



COMPOSITION OF CURED MEAT PRODUCTS WITH REGARD TO NUTRITION AND HEALTH

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SUMMARY

Meat products are produced primarily to prolong the shelflife of meat. Secondly meat products are convenience products. During manufacturing salt and some other additions like nitrate/nitrite or phosphates/citrates etc. are used. Salt we regard as taste enhancer but in meat products it preserves by lowering the water activity. Other treatments must accompany salt. Nitrite and/or nitrate and smoking have further bactericidal effects but also enhance appearance and flavour. Finally heat, drying or fermentation prolong the shelflife and make meat products safe. The fat content varies from 1 to 50 %. Most meat products show fat concentrations between 20 – 30 %. The protein content varies from 10 – 25 % with the main group between 13 – 18 %. Nitrite is low, in most products below 20 mg/kg. Nitrate has an average range from 30 – 60 mg/kg. Thus meat products are healthy and are an essential part in a balanced diet.

NECESSITY OF MEAT PRESERVATION

European meat products have a very long tradition. Long before Christ meat products existed. They were developed for the need to prolong the shelflife of one of the easiest deteriorating but most esteemed and nutritionally important foods, the meat.

Cooking was most probable the first way of enhancing the shelflife of chunks of meat. This was followed by the invention of the influence of salt, fermentation and smoking and the experience that heating could be replaced. Air or heat dried sausages and hams were born.

As it is a part of the human nature to improve his inventions, the appearance and flavour of the products were enhanced. With centuries lasting improvements, meat products of our time were created and they were considered as tasteful and healthy foods. As the available meat species – pigs, poultry, bovines or game – varied and also the climatic conditions were different, special techniques for manufacturing good meat products were favoured in different parts of the world.

In northern and central Europe with its rather wet and cold climate, heating and smoking, as a secondary way of the use of fire, for improving the shelflife of meat products were applied. In southern Europe drying without heat and fermentation were the preferred ways for enhancing the time for a safe consumption. In all European areas the use of salt as a preservative was used. Salt was becoming such an important good that the kings kept it as one of their important royal rights to produce and sell salt.

The combination of salt and acidity, the latter produced either during fermentation or by addition of acid, were a further way of prolonging shelf life of foods. With meat products the use of acid, however, remained a minor issue. pH values below 5.0 are regarded as too sour. Low pH is used in preserving vegetables. In meat product microorganisms like lactobazillae reduced the pH to around 5.0. In many natural salts like some rock or marine salt small amounts of other ingredients were present. In the 19th century the presence of saltpetre (sodium nitrate) in the salt became known for the red curing colour of the meat products. In the beginning of the 20th century it was recognized that the active preservative and colouring compound was nitrite, produced from nitrate by microorganisms.

All techniques, which were invented, prevented or retarded microbial and chemical spoilage.



Table 1. Composition of Fresh Meat for Hams and the Composition of some Dry-cured Hams

Country	Product	Water %	Protein %	Fat %	Salt %	Energy kcal/100 g
Germany	fresh hind legs of pigs ^{a)} without subcutaneous fat	74.5	22	2	1.3	111
	with fat ^{a)}	53.5	15	20.5	1.1	248
Germany	Lachsschinken ^{b)}	68.5	26.8	1.0	3.8	117
	Schinkenspeck ^{b)}	45.0	31.5	18.0	4.0	295
	Rohschinken ^{b)}	45.5	27.5	17.5	5.9	275
France	Jambon sec entire ^{c)}	51	24	19	5.6	268
	Jambon sec supérieur dégraissé ^{c)}	57	27	8	6.9	184
	Lardons soles et fame's ^{c)}	59	17	20	3.0	249

^{a)} Honikel, Wellhäuser 1993; ^{b)} Dederer 2004; ^{c)} CIC (1995)

Table 2. Composition of German Meat Products (Survey in 2003; Honikel 2004)

