgung mit Fleisch in Deutschland. Bundesanstalt für Landwirtschaft und Ernährung. Available at: http://www.ble.de/DE/01_Markt/15_Versorgungsbilanzen/_functions/Dt_Fleisch.html (In German)

Czech Statistical Office 2017: Spotřeba potravin a nealkoholických nápojů na 1 obyvatele v České republice. Czech Statistical Office. Available at: https://www.czso.cz/documents/10180/32955062/32018116_0302.pdf/ab949a3c-cf58-41fd-b0df-b34865e4b91f?version=1.2 (In Czech)

Eurostat 2017: Meat production statistics. Available at: http://ec.europa.eu/eurostat/statistics-explained/index.php/Meat_production_statistics

Fleischwirtschaft 2016a: Die Ereignisse im November. Fleischwirtschaft **96** (12): 6-7 (In German)

Fleischwirtschaft 2016b: Fleisch steht ganz oben auf der Austauschliste. Fleischwirtschaft **96**(12): 18 p (In German)

Höll L, Behr J, Vogel RF 2016: Identification and growth dynamics of meat spoilage microorganisms in modified atmosphere packaged poultry meat by MALDI-TOF MS. Food Microbiol **60**: 84-91

Jedlička M 2017: Co přinese zákaz kastrace kanečků v chovatelské Evropě? Náš chov 2: 29-31 (In Czech)

Joo ST, Kim GD, Hwang YH, Ryu YC 2013: Control of fresh meat quality through manipulation of muscle fiber characteristics. Meat Sci **95**: 828-836

Kameník J, Saláková A, Pavlík Z, Bořilová G, Hulánková R, Steinhauserová I 2014: Vacuum skin packaging and its effect on selected properties of beef and pork meat. Europ Food Res Tech **239** (3): 395-402

Kameník J 2015a: Business on the Wing. Maso 26 (7): 13-26 (In Czech)

Kameník J 2015b: Mylar® COOK – moderní forma balení (a pečení) made in Multivac. Maso 26 (7): 28 p (In Czech)

Kameník J 2016: Sníme více masa než Němci? Maso 27 (5): 16-26 (In Czech)

Löhr H 2016: Smoked & Processed Seminar Brno. Prezentace společnosti Sealed Air® na semináři Jemně mělněné tepelně opracované masné výrobky. Seminář o technologii, technice a hygieně produkce jemně mělněných tepelně opracovaných masných výrobků, 2nd June 2016, VFU Brno, Czech Republic (In Czech)

Šebková V 2016: Spotřeba masa a uzenin v českých domácnostech. Maso 27 (7): 4-5 (In Czech)

Windhorst HW 2011: Einschneidende Verlagerungsprozesse. Strukturen und Dynamik der Schweinefleischproduktion zwischen 1990 und 2009 in den Teilregionen Europas. Fleischwirtschaft **91**(9): 61-68 (In German)