	% Fat			% meat protein			% Salt			mg/kg Nitrite in edible product			mg/kg Nitrat in edible product		
	L	H	M	L	H	M	L	H	M	L	H	M	L	H	M
Aspic products	0.6	20	9.0	10	24	15.6	1.3	2.6	1.80	3	30	17.5	5	29	10.0
Emulsion type / meat pieces	6	27	12.5	12	19.5	16.1	1.5	3.0	2.05	1	30	19.0	12	48	20.5
Emulsion type / coarse gr.	6	30	22.3	10	19	14.0	1.8	3.5	2.10	1	26	11.0	10	105	30.0
Emulsion type / finely comminut.	8	33	24.5	10	16	12.4	1.7	2.3	2.15	1	30	17.0	9	41	28.0
Frankfurter type	14	35	24.5	10	17.5	12.5	1.7	2.5	2.00	1	65	30.0	5	30	17.0
Blood sausages	14	44	25.5	12	23	16.5	1.7	2.5	2.20			20.0			83.0
Liver sausages/ pates	15	44	31.0	10	23	14.0	1.1	3.1	1.85	1	50	11.0	8	150	60.0
Cooked sausage, spreadable	15	50	32.0	10	17	13.5	1.6	2.2	1.75			5.5			24.5
Raw sausage, spreadable	7	50	31.0	11	25	16.0	2.1	4.6	2.85	1	40	8.5	5	200	45.0
Raw sausage, slicable	1	45	29.5	14	30	21.0	2.5	4.7	3.70	1	50	10.5	5	110	29.50

L: lowest; H: highest; M: mean



In meat products:

1. Salt is technologically and for safety reasons necessary in meat products; its concentration varies considerably from 1.5 – 8 %. In Asia sugar replaced the salt partially or total. Both lower the water activity.
2. Salt, curing agents like nitrate or nitrite, smoking and fermentation enhance appearance and flavour. Smoke, nitrite and fermentation prevent also the growth of unwanted microorganisms.
3. Other preservative agents like ascorbate are added for the purpose of an antioxidative environment.

These points are important and very favourable for meat products. Some may be less important for human nutrition but they are necessary for the safety of the product.

Composition of Meat Products. Lean fresh meat consists of three major constituents as shown in table 1: water to about 74 %, 22 % protein, 2 % fat. This adds up to 98 %. Inorganic matter amounts to 1.3 %, the rest are vitamins and nucleotides.

If a fat cover like in hind legs of pigs is left on top of the lean then the water and protein contents of the cut fall and the fat content is enhanced to about 20 % (Table 1). The mineral content is changing to a smaller value. If from these parts dry-cured hams are produced, the fat content despite loss of water remains in a similar range due to cutting of some fat parts. The drying process enhances mainly the protein and salt content (table 1).

Due to the salt addition the salt content is strongly enhanced in the dried product. Dry-cured hams are high in very valuable protein, medium in fat content but high in salt. The composition of fat in pork products is always very similar with about 50 % monounsaturated, 12 – 15 % polyunsaturated and 35 – 40 % saturated fatty acids.

In comparison to dry-cured hams other meat products contain similar and often higher fat concentrations and water, they contain less protein but are also manufactured with smaller salt concentrations (table 2).

Nitrite and Nitrosamines. Most meat products are cured either with nitrite or nitrate. Their concentrations in meat products are shown in table 2. Despite the addition 100 – 150 mg nitrite/kg product and up to 300 mg nitrate/kg the remaining concentrations are far lower. In most meat products the nitrite concentration is below 40 mg/kg (table 2). The median value is around 15 mg/kg. The nitrate concentration is in most products below 60 mg/kg with a median value around 35 mg/kg. Nitrite under unfavourable conditions may form nitrosamines. Several prerequisites are necessary that nitrosamines can come into existence.

1. pH must be low (< pH 5.5), all cooked meat products and many raw meat products show pH-values above 5.5
2. secondary amines (R-NH-R) must be present. They do not exist in fresh meat
3. heating above 130°C accelerates the formation of nitrosamines. These conditions occur only on frying or grilling
4. nitrite must be available in sufficient concentrations (>15 mg/kg)

In **cooked meat products** from fresh meat secondary amines are not present. Also the pH is above 5.5. The nitrite concentration is low (table 2).

In **raw meat products** after a longer period of fermentation secondary amines are formed. The pH is usually, however, at this stage above 5.5. Additionally the nitrite concentration is rather low. Thus nitrosamine formation is unlikely in these products and if they are formed, the concentrations are rather low.

The positive effects of nitrite and nitrate, however, still exist. Nitrite prevents the growth of some pathogenic microorganisms. Nitrite retards oxidation as an antioxidant. Nitrite forms nitrosomyoglobin and provides a pleasant and stable red colour and nitrite is essential for the cured flavour of meat products.

In conclusion if nitrate and nitrite are used in the concentrations necessary for the safety of the products, the uptake of both compounds with normal meat product consumption cannot be regarded as health hazardous. Remember that the maximum residue limit (MRL) for nitrate in salad ranges from 2000 – 4500 mg/kg.

Intake of Meat Products and Nutrients. In the former 15 countries of the European Union the range of meat products intake varies greatly. Spain and Portugal (Clitravi 2001) consume 12.5 resp. 10 kg meat product per head and year, Finland's consumers eat 33 kg per head and year (table 3). The portion of dry-cured ham ranges from 1 to 37 %



It is interesting to mention how much fat, protein and energy we eat all together and with meat. In Germany every 4th year a Nutrition Report is published. In table 4 the published data of 2000 and 2004 are presented. There is a rather small change of consumption of meat and meat products within the 4 years. Women eat about 30 g less meat and meat products than men. In the report of 2000 the assumed amount of fat intake by meat and meat products is calculated to 28 g/head and day for men and 20 g/head for woman. That is about 35 % of all fat eaten and about 10 % of the total energy input. For protein the intake is 25.5 g/head and day of the recommended 60 g/head and day in total.

The average salt content of about 70 g meat products/head and year of men and women is 2 % salt, around 20 mg/kg nitrite and around 30 mg nitrate/kg product. None of these amounts can be regarded as health hazardous, neither with meat products in total nor with dry-cured ham alone.

Table 3. Part of Dried Ham on Total Meat Product Consumption (CLITRAVI 2001)

Country	% dried ham and bacon	kg/head x year
Austria	3	28.6
Belgium	10	15.4
Danmark	30	24.0
Finland	1	33.0
France	4	18.5
Germany	17	30.5
Italy	21	17.5
Luxembourg	18	-
Netherlands	31	22.9
Portugal	11.5	10.0
Spain	37	12.5
Sweden	23	23.0
United Kingdom	13	18.0

Table 4: Fat Intake from Meat and Meat Products and Daily Energy Intake (according to German Nutrition Reports 2000 and 2004)

	Male 25 – 51 years		Female 25 – 51 years	
	2000	2004	2000	2004
Fresh meat (g/d)	74	69	65	63
Meat products (g/d)	82	79	55	59
Total (g/d)	156	148	120	122
Fat intake from meat (g/d)	7.5		6.5	
Fat intake from meat products (g/d)	20.5		13.5	
Total fat from meat/products (g/d)	28		20	
% energy of fat of meat/products from Total energy input	10		9	



CONCLUSION

European meat products are produced to keep the valuable protein with its essential amino acids intact and preserve the easy accessible minerals and vitamins. The fat content which has been reduced in the last decades is now in a medium range of about 25 %. More than 50 % (52 – 65 %) of the fatty acids in meat products are unsaturated. Due to the technology and the few additives meat products are safe either chilled or at ambient temperatures. Meat products taste excellent.

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